EVALUATION OF UPPER ARM FUNCTION OF PATIENTS WITH CERVICAL SPINAL CORD INJURY (SCI) WITHOUT BONE INJURY (CSCIWBI) USING SIMPLE TEST FOR EVALUATING HAND FUNCTION (STEF).

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Introduction

Cervical spinal cord injury (CSCI) without bone injury (CSCIWBI) has been on the rise among countries which have become aging society like Japan. There have been many literatures mentioning the indication and timing of the surgery. However, treatment for cervical SCI without bone injury has not been fully determined: Whether to perform the operation, and if so, when should it be done.

One of the reasons why this discussion has come to confusion might be that there has been no precise and objective methods for evaluation of neurological recovery.

*Simple Test for Evaluating Hand Function (STEF)* was designed and developed by Kaneko et al. in 1974 in Japan to *objectively* evaluate the speed of motion of each upper arm and hand. Ten procedures are performed including carrying eight objects that consists of transferring three kinds of spheres (big, moderate, small), two kinds of disks (moderate, small), a kind of rectangular box, two kinds of cubes (moderate, small) to an arranged area, inserting sticks into holes and turning over cloths
STEF (minimum point : 0, maximum point : 100)

Patients are requested to exert all the procedures as fast as possible, and the STEF score is defined from 0 to 10 points based on the duration time required for each procedure. The maximum score is 100 points which indicates the best performance.

10 procedures with 10 objects

a big disk
a small cube
a stick

a big cube

a small disk

a big ball

a moderate ball

a sheet of cloth

a small ball

a rectangular box

Carrying rectangular boxes to an arranged area.

Inserting pins into holes.

Turning over cloths.
The aim was to evaluate quickness of upper limb and hand function for patients with cervical spinal cord injury without bone injury (CSCIWBI) using STEF and compare the improvement rate of quickness and dexterity of upper limb and hand between surgical and conservative treatment.
Patients enrolled in this study (Jan. 2008- Nov. 2011)

- Patients with acute cervical spinal cord injury without bone injury within 24 hours after injury: 34 patients
- Patients who had over 90 STEF points in both hands at 2 weeks after injury: 5 patients
- Patients who were transferred to another hospital and not able to be followed up: 9 patients
- Patients who firstly took conservative therapy, but who claimed and received operative therapy after 6 months or more after injury: 2 patients

18 patients were enrolled in this study.
The Study Design

**The evaluation with STEF**
- The average score at the each time point.
- The improvement rate from 2 to 8 weeks and 8 to 48 weeks.

**Operative indications**
- Cervical canal stenosis
- Delayed neurological recovery
- Patients’ desire to the surgical treatment

**Open-door laminoplasty at 3 weeks**

**The onset of injury**

**Categorization of upper arms**

- **Operative treatment?**
  - Yes → Conservative-Low group (CL)
  - No → Conservative-High group (CH)

- Did STEF score become less than 60 points at 2 weeks?
  - Yes → Operative-Low group (OL)
  - No → Operative-High group (OH)
## Profile for each group

<table>
<thead>
<tr>
<th></th>
<th>The number of upper arm and hand</th>
<th>Average age</th>
<th>Duration time from injury to operation (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL</td>
<td>3</td>
<td>80.5</td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>9</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>OL</td>
<td>17</td>
<td>70</td>
<td>22.0</td>
</tr>
<tr>
<td>OH</td>
<td>7</td>
<td>66.5</td>
<td>24.0</td>
</tr>
</tbody>
</table>
Results:

Average STEF score of each group during the examined term:

- No statistical differences between the operative group and the conservative group.
- Mann-whitney U-test (P<0.05)
The comparison of improvement rate between the operative and conservative therapy during the designated term

Statistical difference between CL and OL from 8 weeks to 48 weeks was found. Mann-whitney U-test (P<0.05)
Spinal Cord Outcomes Partnership Endeavor (SCOPE) concludes that further validation studies are required to identify the most appropriate tools for specific targets in a human SCI study or clinical trial.

A Road map to Establish outcome measures in spinal cord injury (Ellaway, 2011)

- **Stage 1**: to develop more *sensitive, quantitative* and *objective* outcome measures.
- **Stage 2**: to test them for reliability against natural recovery and treatments expected to produce functional improvements in those with complete or incomplete spinal cord injury (SCI).
Applied fields of STEF

STEF is a sensitive, quantitative and objective outcome measures which have no or little involvement by observers.

• Cervical spondylosis
  – Hashimoto 2001
  – Kawaguchi 1994
  – Doishita 1997
• Brain infarction (Kawahira 2010)
• Rheumatoid arthritis (Tamai 2009)
• *Cervical spinal cord injury without bone injury. (CSCIWBI)*

The evaluation using STEF indicated that the improvement rate of the low-STEF operative group from 8 weeks to 48 weeks was statistically higher than that of the low-STEF conservative group.
We successfully introduced STEF to the evaluation of upper arm function of patients with cervical spinal cord injury without bone injury (CSCIWBI).

Surgical treatment could have positive impact on the improvement of quickness of upper arm 8 weeks after operation.

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