Interlaminar Bony Fusion after C3-6 Double-Door Laminoplasty for Cervical Spondyloytic Myelopathy: Its Predictors and Characteristics

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Background

Bony fusion of the facet joint was observed in 60% of patients, and range of motion (ROM) decreased to 28% after double-door laminoplasty for cervical spondylotic myelopathy (CSM). (Seichi et al 2001)

The high fusion rate and the high reduction in ROM were attributed to patients not being able to perform the required post laminoplasty neck exercises due to wearing long term cervical orthosis. (Kimura et al 2011)

Interlaminar fusion was identified in 53% of patients and ROM decreased to 70% for patients with CSM after open-door laminoplasty followed by 3 weeks of cervical orthosis. (Iizuka et al 2006)

The rate of interlaminar fusion at C2-3 after French-door laminoplasty (double-door laminoplasty) was higher than the rate of fusion at C2-3 after open-door laminoplasty. (Lee et al 2012)

However the extent of interlaminar fusion after double-door laminoplasty, with the early removal of the cervical orthosis has yet to be clarified.
The purpose of this study is to investigate the occurrence of interlaminar fusion following C3-6 double-door laminoplasty and to evaluate its relationship with the clinical data.
Materials and Methods

Between 2005 and 2011, 210 patients with CSM underwent double-door lamioplasty using hydroxyapatite spacers and wearing a cervical orthosis for two weeks after surgery.

We excluded patients who underwent laminoplasty with spinal fusion, patients with previous cervical surgery, patients with ossification of the posterior longitudinal ligament, and patients with other diseases affecting functional status.

Of 105 patients, 81 patients underwent C3-6 double-door laminoplasty, 2 years post surgery 47 of the patients were evaluated.

We divided the patients into two groups as shown below, and the data from the two groups was compared.

47 patients (29 males 18 females)
Two years after surgery

Group A: Patients with interlaminar fusion
(32 patients) (68%)

Group B: Patients without interlaminar fusion
(15 patients) (32%)
Examination data: Clinical data, Involved levels, Surgical outcomes, and Radiographic data.

Involved levels: Magnetic resonance imaging (MRI) by ascertaining signal intensity change. (Morio et al 2001)


Radiographic data:
The lordotic angles of C2-7 = β. (Cobb method)
ROM of C2-7 = α + γ.
Proportion of ROM preservation (ROM preservation) = (postoperative ROM) / (preoperative ROM) × 100. (Machino et al 2012)

Lateral radiographs:
Flexion
Neutral
Extension
Results

Postoperative interlaminar fusion was identified in 32 patients (68%) two years after surgery.

Spinal Level of Interlaminar Fusion.
**Table 1** Demographic Data of Patients.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total</th>
<th>Group A</th>
<th>Group B</th>
<th>p value (A and B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (n)</td>
<td>47</td>
<td>32</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>70.4 (10.8)</td>
<td>71.5 (11.6)</td>
<td>68.1 (8.6)</td>
<td>0.714\textsuperscript{a}</td>
</tr>
<tr>
<td>Gender (men/women)</td>
<td>29/18</td>
<td>16/16</td>
<td>13/2</td>
<td>0.016\textsuperscript{b}</td>
</tr>
<tr>
<td>JOA score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperatively</td>
<td>9.5 (2.8)</td>
<td>9.1 (3.0)</td>
<td>10.3 (2.0)</td>
<td>0.286\textsuperscript{a}</td>
</tr>
<tr>
<td>Two years postoperatively</td>
<td>13.4 (2.2)</td>
<td>13.2 (2.3)</td>
<td>13.6 (2.1)</td>
<td>0.671\textsuperscript{a}</td>
</tr>
<tr>
<td>Recovery ratio (%)</td>
<td>48.2 (35.6)</td>
<td>49.8 (32.6)</td>
<td>44.8 (42.4)</td>
<td>0.864\textsuperscript{a}</td>
</tr>
</tbody>
</table>

Values for number, age, gender, JOA score, and recovery ratio are given as mean (SD).


# Table 2  Radiographic Data of Patients.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total</th>
<th>Group A</th>
<th>Group B</th>
<th>p value (A and B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of fusion (n)</td>
<td>0.87 (0.74)</td>
<td>1.28 (0.52)</td>
<td>0 (0)</td>
<td>&lt; 0.001&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>The lordotic angle (degree)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperatively</td>
<td>11.8 (12.2)</td>
<td>12.9 (12.4)</td>
<td>9.30 (11.9)</td>
<td>0.560&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Two years postoperatively</td>
<td>9.77 (13.2)</td>
<td>10.4 (13.5)</td>
<td>8.30 (12.8)</td>
<td>0.656&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>ROM (degree)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperatively</td>
<td>35.8 (15.7)</td>
<td>34.7 (16.4)</td>
<td>38.2 (14.1)</td>
<td>0.451&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Two years postoperatively</td>
<td>22.4 (10.7)</td>
<td>20.3 (10.0)</td>
<td>27.3 (11.0)</td>
<td>0.064&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Preserved ROM (%)</td>
<td>69.4 (48.5)</td>
<td>67.4 (56.6)</td>
<td>74.3 (24.5)</td>
<td>0.103&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values for number of fusion level, the lordotic angle, ROM and preserved ROM are given as mean (SD).
ROM: Range of motion.
ROM preservation: (postoperative ROM) / (preoperative ROM) × 100.
Table 3 Involved Level of Spinal Cord.

<table>
<thead>
<tr>
<th>Involved level</th>
<th>Number of patients</th>
<th></th>
<th></th>
<th>p value (A and B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>17</td>
<td>17</td>
<td>0</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>C3-4</td>
<td>20</td>
<td>9</td>
<td>11</td>
<td>0.004</td>
</tr>
<tr>
<td>C4-5</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>0.302</td>
</tr>
<tr>
<td>C5-6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.681</td>
</tr>
</tbody>
</table>

Statistical analysis: chi-square test.
Discussion

From this study:
Reduction in ROM may have lead to interlaminar fusion which frequently occurred at C2-3 level.

From previous reports:
Causes of reduction of ROM included long term orthosis (6 weeks and over) and contracture of the paraspinal muscle and facet joint.

(Kimura A et al 2011)

Post double-door laminoplasty, fusion occurred at C2-3 due to the cancellous bone being exposed at the bottom of the C2 lamina.

(Lee DG et al 2013)

To avoid interlaminar fusion and to preserve ROM, early removal of the cervical orthosis, with postoperative neck exercise, and further modification of operation techniques to preserve the C2 lamina and the paraspinal muscle are required.
Discussion

From this study:
All patients with involved levels at C3-4 were identified as having interlaminar bony fusion because of a reduction in postoperative ROM.

From previous reports:
Of patients whose involved level was at C3-4, a greater number of elderly CSM patients experienced severe neurologic symptoms.

(Nagashima et al 2006)

We determined that patients with involved levels at C3-4 were elderly patients. These patients experienced severe degenerative changes and postoperative muscle damage resulting in muscle contracture and a reduction in ROM causing interlaminar fusion.

Limitations

Retrospective study.
Poor follow-up rate.
The sample was small in size.
Conclusions

Interlaminar fusion after laminoplasty frequently occurred at C2-3. This is the first study to show interlaminar fusion in all patients whose involved level was at C3-4.

Therefore, the involved level at C3-4 could be a good predictor of interlaminar fusion following double-door laminoplasty.

Conflict of interest

No benefits in any form have been received or will be received from commercial parties related directly or indirectly to the subject of this article.