PROPRIOCEPTION LOSS CORRELATES TO FUNCTIONAL LOSS OF THE LOWER EXTREMITIES IN CERVICAL MYELOPATHY

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Introduction
The posterior columns of the spinal cord convey information regarding deep sensibility including discriminatory touch, vibration and extremity position sense. With the compression of the posterior columns of spinal cord, the damage in the deep sensibility would be found in myelopathy. Nevertheless, there have been few studies dealing with the deterioration in the deep sensibility in myelopathy. To assess the loss of deep sensibility in myelopathy patients, proprioception measurement will be useful. The proprioception is a somatic sensation that encompasses the sensations of joint movement and joint position. Functionally, proprioception has been evaluated by joint reposition ability.

In the present study, we measured the knee position sense to evaluate the loss of deep sensibility quantitatively in the patient of cervical myelopathy. Furthermore, the correlation between the loss of knee position sense and the functional status of lower extremity was analyzed in the cervical myelopathy patients.

The hypotheses in this study were followings. (1) The knee proprioception is damaged in the patients of cervical myelopathy. (2) The knee proprioception loss correlates to the functional loss of the lower extremity in cervical myelopathy.

Methods
The study group (Group S) included 54 cervical myelopathy patients (14 women and 40 men). Their average age was 54.5 years. We excluded the patients with any pathology in the knee joints and lack of cooperation for the proprioception measurements. The control group (Group C) consisted of 54 volunteers (18 women and 36 men) without any abnormalities in both knee and spine. Their average age was 53.9 years. There were not significant differences in age or sex between two groups.

The knee proprioception was assessed by the joint position sense, which was evaluated by the ability to reproduce the predetermined joint position. The subjects were placed in sitting or prone position, and then asked to reproduce the predetermined knee flexion angles by extension or flexion with eyes closed. The predetermined knee angles were 30 and 60 degrees of flexion. The magnitude of error angle was measured using flexible electrogoniometer (Penny & Giles ADU 301 Blackwood Ltd, Gwent, UK) during reproducing the predetermined knee flexion angle. The error angle measurements were performed 5 times for each angle and position respectively. The average error angles of bilateral knees with either sitting or prone position were calculated to represent the loss of joint position sense for each patient.

The differences in error angles between Group C and S were evaluated using unpaired t-test. Differences of P<0.05 were considered statistically significant. The Japanese Orthopaedic Association (JOA) lower extremity scores (6 points) (Tab.1) were used for functional evaluation in Group S. The correlation was analyzed between the average error angles and the JOA scores using simple linear regression analysis.

Results
The average error angles were 2.4±0.1 (mean±c.e.) and 3.6±0.2 degrees by extension, and 3.2±0.2 and 5.5±0.4 degrees by flexion in Group C and S each respectively (Fig.1). The error angles in Group S were significantly higher than those in Group C in both knee positions (p<0.001).

The average JOA lower extremity scores were 3.8 in Group S. The JOA scores in Group S were significantly correlated to the error angles both by extension (p<0.05, r=0.28) (Fig.2).

Discussion
Most studies about proprioception have focused on the knee disease, including the anterior cruciate ligament injury or the degenerative arthritis. Knee ligaments and other articular structures have a rich sensory innervation that allows for smooth, coordinated joint motion and the prevention of injury. It has also been proposed that proprioception defined with normal aging. Therefore, we excluded the patients with knee pathology in the present study, and we used the age-matched control group to evaluate the influence of cervical myelopathy on the knee proprioception. In the present study, significant loss of knee proprioception was found in cervical myelopathy comparing to normal subjects. Also, significant correlation was found between the loss of knee proprioception and the functional status in the lower extremities evaluated by JOA scores. We can conclude that the proprioceptive ability reflects the severity of cervical myelopathy. The measurement of proprioception would be useful for quantitative assessment of the severity in the cervical myelopathy.

Table 1: The JOA lower extremity scores (6 points)

<table>
<thead>
<tr>
<th>Motor (4 points)</th>
<th>Sensory (2 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Unable to stand</td>
<td>0: Anesthesia</td>
</tr>
<tr>
<td>0.5: Unable to walk</td>
<td>0.5: Severe hypesthesia</td>
</tr>
<tr>
<td>1: Can walk on flat floor without walking aid</td>
<td>1: Mild hypesthesia</td>
</tr>
<tr>
<td>1.5: Can walk on flat floor with walking aid</td>
<td>1.5: Numbness</td>
</tr>
<tr>
<td>2: Can walk up and down stairs without handrail</td>
<td>2: Normal</td>
</tr>
<tr>
<td>2.5: Can walk up stairs without handrail</td>
<td></td>
</tr>
<tr>
<td>3: Lack of stability and smooth gait</td>
<td></td>
</tr>
<tr>
<td>4: Normal</td>
<td></td>
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</tbody>
</table>

References
(2) Wall PD : Brain 100: 641-653, 1977
(3) Barrack RL : Spine 9(7): 681-685, 1984

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