



Review

Open-door versus French-door laminoplasty for the treatment of cervical multilevel compressive myelopathy



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ABSTRACT

Open-door laminoplasty (ODL) and French-door laminoplasty (FDL) are used to treat cervical multilevel compressive myelopathy. However, differences in outcome between the approaches remain unknown. To investigate treatment differences, we performed a systematic review and meta-analysis. Four comparative trials were identified and analyzed in the review. The results showed that ODL had a higher postoperative Japanese Orthopaedic Association (JOA) score than FDL (weighted mean difference [WMD] = 0.83; 95% confidence interval [CI]: 0.47 to 1.19; $p < 0.01$). There were no significant differences between the two methods in terms of operative time (WMD = -6.76 ; 95% CI: -21.70 to 8.18 ; $p = 0.38$), intraoperative blood loss (WMD = 41.70 ; 95% CI: -61.43 to 144.82 ; $p = 0.43$), total complication rate (OR = 2.43 , 95% CI: 0.22 to 27.04 ; $p = 0.47$), postoperative C5 palsy (OR = 1.97 , 95% CI: 0.46 to 8.39 ; $p = 0.36$), postoperative cervical lordosis (WMD = -0.60 ; 95% CI: -0.37 to 1.86 ; $p = 0.63$) or range of motion (WMD = -4.62 ; 95% CI: -13.06 to 3.82 ; $p = 0.28$). These results suggest that neither cervical laminoplasty approach is superior to the other based on the postoperative radiological data and complication rate, although ODL had higher postoperative JOA score than FDL.

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1. Introduction

There are a variety of surgical procedures for cervical multilevel compressive myelopathy. Cervical posterior laminoplasty is a common and effective method to decompress the spinal canal and has achieved favorable outcomes in cervical spondylotic myelopathy (CSM), ossification of the posterior longitudinal ligament (OPLL) and developmental canal stenosis [1–7].

Since cervical laminoplasty was first introduced by Oyama and Moriwaki with the name of “expansive Z-laminoplasty” in 1972 [8], various types of cervical laminoplasty have been developed. At present, the surgical methods of cervical laminoplasty are classified into two types, namely open-door laminoplasty (ODL) and French-door laminoplasty (FDL) (Fig. 1). ODL, also called single-door laminoplasty, was first described by Hirabayashi [9]. In ODL, the spinal canal is opened from one side. FDL, first introduced by Kurokawa, is also referred to as double-door laminoplasty [10]. When FDL is performed, the lamina is sagittally split in a double-door manner. Both ODL and FDL allow a dorsal spinal cord shift

of more than 3 mm, which is considered to produce sufficient canal expansion and good surgical outcomes [11].

To our knowledge, it is unknown whether there is a significant difference between ODL and FDL. Thus, we compared the effectiveness of the two types of laminoplasty in this meta-analysis. We aim to demonstrate differences in the two treatments used for cervical multilevel compressive myelopathy.

2. Materials and methods

2.1. Literature search

As only a small number of randomized controlled trials (RCT) were available in the literature, non-randomized comparative studies (prospective and retrospective) were also included. A literature search was carried out using the MEDLINE, EMBASE, World of Science and Cochrane Central Register of Controlled Trials databases. Retrieval time was from the inception of the databases to March 2014. The key words and text words used in the search included “cervical compressive myelopathy”, “expansive laminoplasty”, “open-door laminoplasty”, “single-door laminoplasty”, “French-door laminoplasty” and “double-door laminoplasty”. Only articles written in English were selected. To identify other relevant

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studies, we manually scanned reference lists from identified trials and reviewed articles. Two investigators independently reviewed all subjects, abstracts and full texts of articles that were potentially eligible based on abstract review. The eligible articles were then selected according to the study eligibility criteria.

2.2. Study eligibility criteria

We systematically reviewed the studies returned by our literature search according to the following criteria: (1) the studies included a comparative design (ODL versus FDL); (2) the study population consisted of adult patients suffering from CSM, OPLL or developmental canal stenosis; and (3) the studies reported at least one desirable outcome and the continuous variable was presented as mean and standard deviation. All selected studies were independently reviewed by two investigators for inclusion in the final analysis. Any inconsistencies were resolved by discussion until a consensus was reached.

2.3. Data extraction

Two reviewers independently extracted data using a standardized form. Data were collected for the following categories when available: (1) basic characteristics, including publication year, study design, patient age, sex, enrolled number and follow-up time; (2) primary outcome, presented as the Japanese Orthopaedic Association (JOA) score; and (3) secondary outcomes, including perioperative complication rate, operative time, intraoperative blood loss, postoperative cervical lordosis and range of motion (ROM). Any disagreement between the reviewers was resolved by discussion.

2.4. Strength of evidence

The risk of bias was assessed by the criteria proposed by the Cochrane Back Review Group [12]. The level of evidence was assessed according to the guidelines of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working group [13].

2.5. Statistical analysis

Continuous variables (JOA score, operative time, intraoperative blood loss, cervical lordosis and ROM) were analyzed by weighted mean differences (WMD) and 95% confidence intervals (CI), while dichotomous data (perioperative complication rate) were analyzed using odds ratios (OR) and 95% CI. Additionally, heterogeneity across trials were evaluated with the I^2 statistic, with heterogeneity

defined as $I^2 > 50\%$. If heterogeneity existed, a random-effects model was applied to assess the overall estimate. Otherwise, a fixed-effects model was chosen. All tests were two-tailed and $p < 0.05$ was considered significantly different. The data were further analyzed using the Review Manager (version 5.1, Copenhagen: The Nordic Cochrane Centre, Cochrane Collaboration, 2011).

3. Results

3.1. Selected studies and characteristics

The details of the literature search and article selection are displayed in Figure 2. A total of 284 potentially relevant citations were initially identified. After independent review of the titles and abstracts of all potential articles, four articles were finally included, two RCT [14,15] and two retrospective comparative studies [16,17]. The detailed characteristics of these studies are shown in Table 1.

3.2. Quality assessment

All studies revealed a high risk of bias. Although the two RCT reported drop-out information, the processes of randomization, allocation and blinding were not presented. According to the GRADE guidelines, all studies were of relatively low quality (Table 2).

3.3. Meta-analysis results

3.3.1. Functional outcome

To evaluate the functional outcome following ODL and FDL, all four trials used the JOA score, first described by Hirabayashi [18]. Statistical analysis was feasible after standardization pooling. Improvement of postoperative functional status was identified following both treatments. The pooled analysis showed that ODL had a higher postoperative JOA score than that of FDL (WMD = 0.83; 95% CI: 0.47 to 1.19; $p < 0.01$; fixed-effects model), and no heterogeneity existed ($p = 0.27$, $I^2 = 24\%$) (Fig. 3).

3.3.2. Operative time and intraoperative blood loss

Three articles [14,15,17] reported operative time and intraoperative blood loss. The pooled results showed that there was no significant difference in operative time between the ODL and FDL groups (WMD = -6.76; 95% CI: -21.70 to 8.18; $p = 0.38$; random-effects model) with a heterogeneity of $I^2 = 74\%$, $p = 0.02$ (Fig. 4). The pooled results regarding intraoperative blood loss also did not reveal a significant difference (WMD = 41.70; 95% CI: -61.43

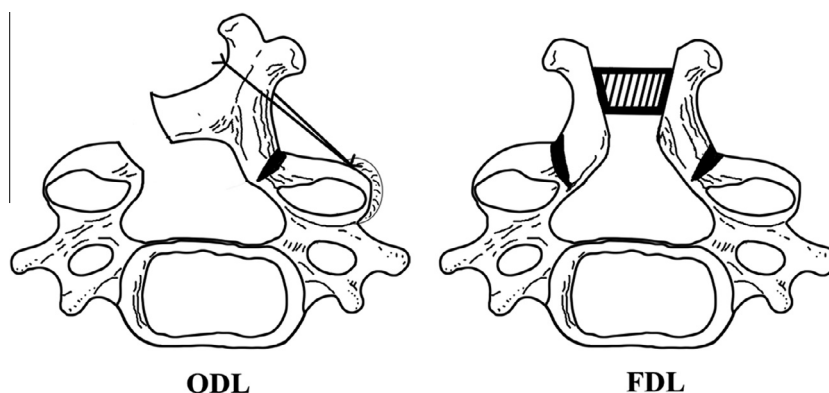


Fig. 1. Schematic axial illustration of the two methods of cervical laminoplasty. FDL = French-door laminoplasty, ODL = open-door laminoplasty.

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