Gait analysis of patients with intermittent claudication due to lumbar radiculopathy

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**Disclosure**

The authors received no benefits or funds in support of this study.
Introduction

We developed a simple examination system for gait analysis and started the research that visualized and quantified gait characteristics of intermittent claudication.

The purpose of this study was to examine the gait characteristics of patients with intermittent claudication due to lumbar spinal canal stenosis (LSS) using our motion analysis method. Especially we evaluated the gait characteristics according to the level of lumbar nerve root injury.
Methods

Subjects

- 12 healthy volunteers (Group C)
- 22 patients with intermittent claudication due to LSS
  - > 7 patients with L4 nerve root injury (Group L4)
  - > 15 patients with L5 nerve root injury (Group L5)

<table>
<thead>
<tr>
<th></th>
<th>Group C</th>
<th>Group L4</th>
<th>Group L5</th>
</tr>
</thead>
<tbody>
<tr>
<td>number</td>
<td>12</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>male/female</td>
<td>4/8</td>
<td>5/2</td>
<td>6/9</td>
</tr>
<tr>
<td>age</td>
<td>41.1 (22-55)</td>
<td>71.1 (56-80)</td>
<td>73.1 (57-81)</td>
</tr>
</tbody>
</table>

The attachment sites of the LED markers were as follows: acromion, anterior superior iliac spine, fibular head, lateral malleolus of the ankle joint, and head of fifth metatarsal bone.
We focused on the knee joint and the ankle joint in this study. The movement of the joint was visualized as a waveform. We evaluated the angle of knee and ankle joints during the last ten seconds.

- The subjects walk on the treadmill in semidarkness.
- We decided the speed so that the subject can normally walk.
- If the subject feels pain, then we stop the measurement.
- If the subject does not feel pain, the subject walks for 10 minutes.
Results

Knee joint waveform of normal gait

Ankle joint waveform of normal gait
focused on the knee joint and the ankle joint in this study. The movement of the joint was visualized with a waveform. Derived waveforms were compared among three groups. In addition, we examined the angle of the joint.

Group C
22 year-old male

Waveform of typical case

Group L4
56 year-old male

notch

Group L5
81 year-old male

notch

deeper notch

shallower notch
Ankle Waveform of typical case focused on the knee joint and the ankle joint in this study. The movement of the joint was visualized as a waveform. Derived waveforms were compared among three groups. In addition, we examined the angle of the joint.

- **Group C**: 48 year-old male
  - Single-peak waveforms: 0/12 (0%)

- **Group L4**: 56 year-old male
  - Single-peak waveforms: 1/7 (14.2%)

- **Group L5**: 82 year-old female
  - Single-peak waveforms: 6/15 (40%)
Ankle notch depth

- Amplitude of the ankle joint during swing phase

**Knee**

<table>
<thead>
<tr>
<th>Group</th>
<th>Notch Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group C</td>
<td>5.3 ± 3.9</td>
</tr>
<tr>
<td>Group L4</td>
<td>7.1 ± 6.7</td>
</tr>
<tr>
<td>Group L5</td>
<td>2.4 ± 3.2</td>
</tr>
</tbody>
</table>

**Ankle**

<table>
<thead>
<tr>
<th>Group</th>
<th>Amplitude (degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group C</td>
<td>16.5 ± 5.5</td>
</tr>
<tr>
<td>Group L4</td>
<td>15.5 ± 6.0</td>
</tr>
<tr>
<td>Group L5</td>
<td>9.7 ± 5.8</td>
</tr>
</tbody>
</table>

Scheffe’s test * P<0.05

**SPINEWEEK 2012 RAI AMSTERDAM 28 MAY - 1 JUNE**
Deeper notches in the knee joint is strongly suggestive of a decrease in the muscle strength of the quadriceps femoris.
Single-peak waveforms and Decreased amplitudes during the swing phase in the ankle joint is strongly suggestive of a decrease in the muscle strength of the tibialis anterior.
Conclusions

› We investigated gait characteristics of patients with L4 nerve root injury and patients with L5 nerve root injury to make the diagnosis.
› In Group L4, “Deeper notches” in the knee joint was showed.
› In Group L5, “Single-peak waveforms” and “Decreased amplitudes during the swing phase” in the ankle joint were showed.