Laminar closure is associated with expansive open-door laminoplasty. Suture anchor fixation and titanium miniplate fixation are used to prevent laminar reclosure. However, few studies have compared the clinical effects of the 2 fixation methods. The authors performed a prospective study of 55 patients with cervical spondylotic myelopathy who underwent single open-door laminoplasty with suture anchor fixation (n=30) or titanium miniplate fixation (n=25) from June 2005 to May 2011. Clinical and radiologic outcomes were evaluated at 1 week and 1 year postoperatively. There were no significant differences between the 2 groups in terms of Japanese Orthopaedic Association (JOA) scores, JOA recovery rates at 1 week postoperatively, and the incidence of C5 palsy. Compared with the suture anchor group, the recovery rate in the titanium miniplate group was significantly higher at 1 year postoperatively, and the incidence of axial symptoms and mean axial symptom scores were significantly lower at 1 week, but not 1 year, postoperatively. Radiologic examination showed no significant differences in the anteroposterior diameter of the spinal cord and the vertebral body-to-spinal cord distance between the 2 groups. At 1 year postoperatively, the opening angle in the suture anchor group was significantly less than that in the titanium miniplate group. Titanium miniplate fixation is more effective than suture anchor fixation in preventing laminar closure, accompanied by a higher JOA recovery rate at 1-year follow-up and a lower incidence of axial symptoms.
Cervical spondylotic myelopathy is a common degenerative disease that causes narrowing of the spinal canal. Cervical laminoplasty is often used to decompress the spinal cord by widening the spinal canal through reconstructing the lamina.\(^1\,\(^2\)\) Expansive open-door laminoplasty has been well established for the treatment of multiple-level cervical spondylotic myelopathy and ossification of the posterior longitudinal ligament and can achieve satisfactory long-term clinical outcomes.\(^3\,\(^4\)\) However, many complications, such as axial symptoms, nerve root palsy, and elevated laminar closure, may occur.\(^5\,\(^6\)\) Laminar closure is associated with this procedure because it can lead to restenosis of the spinal canal, thereby decompressing the spinal cord.\(^8\) Matsumoto et al\(^9\) reported that laminar closure, which was defined as a decrease of 10% or more in the canal-to-body ratio at follow-up compared with that immediately postoperatively at 1 or more vertebral levels, occurred in 34% of patients with cervical myelopathy who underwent open-door laminoplasty, and preoperative kyphosis was a significant risk factor for laminar closure.\(^9\)

In the original method developed by Hirabayashi et al\(^10\), the opened laminae are held by sutures between the laminae and the paraspinal muscles. Since then, several modified methods using titanium miniplates or anchoring screws have been developed to secure the opened lamina.\(^11\) Lee et al\(^11\) reported that laminar closure occurred 6 months after classic Hirabayashi open-door laminoplasty. No hinge closure has been reported after open-door laminoplasty using plate fixation,\(^12\,\(^13\)\) suggesting that plate fixation is better than suture fixation in preventing laminar closure. However, in a recent retrospective study of 54 patients with cervical spondylotic myelopathy who underwent laminoplasty, Chen et al\(^14\) found no significant difference in opening angle between titanium miniplate fixation (n=29) and suture fixation (n=25) at 1-year follow-up. This difference may due to different patient populations and surgeon skill in these studies. Therefore, the effect of the titanium miniplate in preventing laminar closure after open-door laminoplasty remains to be determined.

The current authors report a prospective study of 55 patients with cervical spondylotic myelopathy who underwent single open-door laminoplasty with suture anchor fixation (n=30) or titanium miniplate fixation (n=25) from June 2005 to May 2011. The purpose of this study was to compare and evaluate the clinical results, especially laminar closure, at 1-year follow-up after single open-door laminoplasty using the 2 fixation methods.

**Materials and Methods**

This study was approved by the authors’ institutional review board, and all patients gave their informed consent prior to inclusion in the study. This prospective study enrolled 67 patients with cervical spondylotic myelopathy who underwent single open-door laminoplasty from June 2005 to May 2011. Inclusion criteria were (1) age between 45 and 65 years; (2) male or female sex; (3) disease duration between 12 and 24 months; (4) patients with cervical disk herniation and stenosis who underwent single open-door laminoplasty with 4 or more levels of decompression; (5) patients with clinical symptoms and signs, such as gait difficulties, hypesthesia in trunks and extremities, weakness in extremities, tendon hyperreflexia, positive Hoffman sign, and positive Babinski sign; (6) stenosis of the spinal canal confirmed by magnetic resonance imaging (MRI) of the cervical spine; and (7) no improvement of symptoms and signs after conservative treatment for at least 3 months preoperatively. Exclusion criteria were (1) ossification of the posterior longitudinal ligament; (2) nerve root–type cervical spondylosis; (3) congenital spinal deformity, trauma, tumor, infection, or severe osteoporosis; (4) cervical instability; (5) history of cervical spine surgery; (6) severe systemic disease and metal allergy; and (7) follow-up period less than 12 months.

A total of 55 (82.1%) patients (30 males and 25 females) were successfully followed for more than 12 months. Of 12 patients who were lost to follow-up, 7 were unable to be contacted due to an incorrect phone number or address. The other 5 patients were lost to follow-up because of their inability to afford long-distance transportation and hospital visits. Average patient age was 55.6±4.1 years (range, 45-62 years). Mean disease duration was 17.6±3.6 months (range, 12-24 months). The diagnosis of cervical spondylotic myelopathy was made based on the clinical symptoms and signs and MRI findings. All patients had progressive neurological symptoms. The major clinical manifestations were hypesthesia in trunks and extremities (n=45), weakness in extremities (n=40), unsteady gait (n=38), tendon hyperreflexia (n=35), positive Hoffman sign (n=32), and positive Babinski sign (n=35). Preoperative MRI showed multiple levels of cervical spinal stenosis.

Patients were assigned to 1 of 2 groups according to fixation method: the suture anchor group and the titanium miniplate group. All patients were suitable to the use of Revo suture anchors (ConMed Linvatec, Largo, Florida) or Centerpiece titanium miniplates (Medtronic Sofamor Danek, Memphis, Tennessee) with no contraindications. All surgical procedures were performed by the same surgeon (J.W.). The surgeon had no preference on the use of the fixation methods and had no bias on the selection of fixation methods. Patients were not randomly assigned to their groups; method selection was determined preoperatively by the patients, who were informed of the 2 surgical procedures and the potential for complications, such as infection, hematoma, injury to the spinal cord, postoperative axial symptoms, C5 palsy, and laminar closure. Patients were informed that the purpose of the study was to observe the differences...
in the occurrence of these complications, including laminar closure, between the 2 surgical procedures.

The suture anchor group comprised 30 patients (17 men and 13 women) with an average age of 56.3±3.6 years (range, 48-62 years). Decompression segments were C3-C6 in 14 patients and C3-C7 in 16 patients. Laminae were opened on the left side in 17 patients and the right side in 13 patients. Mean follow-up was 21.5±6.3 months (range, 12-36 months).

The titanium miniplate group comprised 25 patients (12 men and 13 women) with an average age of 54.8±4.7 years (range, 45-60 years). Decompression segments were C3-C6 in 11 patients and C3-C7 in 14 patients. Laminae were opened on the left side in 13 patients and the right side in 12 patients. Mean follow-up was 20.1±5.0 months (range, 14-30 months).

**Surgical Technique**

Single open-door laminoplasty was performed on all patients. Under general anesthesia, each patient was placed in a prone position on an operating table. A midline approach was made to expose the spinous process, lamina, and bilateral articular processes. The hinged side was determined by the side with less neurological deficits. The opposite side with more neurological deficit served as the opened side. Both the hinged- and opened-side gutters were created in the lamina just medial to each articular process with a high-speed spur. On the opened side, the outer cortex, cancellous bone, and inner cortex were removed. On the hinged side, the inner cortex remained. The ligamentum flavum between the opening and remaining segment was cut to allow adequate mobilization and rotation of the laminae.

For patients in the suture anchor group, Revo suture anchors (ConMed Linvatec) were placed into the lateral masses of the hinged side. A dental drill with a 2-mm burr tip was used to make a hole in the base of the spinous processes. The lamina door was opened by carefully moving the lamina on the opened side laterally toward the hinged side. The nonabsorbable suture on the suture anchor was brought through the hole in the spinous process, and a knot was tied to prevent laminar closure. Bones trimmed from the spinous processes were grafted into the hinges to secure the expansion of the spinal canal.

For patients in the titanium miniplate group, after the laminar door was opened, appropriate-sized Centerpiece titanium miniplates were selected for each level. Two holes were then made in the lamina and 2 holes were made in the lateral mass using the 5-mm-depth drill. The plates were held in position with 2-mm screws (5 mm in length).

After adequate decompression and secure fixation with suture anchors (Figure 1) or titanium miniplates (Figure 2), a negative pressure drainage tube was placed; it was removed 24 hours postoperatively. Patients were braced in a cervical collar to immobilize the neck for 6 weeks and were mobilized 5 days postoperatively.

**Neurologic Evaluation**

The neurologic function of each patient was evaluated according to Japanese Orthopedic Association (JOA) score preoperatively and 1 week and 12 months postoperatively. The recovery rate was calculated according to the following equation: recovery rate=(postoperative score–preoperative score)/(17–preoperative score)×100%. Axial symptoms, in-
including neck pain, neck stiffness, shoulder pain, and shoulder stiffness, were scored on a scale from 0 to 3 as follows: 0=no symptoms; 1=occasional and mild symptoms; 2=frequent and mild symptoms with occasional severe symptoms; and 3=frequent and severe symptoms. The maximum score was 12.

Radiological Evaluation

All patients underwent computed tomography (CT) and MRI preoperatively and 1 week and 12 months postoperatively. Axial MRI were used to measure the vertebral body-to-spinal cord distance (defined as the distance from the posterior surface of the vertebral body to the anterior surface of the spinal cord) and the anteroposterior (AP) diameter of the spinal cord (defined as the distance from the anterior surface to the posterior surface of the spinal cord) (Figure 3). Axial cervical CT images were used to measure the opening angle, which was defined as the angle between the lines connecting the hinged point with the 2 opened ends of the lamina (Figure 4). For each patient, the opening angle, vertebral body-to-spinal cord distance, and AP diameter of the spinal cord at each decompression segment were measured by the surgeons (W.H., X.S.) blinded to the patients’ conditions, such as baseline patient characteristics and neurological functions.

Statistical Analysis

Statistical analysis was performed using SPSS version 19.0 statistical software (SPSS Inc, Chicago, Illinois). Values are presented as mean±SD. Student’s t test was used to compare differences between the groups. Chi-square test was used to compare differences in the incidence of postoperative axial symptoms between the groups. P values less than .05 were considered statistically significant.

RESULTS

Baseline Patient Characteristics

Thirty patients underwent laminoplasty by titanium miniplate fixation, and 25 patients underwent laminoplasty by suture anchor fixation (Table 1). Average patient age was 56.3±3.6 years in the suture anchor group and 54.8±4.7 years in the titanium miniplate group (P=.46). Mean disease duration was 17.1±3.2 months in the suture anchor group and 18.7±3.8 months in the titanium miniplate group, which was not significantly different. Mean operative time was 143±10.1 minutes in the suture anchor group and 146±12.7 minutes in the titanium miniplate group, which was not significantly different. Mean intraoperative blood loss was 208.7±32.0 mL in the suture anchor group and 205.4±32.3 mL in the titanium miniplate group, which was not significantly different. Mean postoperative axial symptom score was 2.3±1.0 in the suture anchor group and 7.5±1.9 in the titanium miniplate group, which was not significantly different. No significant difference was found in 1-week and 1-year postoperative JOA scores and 1-week postoperative recovery rates (Table 2). However, 1-year postoperative recovery rate in the titanium miniplate group was significantly higher than that in the suture anchor group (P=.012).

Clinical Evaluation

Mean preoperative JOA score was 8.5±1.3 in the suture anchor group and 8.0±1.9 in the titanium miniplate group (P=.731). In the suture anchor group, mean JOA score improved to 13.2±0.8 at 1 week postoperatively, with a recovery rate of 54.1%±10.3%, and to 14.5±0.8 at 1 year postoperatively, with a recovery rate of 70.0%±11.5%. In the titanium miniplate group, mean JOA scores improved to 12.9±1.2 at 1 week postoperatively, with a recovery rate of 54.1%±10.3%, and to 15.0±1.3 at 1 year postoperatively, with a recovery rate of 78.2%±11.9%. No significant difference was found in 1-week and 1-year postoperative JOA scores and 1-week postoperative recovery rates (Table 2). However, 1-year postoperative recovery rate in the titanium miniplate group was significantly higher than that in the suture anchor group (P=.012). Mean preoperative axial symptom score was 2.3±1.0 in the suture anchor group.
group and 2.2±1.1 in the titanium miniplate group (P>.05). At 1 week postoperatively, mean axial symptom score in the titanium miniplate group (2.9±2.0) was significantly lower than that in the suture anchor group (4.2±2.1) (P<.05) (Table 2). The incidence of axial symptoms in the titanium miniplate group (2 of 25) was also significantly lower than that in the suture anchor group (11 of 30) (P<.05). However, no significant difference was observed between the groups in mean axial symptom scores and incidence of axial symptoms at 1 year postoperatively (P>.05) (Table 2).

C5 palsy was observed in 3 (10%) of 30 patients in the suture anchor group. The C5 palsy developed on the opened side at 1 to 2 weeks postoperatively. The patients received conservative treatment and recovered 3 months postoperatively. No C5 palsy was observed in the titanium miniplate group. There was no significant difference in the incidence of C5 palsy between the 2 groups (P>.05).

No other complications, such as screw breakout, infection, cerebrospinal fluid leakage, hematoma, and spinal cord injuries, were observed in either group.

Radiologic Evaluation
In the suture anchor group, mean AP diameter of the spinal cord increased from 3.00±0.59 mm preoperatively to 6.26±0.46 mm at 1 week postoperatively and 6.17±0.41 mm at 1 year postoperatively. In the titanium miniplate group, mean AP diameter of the spinal cord increased from 3.12±0.63 mm preoperatively to 6.26±0.46 mm at 1 week postoperatively and 6.28±0.44 mm at 1 year postoperatively. No significant difference was found in pre- and postoperative AP diameter of the spinal cord between groups (Table 3). Similarly, mean vertebral body-to-spinal cord distance increased at 1 week and 1 year postoperatively in both groups but was not significantly different between groups (Table 3).

Mean opening angle in the suture anchor group was 41.87°±8.02° at 1 week postoperatively, which was not significantly different from that in the titanium miniplate group (39.96°±6.51°) (P>.05) (Table 3). However, mean opening angle at 1 year postoperatively decreased to 33.30°±5.88° in the suture anchor group, which was significantly less than that in the titanium miniplate group (38.96°±6.52°) (P<.05) (Table 3).

**Table 1**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Suture Anchor Group (n=30)</th>
<th>Titanium Miniplate Group (n=25)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>56.3±3.6</td>
<td>54.8±4.7</td>
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<tr>
<td>Disease duration, mo</td>
<td>17.1±3.2</td>
<td>18.7±3.8</td>
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<td>Operative time, min</td>
<td>143±10.1</td>
<td>146±12.7.1</td>
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<td>Blood loss, mL</td>
<td>208.7±32.0</td>
<td>205.4±32.3</td>
<td>.709</td>
</tr>
<tr>
<td>Follow-up, mo</td>
<td>21.5±6.3</td>
<td>20.1±5.0</td>
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**Table 2**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suture Anchor Group (n=30)</th>
<th>Titanium Miniplate Group (n=25)</th>
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</tr>
</thead>
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<tr>
<td>Mean JOA score</td>
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<td></td>
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<tr>
<td>Preop</td>
<td>8.5±1.3</td>
<td>8.0±1.9</td>
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<tr>
<td>1 wk postop</td>
<td>13.2±0.8</td>
<td>12.9±1.2</td>
<td>.403</td>
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<tr>
<td>1 y postop</td>
<td>14.5±0.8</td>
<td>15.0±1.3</td>
<td>.095</td>
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<td>Mean recovery rate, %</td>
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<tr>
<td>1 wk postop</td>
<td>54.1±10.3</td>
<td>54.7±9.8</td>
<td>.807</td>
</tr>
<tr>
<td>1 y postop</td>
<td>70.0±11.5</td>
<td>78.2±11.9</td>
<td>.012a</td>
</tr>
<tr>
<td>Axial symptoms</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mean score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>2.3±1.0</td>
<td>2.2±1.1</td>
<td>.731</td>
</tr>
<tr>
<td>1 wk postop</td>
<td>4.2±2.1</td>
<td>2.9±2.0</td>
<td>.022a</td>
</tr>
<tr>
<td>1 y postop</td>
<td>2.9±1.6</td>
<td>2.7±1.6</td>
<td>.670</td>
</tr>
<tr>
<td>No. at 1 wk postop</td>
<td>11</td>
<td>2</td>
<td>.023a</td>
</tr>
<tr>
<td>No. at 1 y postop</td>
<td>5</td>
<td>1</td>
<td>.204</td>
</tr>
</tbody>
</table>

Abbreviations: JOA, Japanese Orthopaedic Association; postop, postoperatively; preop, preoperatively.
aStatistically significant.

**Table 3**

Means±SD of AP diameter of the spinal cord, vertebral body-to-spinal cord distance, and opening angle at 1 week and 1 year postoperatively are presented in Table 3.

**Discussion**
Expansive open-door laminoplasty has been used to treat cervical spondylotic myelopathy with satisfactory outcomes by expanding the spinal canal to decompress the spinal cord.3,15 Once the lamina...
has been opened, preventing laminar closure is a primary concern because a narrowed spinal canal due to laminar closure can cause compression of the spinal cord. It has been reported that laminar closure is associated with a decreased recovery rate during the long-term follow-up period after open-door laminoplasty. Lee et al found that laminar closure occurred 6 months after classic Hirabayashi open-door laminoplasty with an approximately 10% decrease in the opening angle. In classic Hirabayashi open-door laminoplasty, the opened lamina is held by stay sutures placed in the spinous process and paraspinal muscle. Laminar closure may be caused by loose sutures and or spring-back of the opened door due to increased cervical motion during postoperative recovery. The use of a titanium miniplate can stabilize the posterior elements, thereby preventing laminar closure and facilitating neurological recovery after open-door laminoplasty.

In the current study, no significant difference was found in the opening angle at 1 week postoperatively between the suture anchor and titanium miniplate groups. However, opening angle at 1 year postoperatively in the suture anchor group was significantly less than that in the titanium miniplate group, suggesting that titanium miniplate fixation is better than suture anchor fixation in preventing laminar closure after open-door laminoplasty. However, using similar measuring methods, Chen et al found that titanium miniplate fixation produced a similar result in opening angle at 1-year follow-up after laminoplasty compared with suture fixation. The similar opening angle at 1 year after laminoplasty using titanium miniplate fixation and suture fixation is likely due to a meticulous procedure to reduce the incidence of laminar closure in the suture fixation group or because a larger opening angle was created in the suture fixation group; the opening angle immediately postoperatively was not reported in the study. The difference may also result from different patient populations in different studies. In addition, in the current study, the opening angle at 1-year follow-up decreased by approximately 20% in the suture anchor group, which is higher than that in classic Hirabayashi open-door laminoplasty (approximately 10%). The difference may be due to different patient populations, surgeons’ skills, and postoperative movement in these studies.

The current study also found that single open-door laminoplasty using suture anchor fixation or titanium miniplate fixation can effectively decompress the spinal cord, as evidenced by increased AP diameter of the spinal cord and vertebral body-to-spinal cord distance at 1 week and 1 year postoperatively, accompanied by an increased JOA score. No significant difference was found in mean AP diameter of the spinal cord, vertebral body-to-spinal cord distance, and JOA score preoperatively and 1 week and 1 year postoperatively between the 2 groups. Although the differences were not statistically different, mean JOA score at 1-year follow-up tended to be higher in the titanium miniplate group. Moreover, the recovery rate at 1 year postoperatively was significantly higher in the titanium miniplate group compared with the suture anchor group, accompanied by a larger opening angle. These findings suggest that laminar closure in the suture anchor group may be associated with a slow functional recovery. This study agrees with the previous finding that laminar closure is associated with a decreased JOA recovery rate during the long-term follow-up period. For most patients in the suture anchor group, although the opening angle decreased at 1-year follow-up, the laminar door was still opened without significant compression of the spinal cord. However, in 2 cases with an opening angle less than 25° at 1 week postoperatively and less than 20° at 1-year follow-up, the patients exhibited obvious symptoms of spinal compression.

Axial symptoms such as pain and stiffness are well-documented complications

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### Table 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suture Anchor Group (n=30)</th>
<th>Titanium Miniplate Group (n=25)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP spinal cord diameter, mm</td>
<td>Preop 3.00±0.59</td>
<td>3.12±0.63</td>
<td>.471</td>
</tr>
<tr>
<td>1 wk postop 6.26±0.46</td>
<td>6.62±0.47</td>
<td>.975</td>
<td></td>
</tr>
<tr>
<td>1 y postop 6.17±0.41</td>
<td>6.28±0.44</td>
<td>.321</td>
<td></td>
</tr>
<tr>
<td>Vertebral body-to-spinal cord distance, mm</td>
<td>Preop 2.23±0.36</td>
<td>2.35±0.62</td>
<td>.392</td>
</tr>
<tr>
<td>1 wk postop 6.26±0.46</td>
<td>6.21±0.46</td>
<td>.701</td>
<td></td>
</tr>
<tr>
<td>1 y postop 6.17±0.46</td>
<td>6.22±0.42</td>
<td>.676</td>
<td></td>
</tr>
<tr>
<td>Opening angle, deg</td>
<td>1 wk postop 41.87±8.82</td>
<td>39.96±6.51</td>
<td>.344</td>
</tr>
<tr>
<td>1 y postop 33.30±5.88</td>
<td>38.96±6.52</td>
<td>.001*</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: AP, anteroposterior; deg, degrees; postop, postoperatively; preop, preoperatively. *Statistically significant.
after laminoplasty.\textsuperscript{5} Axial symptoms have been reported to occur in as many as 60% to 80% of patients who undergo laminoplasty.\textsuperscript{19,20} Although the exact causes of axial symptoms remain unclear, many surgeons suspect that the nuchal muscle, facet joints, and nerve root may contribute to axial symptoms.\textsuperscript{17,21} In the current study, axial symptoms, including neck pain, neck stiffness, shoulder pain, and shoulder stiffness, were evaluated using a 12-point scale.

The incidence of axial symptoms at 1 week postoperatively was low in the suture anchor group (37%) and the titanium miniplate group (8%). Mean axial symptom score and incidence of axial symptoms in the titanium miniplate group were significantly lower than those in the suture anchor group, suggesting that titanium miniplate fixation could reduce postoperative axial symptoms after open-door laminoplasty. The lower incidence of axial symptoms with the use of a titanium miniplate may be due to its better stabilization of the cervical vertebrae, thereby reducing potential movement of muscle and facet joints. However, no significant difference was found in axial symptoms at 1-year follow-up between the 2 groups, which exhibited significant differences in opening angle, suggesting that laminar closure may not contribute to axial symptoms.

C5 palsy occurred in 3 (10%) of 30 patients in the suture anchor group but in 0 of 25 patients in the titanium miniplate group. Although no statistically significant difference was observed between the 2 groups, the incidence of C5 palsy tended to be higher in the suture anchor group. Because the incidence of C5 palsy is low (approximately 8%),\textsuperscript{22} a larger sample size is required to determine whether a lower incidence of C5 palsy is associated with the use of a titanium miniplate. Although the etiology of C5 palsy is unclear, tethering of the nerve root may cause the development of C5 palsy as a result of posterior movement of the spinal cord after posterior decompression.\textsuperscript{23,24} In agreement with this hypothesis, the current study found that the posterior movement (calculated by the difference between the pre- and postoperative vertebral body-to-spinal cord distances) in patients with C5 palsy (5.13±0.21 mm) was greater than the average (3.96±0.67 mm).

The current study has some limitations. First, although the sample size of the study was large enough to detect a significant difference in complications with a high incidence rate (axial symptoms), the sample size was relatively small to analyze complications with a low incidence rate (C5 palsy). Second, patients were assigned to the suture anchor group and the titanium miniplate group based on a preoperative decision made by the patients. This decision resulted in a different number of patients in each group, although the baseline characteristics of the patients in both groups were comparable. Third, the follow-up period of 1 year may be short for studying laminar closure because a narrowed spinal canal can cause prolonged compression of the spinal cord, and some outcomes due to laminar closure may require a longer time to occur. A study with a longer follow-up period is warranted for further investigation.

**Conclusion**

Compared with suture anchor fixation, titanium miniplate fixation was more effective in preventing laminar closure, accompanied by a higher JOA recovery rate at 1-year follow-up and a lower incidence of axial symptoms.

**References**


