Objectives. Asymmetrical posture during static stance has been identified as a common problem in persons with hemiplegia. This study examined the effect of an activity-based therapy regimen on symmetric weight bearing and midline position of center of gravity (COG) in three adult subjects with hemiplegia.

Method. An ABAB single-subject design was used. The intervention program, including sanding in front of a standing table and play a bean bag game, was introduced for 30 min each day during each intervention phase. Quantitative measurements of the weight distribution and the midline position of COG were taken with the Balance Master System (version 2.20).

Results. Visual inspection and statistical analysis of the data revealed a significant improvement in symmetric weight distribution and midline position of COG. The study suggests that this program may be a promising alternative to a variety of postural rehabilitation programs for persons with hemiplegia.

Conclusion. Insecurity caused by poor stabilization and abnormal reactions to body weight bearing in an antigravity position might contribute to asymmetric postures. Results of this study suggest that an activity-oriented program can be effective in helping the persons with hemiplegia achieve symmetric stances.
Lee (1989) further suggested that free limb performance in activities of daily living could be limited by abnormal postural control. Accordingly, a symmetrical standing posture should be the foundation for optimal functions in locomotor performance and activities of daily living. Therefore, one functional goal in rehabilitating persons with hemiplegia should be set to improve symmetrical characteristics of postural control. Numerous studies have been published on the improvement of postural control during static standing. Use of loading exercises emphasizing weight transfer and weight bearing on the affected limb have been shown to be effective in reducing the asymmetrical standing posture (Bohannon & Larkin, 1985; Dickstein, Nissan, Pillar, & Scheer, 1984; Lane, 1978; Rogers, Hedman, & Pai, 1995). Biofeedback techniques to provide patients with auditory or visual information regarding limb loading or the position of COG during postural exercises have been investigated and reported to be successful in reestablishing stance symmetry (Hamman, Mekjavic, Mallinson, & Longridge, 1992; Seege & Caudrey, 1981; Shumway-Cook, Anson, & Haller, 1988; Wannstedt & Herman, 1978; Winston, Gardner, McNeal, Barto, & Nicholson, 1989).

An activity-oriented intervention for postural control has been implemented in the rehabilitation of patients with hemiplegia for many years in our facility. The intervention used in this study is different from other approaches that only involve the mechanical loading of weight on the patients’ affected sides. Our strategy emphasizes the use of purposeful activities to direct motor relearning, process and organize all incoming information, and coordinate the whole body to achieve a better learning effect on postural control (Wu, 1987, 1990). The purpose of this study was to evaluate the effects of this program in improving symmetrical weight bearing and midline position of COG in three subjects with hemiplegia.

Method

Subjects

Three patients hospitalized for cerebrovascular accident (CVA) participated in this study. All had hemiplegia but were able to stand independently with no assistive devices at initial testing. The subjects had no evident language, cognition, or sensory deficits. Their gender, age, affected side, and duration since CVA are shown in Table 1.

Research Design

An ABAB (withdrawal-reinstatement) single-subject design was used to provide evidence of intervention effects (Kazdin, 1982; Ottenbacher, 1986). Baseline measurements of weight distribution and mean position of COG were taken in the first A phase, and intervention was implemented during the first B phase, withdrawn during the second A phase, and reinstated during the second B phase. Each phase lasted 7 days. Measurements were conducted each day, for a total of 28 sessions. During each A phase, measurements were taken each day. During each B phase, measurements were taken the day after treatment.

Measurement

The Balance Master System (version 2.20) was used to measure the midline position of COG and weight bearing distribution. During each measurement session, the subject was positioned on the Balance Master forceplate, with the recommended foot placement, and asked to stand as symmetrically as possible, keeping his or her feet still and arms relaxed at both sides. The weight-bearing parameter was selected through Balance Master’s Therapy Menu (F4, View Weight Distribution software) (NeuroCom International Inc., 1989). Three readings were taken for each measurement of weight distribution, and the average was used for data analysis.

The COG position was selected from Balance Master’s Standard Assessment Menu (F1, Align–No Target, Eyes Open). Data were collected for 20 sec and expressed as a percentage of the theoretical limits of stability in the mediolateral direction (NeuroCom International Inc., 1989).

Intervention Program

The intervention program consisted of two activities: sanding in front of a standing table and participating in a bean bag game. The intervention program lasted for 30 min each day. Subjects only received this intervention program in their occupational therapy sessions. These two activities were selected because (a) they are simple to perform, (b) the subjects were familiar with them, and (c) they are intrinsically performed in an upright (antigravity) position. We believe that any activity with the above qualities is a suitable choice for postural control training in patients with hemiplegia. During the course of this study, the subjects still received physical therapy every day.

Table 1

<table>
<thead>
<tr>
<th>Subject</th>
<th>Gender</th>
<th>Age (Years)</th>
<th>Affected Side</th>
<th>Duration Since CVA (Weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>50</td>
<td>Right</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>66</td>
<td>Left</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>62</td>
<td>Left</td>
<td>5</td>
</tr>
</tbody>
</table>

Note. CVA = cerebrovascular accident.
However, during both A phases, no further occupational therapy was provided.

Procedure

Standing in Front of Standing Table

The subjects stood in front of the standing table in an erect position with a separator between the heels. The affected elbow was supported by suspension, and the affected hand was fixed onto the bar of the sander. Subjects with an asymmetrical posture were positioned in normal alignment with a strap. The subjects were asked to push the sander forward and pull it backward bilaterally and slowly while keeping the trunk of their bodies firmly fixed (i.e., no backward movement of the trunk during the pulling action). We deliberately asked the subjects to perform this activity in this posture to train trunk stability (fixation of the trunk) without excessive body sways or any tendency of falling backward. The subjects were asked to complete 3 rounds of 10 repetitions of the sanding action. Resistive weight was applied progressively with each round.

Bean Bag Game

This activity was carried out in a standing position. The therapist stood next to the subjects' affected side and assisted them in maintaining a normal posture. The subjects were asked to use their unaffected hand to pick up a bean bag placed in front of them and throw it at a target. The bean bag was placed in several different locations in relation to the subject according to a hierarchically ordered sequence: Grade 1, on the ground in an upwardly sloping direction about 60 cm to 75 cm from the subject's unaffected foot; Grade 2, on the ground in front of the subject's unaffected foot; Grade 3, on the ground in front of the subject's midline; and Grade 4, on the ground in front of the affected foot. The distance between the bean bag and the subject's big toe was 45 cm to 60 cm for Grades 2 through 4, depending on the subject's condition. The distance between the target and the subject was 90 cm to 450 cm, depending on the subject's condition. Bean bag placement started with Grade 1 and progressed one grade at a time as the subject became comfortable reaching for the bean bag. The subjects were asked to complete 3 rounds of 10 repetitions of the picking up and throwing actions.

Data Analysis

Visual analysis of data is the standard method used for single-subject design studies (Kazdin, 1982; Ottenbacher, 1986; Wolery & Harris, 1982). The measurements collected from each session across all four phases (ABAB) were plotted on a simple line graph for visual inspection. Data were tested for serial dependency of the separate phases by computing the autocorrelation coefficient. A celeration line was drawn to aid in the visual analysis of changes in the subjects' performance. Bloom's probability table was used to determine whether the number of data points above or below the projected celeration line in the intervention phases was significant (Ottenbacher, 1986).

Results

The measurements collected for each variable for all three subjects and the means for each phase are shown in Figures 1 and 2. The autocorrelation coefficients computed across the seven measurements within each phase are presented in Table 2. When Bartlett's test was applied to determine whether the autocorrelation for each phase was statistically significant, the coefficients were less than $2/\sqrt{n} = 2/\sqrt{7} = .756$ ($n =$ the number of baseline observations). The lack of a significant coefficient indicates that the data were not serially dependent in any phase. This finding suggested that visual inspection and the celeration line approach would be appropriate for the data analysis.

The celeration line for the baseline and treatment-withdrawal (A) phases was extended into the intervention (B) phases, and the proportion of the data points above (or below) this line was evaluated. For all three subjects, the data points during the intervention phases were found to be completely above the projected celeration line for the weight distribution variable (see Figure 1) and completely below the projected celeration line for the midline deviation from COG variable (see Figure 2). This finding suggests that a change in the subjects' performance during the intervention phases was significant when Bloom's probability table was used (Ottenbacher, 1986). From the plots in Figure 1, it can be observed that most of the data points in the B phases fell above the celeration line, representing the subjects' tendency to put more weight over their affected legs. In Figure 2, most of the data points in the B phases fell below the celeration line, implying that the subjects displayed fewer COG sways during the intervention phases. Moreover, a uniform positive trend (i.e., toward 50% of weight distribution) could also be observed across both B phases (see Figure 1), representing a continuous progression in weight bearing over the affected leg during the interven-

Table 2: Autocorrelation Coefficients for Each Variable in Each Phase

<table>
<thead>
<tr>
<th>Subject</th>
<th>Weight Bearing</th>
<th>Position of Center of Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>.576</td>
<td>.672</td>
</tr>
<tr>
<td>2</td>
<td>.571</td>
<td>.535</td>
</tr>
<tr>
<td>3</td>
<td>.499</td>
<td>.382</td>
</tr>
</tbody>
</table>
Figure 1. Weight distribution over the affected leg (in percentage of the total body weight) during static stance measured in four phases for three subjects (X = mean).
Figure 2. Midline deviation from COG during static stance measured in four phases for three subjects. The numeric scores for the midline position of COG in the mediolateral direction is expressed as a percentage of the theoretical limits of stability according to Balance Master System (X = mean).
Downloaded from http://ajot.aota.org on 04/10/2019 Terms of use: http://AOTA.org/terms
body weight over the impaired or unaffected leg in an antigravity position might also contribute to asymmetric postures, especially during early recovery or rehabilitation after onset of a CVA. An activity-oriented program for normalizing reaction to weight bearing over the impaired or unaffected leg and postural stabilization may have a positive clinical effect on the symmetric stance of persons with hemiplegia. Results of this study suggest that the use of a specific intervention program involving a weight distribution activity and a midline position of COG activity, were effective in achieving symmetric stance in persons with hemiplegia.

References


