Effect of Acceleration of Righting reaction on Balance and Trunk Control of Stroke Patients
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Purpose The purpose of this study to investigate the effect of acceleration of righting reaction on balance and trunk control in stroke patients. Methods The subject was an 82-year-old woman. The intervention was acceleration of righting reaction for four-week 30-minute. Result The Berg Balance scale (BBS) increased from 35 points to 42 points and the Trunk Impairment Scale (TIS) increased from 14 points to 15 points and the Functional Reach Test (FRT) increased from 19cm to 23cm. Conclusion The results of the study showed that acceleration of righting reaction was effective in improving balance and trunk control ability of stroke patients.

Key words trunk, righting reaction, balance, control, stroke

Ⅰ. Introduction

As a result of stroke, hemiplegic patients have problems such as asymmetrical posture, balance reaction disorder, poor walking ability, and loss of ability to perform a delicate function (Carr JH, Shepherd RB, 1985) (Eggers O, 1984). In particular, the concept of midline and space is impaired due to the asymmetry of the pelvis, the spine can not be maintained straight, the rotation of the trunk, the separation of the trunk and limbs, the movement of the pelvis before and after the body weight shift, the orientation reaction, the protection reaction, and the equilibrium reaction
Balance is a series of complex processes that are influenced by various factors with the ability to maintain body centering on their bases in a given environment (Tyson S, Watson A, et al, 2008). Proper postural balance control maintains and moves the standing posture, performs voluntary arm and head movements necessary for all daily activities, and stabilizes the body (Dietz V, 1992). Patients with brain diseases caused by various causes it is common to experience the balance problem because it is accompanied by the perception of the sensory system that is the basis of the body balance function, the integration of the sensory information through the central nervous system,(Kim Eun-joo, 2013).

The use of unbalanced muscles formed due to the biased posture control of stroke patients reduces the static and dynamic balance ability in a sitting position (Harley C, Boyd JE et al, 2006). (Campbell FM, Ashbum AM, et al., 2001), symmetrical weight bearing is also achieved because the center of the body is moved to the paralyzed side due to the loss of asymmetry of the posture control ability and the asymmetry And stability limits are also reduced (Geiger RA, Allen JB, 2001).

In balance control, sensory processing refers to the interaction between somatic sensations including the proprioceptive sensation, visual sensation, and stereotypic input from the electrograph (Shumway-Cook and Horack, 1986). The somatosensory plays an important role in maintaining a stable standing posture. The sensory system is most important in providing information about balance in adults (Shumway-Cook and Wollacott, 2000). Mittelstaedt suggested that it is essential to establish postural control of gravity in the somatosensory for optimal integration of visual, somatosensory, and vestibular information. Stimulation of receptors changes sensory input, induces postural responses by these receptors, and affects nerve and muscle activity (Woollacott & Shumway-Cook, 2002). These sperm sensations show a tactile and proprioceptive sensory impairment in 50% of stroke patients, and the prognosis of stroke patients with both sensory and motor problems is less than that of stroke patients with purely motor problems (Lin et al., 2004; Winward et al., 2002).

Normal posture reflexes are necessary to maintain the center of the body against gravity when the support surface changes, and posture adaptation occurs primarily in the head, trunk, and limbs, and appears as a complex form of suppression and excitement of these muscles (Wiliams HG, Fisher JM, et al, 1983). The human body maintains balance by using upright reaction and stereotactic reaction, and by adjusting the muscles of the head, neck and limbs through vestibular response, the body always stands up to gravity at all times (Panosian & Paige, 1995). Carr and Shepherd have reported that there is a deficit in balance capability that can automatically adapt when the rigid center line changes, or that the response is delayed and improper. However, in the case of stroke patients, it is difficult to integrate the motor neuron with the process of accepting sensory information, visual sensation, and sensory information to control posture (Barclay-Goddard R, Stevenson T, et al., 2005). In and Soon - deok Song showed that stroke patients had a deficit in their ability to position the body compared with normal adults, as a result of adjusting the angle of the supporting surface dynamically changing in the sitting position of stroke patients and normal adults. The purpose of this study is to investigate the
effect of stimulation of stereotactic reaction on the balance of stroke patients by promoting the stereotactic response in stroke patients.

II. Method

1. Subject and Period
   (1) Research subjects
   September 16, 2018 Lt. BG, Rt due to CR infarction. This study was conducted as a patient diagnosed with hemiplegia. On September 16, 2018, the patient suffered from weakness in the right limbs and visited the hospital. BG, and CR infarction, and was an 82-year-old woman who was admitted to S hospital in Suwon city, Gyeonggi-do, on October 4,

   (2) Research period
   From November 05, 2018 to November 30, 2018, four times a week for four weeks, 30 minutes of treatment was performed to promote the orthotropic response.

2. Measurement tools and methods
   In this study, static balance balance and dynamic balance evaluation were performed through Berg Balance Scale (BBS) in order to evaluate the balance ability by promoting the orthotropic reaction. Trunk impairment scale TIS) and Functional Reach Test (TUG) were used to evaluate the static balance ability.

(1) Berg Balance Scale
   The Berg balance scale measures the functional standing balance of the elderly and consists of three areas: sitting, standing posture, and postural change. The minimum total score of 14 items is 56 points. The higher the score, the better the balance. This measure was highly reliable, with both in-rater reliability and inter-rater reliability $r = .99$ (p <.001) and $r = .98$ (p <.001) (Berg et al., 1989).

(2) Trunk Impairment scale
   TIS measures the static, dynamic balance ability and coordination ability of the trunk in a sitting position as a clinical test method for movement damage of the trunk of a stroke patient. There are a total of 17 items as static balance ability in sitting position, 10 items in dynamic balance ability, 4 items in coordination ability of the trunk, and the score can be calculated from a minimum of 0 to a maximum of 23 points. The intra-test reliability
was $r = 0.87$ at $r = 0.96$ and the intra-test reliability was high between $r = 0.85$ and $r = 0.99$ (Verheyden G, Nieuwboer A, Van de Winckel A, 2007).

(3) Functional Reach Test
FRT was used as a tool to assess static balance. When the subject stretches his legs as much as his shoulder, stretches his elbows, holds his fist, flexes the shoulder by 90°, moves his body forward as far as possible, and reaches the fifth posture of his right hand. The distance between the first posture and the last posture was measured based on the head of the back of the hand. The interrater and interrater reliability of this test was $r = 0.89$ and $r = 0.98$ (Duncan et al., 1990). However, the FRT was revised to fit the study, and the arm was stretched at 90 degrees in the sitting position, then the elbows were stretched, the fist holding state was set as the starting posture, the body was moved as far as possible to the side. The distance of the posture was measured.

3. Content and method of research

Arbitration method
- In the sitting position, the body was placed straight on the vertical line, and the alignment of the body was maintained symmetrically in the left and right sides to promote the orthotopic response and to improve the balance ability and the trunk control ability.
- To induce the neutral position of the pelvis and the selective movement of the lower body through the inclination of the pelvis
First, to reduce the compensatory effect in the upper torso, we placed the arm on the table in the sitting position to provide stability of the upper limb. Through the pelvic tilt movement, the stability of the lower body was secured, and the muscles of the legs were stimulated to activate the anti-gravity muscles of the trunk so that the body could be held perpendicular to the gravity.
The eccentricity of the broad isthmus and the afferent contraction contributed to the stability of the middle trunk
Symmetrical muscle activity of the left and right muscles of the body.

Figure 1. The tilt exercise of the pelvis leads to the neutral position of the pelvis and selective movement of the lowe trunk
Figure 2. Latissimus dorsi, eccentric and concentric contraction to provide stability to the mid trunk

The scapula setting allows the alignment of the shoulder bones to be symmetrical so that the length of the muscles can be maintained properly. The position of the body on the vertical line and the alignment of the left and right torso are symmetrical so that the orientation reaction can occur.

Figure 3. Make a symmetrical alignment of the scapula through the scapula setting

In order to facilitate the orthotopic reaction, the pelvis and body movements were guided by hand, and the weight movement started at the bottom of the body, and the weight was shifted to one side by extending the arm toward the object placed next to the body. Is placed on the right chest of the subject and the left hand of the therapist is placed on the left side of the patient's pelvis. The right hand of the therapist pushes the right chest to the left and begins to move. As the torso begins to move, the right hand grasps the right chest bone of the subject and diverts the force diagonally to the left hip through the vertebra. The left hand of the therapist presses the left side of the pelvis downward. Movements are induced by placing hands on both pelvises to train weight shifts on both sides of the pelvis (Ryerson, 2001).

In order to accelerate the body's vertical posture against gravity while the subject is moving to one side of the body, the side of the pelvis where the pelvis ascends using the head-standing reaction shrinks the muscles of the body centripetally and contrarily shrinks the muscles of the body to the eccentricity.
Figure 4. Reaching toward the object placed next to it and cause the righting reaction

Figure 5. Place therapist hands on both pelvis and induce movement.

III. Research Results

Table 1. Berg Balance scale result

<table>
<thead>
<tr>
<th>Activity</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sito to stand</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Standing unsupported</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sitting unsupported</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>stand to sit</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Transfers</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Standing with eyes closed</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Standing with feet together</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Reaching forward with outstretched arm</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Retrieving object from floor</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Turning to look behind</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Running 360 degrees</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Placing alternate foot on stool</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Standign with one foot in front</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Standing on one foot</td>
<td>0</td>
<td>0</td>
</tr>
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</table>
Table 2. Functional Reach Test result

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRT(cm)</td>
<td>19</td>
<td>23</td>
</tr>
</tbody>
</table>

Table 3. Trunk Impairment scale result

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Sitting balance</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Dynamic Sitting balance</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Co-ordination</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

Posture alignment analysis
(1) sitting position before (Anterior) / after (Anterior)

Figure 6. Before treatment, sitting position(front).
Figure 7. After treatment, sitting position(front).

(2) sitting position before (Right) / after (Rght)
Figure 8. Before treatment, sitting position (Right).
Figure 9. After treatment, sitting position (Right).

(3) sitting position before (Anterior) / after (Anterior)

Figure 10. Before treatment, standing position (front).
Figure 11. After treatment, standing position (front).

(4) standing position before (Left) / after (Left)
Figure 12. Before treatment, standing position (Left).
Figure 13. After treatment, standing position (Left).

(5) standing position before (Right) / after (Right)

Figure 14. Before treatment, standing position (Right).
Figure 15. After treatment, standing position (Right).

4. Righting reaction before / after
IV. Consideration

Stroke patients have difficulties in maintaining stability and motor function due to decreased posture and balance (F. E. Huxham, P. Goldie and A. E. Patla, 2001).

Perennou et al. Measured the vertical behavior of subjects with stroke using an unstable support surface. Subjects were asked to sit on the unstable support surface with their feet untouched on the floor and to keep the body vertically and to maintain the support surface level. In this task, the subjects showed defects in body orientation (Perennou DA et al., 2002). In this study, BBS, FRT, and TIS were performed after the start and end of exercise to see how the stimulation of the orientation reaction affected the balance and trunk control ability. As a result, the BBS improved from 19 points before treatment to 26 points after treatment to improve balance ability. In FRT, improvement of balance ability was improved by 4cm from 19cm to 23cm before treatment. In TIS, one point increased from 14 points before treatment to 15 points after treatment, showing improvement in balance ability and trunk control ability.

Therefore, it is necessary to study the effect of the stimulation on the balance ability and trunk control ability in the future.

V. Conclusion

The purpose of this study was to investigate the effects of stimulation of
orthotopic response on stroke patients admitted to S hospital in Suwon city, Gyeonggido, for 4 weeks, 4 times a week for 30 minutes. Before and after the reporter exercise, we measured the balance ability and trunk control ability and compared them.

1. Among the 56 points of the bug balance scale, the score increased from 19 points to 26 points in the items 5, 7, 8, and 10, showing a total improvement of 7 points.
2. Functional arm stretch test showed a total increase of 4cm from 19cm to 23cm.
3. From 14 points to 15 points in the body damage scale, one point was improved in the dynamic sitting balance item.

Thus, this study shows that the promotion of the stereotypic response is effective in improving the balance and body control ability of stroke patients.

references


26. Pérennou DA, Amblard B, Laassel el M, Benaim C, Hérisson C, Pélissier J,