INTRODUCTION:
Cervical laminoplasty (LP) has been reported to produce stable long-term neurological improvement for cervical myelopathy. However, C5 palsy and axial neck pain are noticeable complication after cervical LP. It was reported that postoperative axial neck pain rarer after C3-6 LP than after C3-7 LP. But we experienced that some patients with C3-6 LP complained new dysesthesia around ring and little fingers or ulnar aspect of forearm. In these cases, the spinal cord shifted posteriorly, impinging the intact C7 laminae on magnetic resonance imaging (MRI).
The purpose of this study was to investigate the difference in the spinal cord posterior shifting between C3-6 LP and C3-7 LP on MRI at 24 hours and 2 weeks after operation.

METHODS:
Patient Population
Between April 2006 and April 2011, 11 patients (8 men, 3 women, mean age 61 (42-84) years) with cervical myelopathy were treated with C4-6 LP with C3 laminectomy (C3-6 LP), and 40 patients (26 men, 14 women, mean age 66 (34-85) years) with cervical myelopathy were treated with C4-7 LP with C3 laminectomy (C3-7 LP).
Operative Technique and Postoperative Management
In all cases, laminectomy was performed at C3, and the semispinalis cervicis muscle insertion in C2 was preserved completely. LP was performed at C4-6 or C4-7. LP was adopted from the spinous process-splitting LP using hydroxyapatite spinous process spacer. The suction tube drain was removed within 2 days after surgery.
The indication for C3-6 LP was that there was not myelopathy at C6-7, and there was posterior subarachnoid space at C6-7. Evaluation of C8 and T1 Symptoms
New dysesthesia around ring and little fingers was defined as C8 symptom and new dysesthesia around ulnar aspect of forearm was defined as T1 symptom. In all patients, postoperative C8 and T1 symptoms were evaluated after operation for 1 week.
Measurement of the Spinal Cord after Operation Using MRI
All patients were prospectively examined by MRI at 24 hours and 2 weeks after operation. T2-weighted midsagittal MRI were measured using ImageJ (http://rsbweb.nih.gov/ij/). The distance from the posterior edge of each vertebral body to the center of the spinal cord, the distance of anteroposterior dura mater, and the distance of posterior subarachnoid space was measured from C2 to T1. The posterior shifting of the spinal cord was determined by calculating: Posterior shifting (mm) = distance at 24 hours and 2 weeks after operation – distance before operation.
Statistical Analysis
Differences in the distance between C3-6 LP and C3-7 LP were statistically analyzed by Mann-Whitney U test. P < 0.05 was considered significant.

RESULTS:
C8 Symptom and T1 Symptom
In C3-6 LP, 6 of 11 (54.3%) patients had C8 or T1 symptoms (C8 symptom: 4 patients and T1 symptom: 2 patients). In C3-7 LP, 3 of 40 (7.5%) patients had C8 or T1 symptoms (C8 symptom: 2 patients and T1 symptom: one patient).

Distance of Posterior Shifting of the Spinal Cord (Figure 1)
At 24 hours after operation, the distance of posterior shifting of the spinal cord was the following (C3-6 LP and C3-7 LP): 0.14mm at C2, 1.12mm and 1.23mm at C3, 2.51mm and 2.68mm at C4, 2.99mm and 2.93mm at C5, 2.72mm and 2.97mm at C6, 1.04mm and 2.32mm at C7, and 0.01mm and 0.43mm at T1. There was significant difference at C7 (p=0.01), but there was no significant difference at C6.
At 2 weeks after operation, the distance of posterior shifting of the spinal cord was the following (C3-6 LP and C3-7 LP): -0.34mm and 0.14mm at C2, 0.49mm and 0.88mm at C3, 1.34mm and 1.89mm at C4, 1.87mm and 2.07mm at C5, 1.41mm and 2.23mm at C6, 0.35mm and 1.58mm at C7, and -0.17mm and 0.19mm at T1. There was significant difference at C6 (p=0.05) and C7 (p=0.001).

Distance of Anteroposterior Dura Mater
Before operation, the distance of anteroposterior dura mater was not significantly different between C3-6 LP and C3-7 LP.
At 24 hours and 2 weeks after operation, the distance in C3-6 LP was significantly shorter than in C3-7 LP at C7 (p<0.001). But there was no significant difference at C6.

Distance of posterior subarachnoid space
Before operation, the distance of posterior subarachnoid space was not significantly different between C3-6 LP and C3-7 LP.
At 24 hours and 2 weeks after operation, the distance in C3-6 LP was significantly shorter than in C3-7 LP at C7 (p<0.001). But there was no significant difference at C6.
In the intact laminae, the distance in C3-6 LP at C7 (1.31mm) was significantly shorter than in C3-7 LP at T1 (1.87mm) (p=0.01).

DISCUSSION:
Some authors reported that postoperative axial neck pain rarer after C3-6 LP than after C3-7 LP. On the other hand, some authors reported that there was no significant difference in severity axial neck pain between C3-6 LP and C3-7 LP one year after operation. It is controversy if preventing C7 spinous process and its muscle and ligament attachments would reduce axial neck pain.
In our cases, 2 patients in C3-6 LP complained severe C8 or T1 symptom (Figure 2). In this study, the distance of posterior shifting of the spinal cord at C6 in C3-6 LP was equal to in C3-7 LP on MRI at 24 hours after operation. We assume that the spinal cord impinged intact laminae in the early period after LP, and C8 or T1 symptom occurred.
We cannot predict the distance of posterior shifting of the spinal cord after LP, therefore we should decide carefully the indication for C3-6 LP.

SIGNIFICANCE:
The distance of posterior shifting of the spinal cord at C6 in C3-6 LP was equal to in C3-7 LP in the early period after LP. Therefore we assumed that the spinal cord impinged intact laminae, and C8 or T1 symptom occurred in the patients with C3-6 LP.