C6 nerve root palsy after double-door cervical laminoplasty

Isamu Miura¹, Kubota Motoo², Takakazu Kawamata¹, Masahito Yuzurihara²

¹Department of Neurosurgery, Tokyo Women’s Medical University, Shinjuku, Tokyo, ²Department of Spinal Surgery, Kameda Medical Center, Kamogawa, Chiba, Japan.

E-mail: *Isamu Miura - isamu2345@yahoo.co.jp; Kubota Motoo - kubota.motoo@kameda.jp; Takakazu Kawamata - tkawamata@twmu.ac.jp; Masahito Yuzurihara - yuzurihara.masahito@kameda.jp

INTRODUCTION

Studies focusing on the new onset of C6 root palsies following posterior cervical decompression are rare.¹²³ Here, we assessed how often 318 patients undergoing double-door cervical laminoplasty developed the new onset of postoperative C6 nerve root palsies.

MATERIALS AND METHODS

Clinical presentation

We retrospectively reviewed the records of 318 consecutive patients undergoing double-door cervical laminoplasty (i.e. with sagittal splitting of the spinal process without foraminotomies) [Tables 1 and 2].
Definition of C6 nerve root palsy

In our study, C6 nerve root palsy was defined by a loss of motor and/or sensory function in the C6 distribution within 2 weeks of surgery/laminoplasty. We additionally compared the C6 palsy group with 40 control patients selected randomly from among the 306 patients without C6 palsy.

Radiological evaluation

Patients in both groups underwent preoperative plain radiography, computed tomography (CT), and magnetic resonance imaging (MRI). Postoperative CT’s were performed on the day of or within days of the surgery, while postoperative MRIs were performed on postoperative day 7 [Figures 1-4].

Statistics

Statistical analysis was performed using the R statistical software. Results are reported as mean ± standard deviation. The Student t-test, Pearson Chi-square test, and Fisher exact test were used, as appropriate. Any P < 0.05 was considered significant. Approval was obtained from the institutional review board of Kameda Medical Center.

RESULTS

Incidence of postoperative C6 palsy

Twelve (3.8%) patients developed unilateral new postoperative C6 nerve root deficits occurring an average of 2.0 ± 1.3 days (0–5 days) postoperatively. Deficits included: 5 with paresis alone, 4 with isolated C6 sensory loss, and 3 with both paresis and sensory deficit. All 12 patients were managed without, additional surgery, and paresis improved at 6 postoperative months in 7 of 8 patients. Notably, seven patients with C6 nerve root palsies also had C5 palsies (58%). A prevalence was significantly higher than in the control group (P < 0.001) [Table 3]. No significant differences with/
without C6 nerve root palsies were observed for the following variables; medical history, diabetes, and preoperative Japanese Orthopaedic Association score.

Radiographic data for the 12 patients with C6 palsies

The 12 patients with C6 nerve root palsies showed no significant differences in their C2–C7 lordotic angle ($\theta$) on the plane radiographs, but their CT studies demonstrated significantly narrower C6 intervertebral foramina versus those without C6 palsies [Table 4]. Further, on CT they demonstrated significantly greater anterior protrusions of the C6 articular process (6.2 ±

| Table 1: Surgical Procedures of Laminoplasty. |
|-----------------------------------------------|
| Laminectomy                                   |
| Partial laminectomies on the lower half of C3 and upper half of C7 are performed (In some cases, total laminectomy of C3 is performed) |
| Laminoplasty                                   |
| Bilateral gutters for the hinges are made with a high-speed burr at the transition area between the facet joint and laminae. The spinal processes are then split sagittally with a high-speed burr. The spinal canal is enlarged by bilaterally splitting the laminae. HA spacers (Apacerum; Asahi Optical Co., Ltd., Tokyo, Japan) are placed between the split laminae and fixed with nonabsorbable sutures. Foraminotomies Prophylactic cervical foraminotomies are not performed |

| Table 2: Demographic characteristics of 318 patients with cervical myelopathy. |
|-----------------------------------------------|
| **Characteristics**                          | **Value** |
| Mean age, years, ±SD                        | 66.0±11.8 |
| Men, n (%)                                   | 225 (71) |
| Clinical diagnosis, n (%)                    | 176 (55) |
| Cervical spondylotic myelopathy              | 194 (61) |
| Ossification of the posterior longitudinal ligament | 87 (27) |
| Cervical herniation                          | 37 (12) |
| Mean Japanese Orthopaedic Association scores (Pre-operative), ±SD | 11.3±3.0 |
| Levels of laminoplasty, n (%)                |           |
| C4-6                                         |           |
| C4-7                                         |           |
| Others                                       |           |
| Postoperative neurological disturbance of the upper extremities, n (%) |           |
| C5 palsy                                     | 21 (6.6) |
| C6 nerve root disturbance                    | 12 (3.8) |
| Others                                       | 7 (2.2)  |

| Table 3: Clinical Data of the C6 Nerve Root Palsy and Control Groups. |
|-----------------------------------------------|
| **Characteristics**                          | **C6 palsy** | **Control group** | **P-value** |
| Mean age, years, ±SD                        | 66.1±11.0     | 63.0±13.2         | 0.462       |
| Men, n (%)                                   | 6 (50)        | 27 (68)           | 0.270       |
| Body Mass Index, ±SD                        | 24.6±3.9      | 24.9±5.1          | 0.850       |
| Diabetes                                     | 3 (25)        | 11 (28)           | 0.864       |
| Clinical diagnosis, n (%)                    | 5 (42)        | 23 (58)           | 0.335       |
| Cervical spondylotic myelopathy              | 7 (58)        | 17 (43)           | 0.585       |
| Ossification of the posterior longitudinal ligament | 12.2±1.8     | 11.5±2.9          |            |
| Mean Japanese Orthopaedic Association scores (Pre-operative), ±SD |           |           |            |
| Levels of laminoplasty, n (%)                | 6 (50)        | 25 (63)           | 0.683       |
| C4-6                                         | 5 (42)        | 10 (25)           | 0.843       |
| C4-7                                         | 1 (8)         | 5 (13)            |            |
| Mean operating time, mins, ±SD              | 139±41        | 142±42            | <0.001      |
| C5 palsy                                     | 7 (58)        | 2 (5)             |            |

Figure 4: Posterior shift of the spinal cord at the C3/C4, C4/C5, C5/C6, and C6/C7 levels, measured from the posterior compressive mass to the preoperative and postoperative midpoints of the spinal cord on T2-weighted midsagittal magnetic resonance images. For measurement of the spinal cord shift, the preoperative values are subtracted from the postoperative values (a and b). Representative image of the high-intensity area in the spinal cord on the preoperative T2-weighted images (c).
2.6 mm vs. 4.7 ± 2.2 mm, \( P = 0.042 \), but no significant difference in gutter position.

On the MRI scans, the mean spinal cord shift from C4/C5 to C6/C7 was larger for those with new C6 palsies versus controls, but there were not significant differences in the rate of high cord signals on the preoperative T2-weighted images between the groups (58% vs. 73%, \( P = 0.351 \)).

**DISCUSSION**

Several factors are thought to predisposing patients to new C6 palsies following cervical surgery, including laminoplasty. Several studies have suggested that foraminal stenosis is associated with C5 palsies, and here, in our study, we found significantly narrowed C6 intervertebral foramen for those with C6 palsies.\(^{[4]}\) Nerve root traction caused by the posterior drift of the spinal cord after posterior cervical decompression is also one of the most touted pathological mechanisms of C5 palsy; in our study, the mean spinal cord shifts of from C4/C5, C5/C6, and C6/C7 were larger in those with C6 palsies.\(^{[3,5]}\)

Ossification of the posterior longitudinal ligament is also thought to be a risk factor for postoperative C5 and C6 nerve root palsies, but in our series, this difference did not reach statistical significance.\(^{[6,7]}\) Although our patients with C6 palsies additionally showed greater anterior protrusion of the C6 superior articular process, this was not a factor specifically analyzed in other studies.

**CONCLUSION**

Patients experiencing the new onset of a C6 root palsy following a cervical laminoplasty demonstrated: a higher rate of accompanying C5 palsies, greater C6 intervertebral foraminal stenosis, more significant greater anterior protrusion of the C6 articular processes, and more MR-demonstrated extensive dorsal shift of the spinal cord into the laminoplasty defect.

**Declaration of patient consent**

Institutional Review Board (IRB) permission obtained for the study.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Chiba K, Toyama Y, Matsumoto M, Maruiwa H, Watanabe M, Hirabayashi K. Segmental motor paralysis after expansive open-door laminoplasty. Spine (Phila Pa 1976) 2002;27:2108-15.
2. Hasegawa K, Homma T, Chiba Y. Upper extremity palsy following cervical decompression surgery results from a transient spinal cord lesion. Spine (Phila Pa 1976) 2007;32:E197-202.
3. Hatta Y, Shiraishi T, Hase H, Yato Y, Ueda S, Mikami Y, et al. Is posterior spinal cord shifting by extensive posterior decompression clinically significant for multisegmental cervical spondylotic myelopathy? Spine (Phila Pa 1976) 2005;30:2414-9.
4. Ko S, Choi W, Lee J. The prevalence of cervical foraminal stenosis on computed tomography of a selected community-based Korean population. Clin Orthop Surg 2018;10:433-8.
5. Liu G, Reyes MR, Riew KD. Why does C5 palsy occur after...
prophylactic bilateral C4-5 foraminotomy in open-door cervical laminoplasty? A risk factor analysis. Global Spine J 2017;7:696-702.

6. Nagoshi N, Yoshii T, Egawa S, Sakai K, Kusano K, Nakagawa Y, et al. Comparison of surgical outcomes after open- and double-door laminoplasties for patients with cervical ossification of the posterior longitudinal ligament: A prospective multicenter study. Spine (Phila Pa 1976) 2021.

7. Oya J, Burke JF, Vogel T, Tay B, Chou D, Mummaneni P. The accuracy of multimodality intraoperative neuromonitoring to predict postoperative neurologic deficits following cervical laminoplasty. World Neurosurg 2017;106:17-25.

8. Yoshioka N, Takayama M, Kobayashi T, Murai N, Ioroi Y. Neurological disturbance of the upper extremities after cervical laminoplasty: A morphological assessment focused on the intervertebral foramen. Spine (Phila Pa 1976) 2020;45:E1549-55.

How to cite this article: Miura I, Motoo K, Kawamata T, Yuzurihara M. C6 nerve root palsy after double-door cervical laminoplasty. Surg Neuro Int 2021;12:502.