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Original Article

C6 nerve root palsy after double-door cervical laminoplasty

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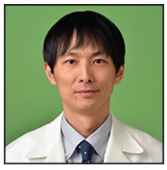

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ABSTRACT

Background: This study correlated the relationship between postoperative C6 nerve root palsies and various patient-related clinical, radiographic, and surgical parameters.

Methods: The medical records of 318 patients undergoing double-door cervical laminoplasty for myelopathy were reviewed. Twelve (3.8%) had postoperative C6 nerve root palsies. Their clinical, radiographic, and surgical procedures were analyzed looking for a correlation/explanation for these new C6 root deficits.

Results: The following factors correlated with patients' developing new postoperative C6 nerve root deficit following double-door cervical laminoplasty; a high correlation with additional C5 palsies, narrower C6 intervertebral foraminal widths, greater anterior protrusions of the C6 articular process, and larger posterior shifts of the spinal cord on magnetic resonance (MR) between the C4/C5-C6/C7 levels.

Conclusion: Factors correlating with the new onset of C6 nerve root palsies following double-door cervical laminoplasty included; a high correlation with new C5 palsies, more severe foraminal stenosis, greater anterior protrusions of the C6 articular process, and more extensive dorsal spinal cord migration.

Keywords: C5 palsy, C6 nerve root palsy, Double-door laminoplasty, Foraminal stenosis, Postoperative complication

INTRODUCTION

Studies focusing on the new onset of C6 root palsies following posterior cervical decompression are rare.[1,2,8] 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 MRI's 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.

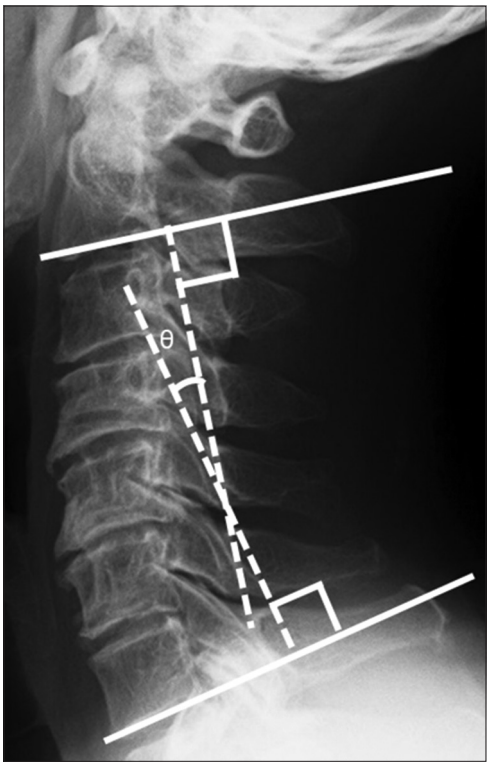

Figure 1: Plain radiographic assessment of the preoperative C2–7 lordotic angle (θ).

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/

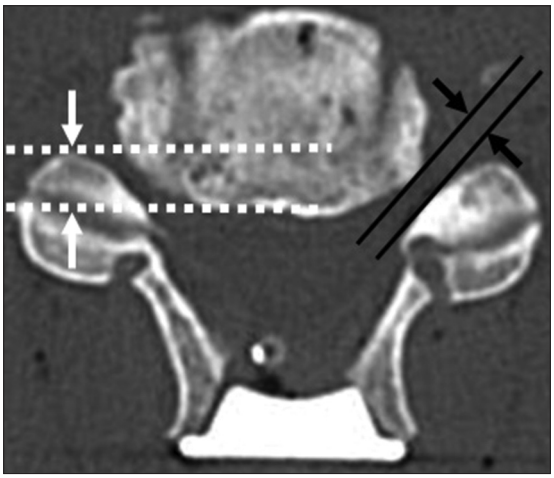

Figure 2: Measurement of the position of the superior articular process as illustrated with dotted lines. The black arrows indicate the width of the intervertebral foramen of C5–C6 at the narrowest point.

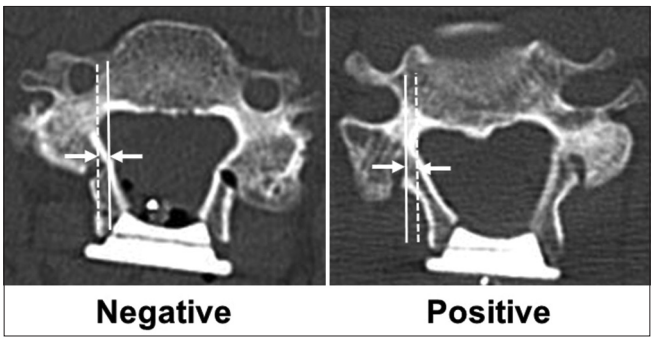

Figure 3: Measurement of the gutter position by drawing two vertical lines on postoperative computed tomography images, one at the most lateral point of the spinal canal (dotted line), and the other at the most medial position of the gutter (white line). The gutter position is defined as the distance between these two lines. If the gutter line is medial to the canal line, the distance is expressed as a negative number.

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* (%)	
Cervical spondylotic myelopathy	176 (55)
Ossification of the posterior longitudinal ligament	138 (45)
Cervical herniation	4 (1)
Mean Japanease Orthopaedic Association scores (Pre-operative), ±SD	11.3±3.0
Levels of laminoplasty, *n* (%)	
C4-6	194 (61)
C4-7	87 (27)
Others	37 (12)
Postoperative neurological disturbance of the upper extremities, *n* (%)	
C5 palsy	21 (6.6)
C6 nerve root disturbance	12 (3.8)
Others	7 (2.2)

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 (θ) 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 ±

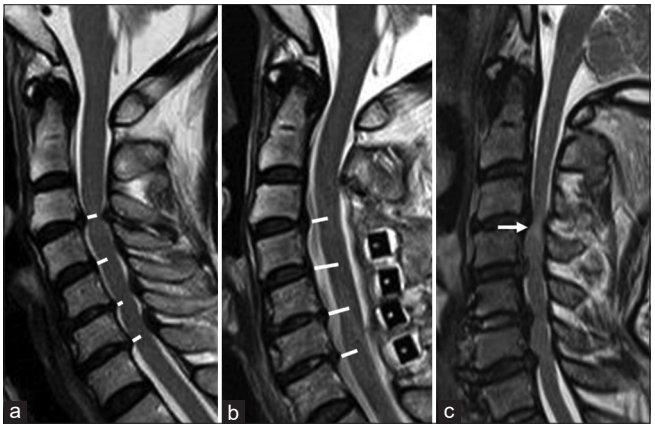

Figure 4: Posterior shift of the spinal cord at the C3/C4, C4/C5, C5/C6, and C6/C7 levels, measured from the posterior compressive mass to the preoperative and postoperative midpoints of the spinal cord on T2-weighted midsagittal magnetic resonance images. For measurement of the spinal cord shift, the 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).

Table 3: Clinical Data of the C6 Nerve Root Palsy and Control Groups.

Characteristics	C6 palsy *n*=12	Control group *n*=40	*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 (%)			
Cervical spondylotic myelopathy	5 (42)	23 (58)	0.335
Ossification of the posterior longitudinal ligament	7 (58)	17 (43)	
Mean Japanease Orthopaedic Association scores (Pre-operative),±SD	12.2±1.8	11.5±2.9	0.585
Levels of laminoplasty, n (%)			
C4-6	6 (50)	25 (63)	0.683
C4-7	5 (42)	10 (25)	
Others	1 (8)	5 (13)	
Mean operating time, mins, ±SD	139±41	142±42	0.843
C5 palsy	7(58)	2 (5)	<0.001

Table 4: Radiological Assessment of the C6 Nerve Root Palsy and Control Groups.

Characteristics	C6 palsy *n*=12	Control *n*=40	*P*-value
C2-C7 lordotic angle (θ) on plane radiographs, degree±SD	11.9±10.0	9.2±11.9	0.466
Width of C6 intervertebral foramen on 3D-CT, mm±SD	2.2±1.0	3.5±1.7	0.018
Anterior protrusion of the C6 anterior articular process on 3D-CT, mm±SD	6.2±2.6	4.7±2.2	0.042
Gutter position on 3D-CT, mm±SD	0.1±1.4	-0.8±1.6	0.061
The shift of the spinal cord on MRI, mm±SD			
C3/4	1.8±1.0	1.1±1.1	0.057
C4/5	2.8±0.7	1.9±1.3	0.027
C5/6	2.8±0.9	2.0±1.2	0.034
C6/7	2.1±1.3	1.2±1.0	0.019
High intensity of the spinal cord on MRI, n (%)			
Presence of the high intensity area	7 (58)	29 (73)	0.351
C3/4	3 (25)	10 (25)	1.000
C4/5	2 (17)	16 (40)	0.136
C5/6	2 (17)	14 (35)	0.227

MRI: Magnetic resonance imaging

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.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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