Supervised Versus Home Physiotherapy Outcomes in Stroke Patients With Unilateral Visual Neglect: A Randomized Controlled Follow-Up Study

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Summary

Objective: The aims of this randomized controlled study were to compare the 12 weeks specialized physiotherapy program outcomes in stroke patients diagnosed with unilateral visual neglect (UVN), and to determine the follow-up results of one year.

Methods: The supervised exercise group (SE, n=10) continued with standardized regular three sessions per week in the rehabilitation room. The home exercise group (HE, n=10) patients were given written exercise program and were encouraged to exercise with weekly calling by the physical therapist through the intervention. Disability (Barthel Index-BI), mobility (Rivermead Mobility Index-RMI), posture (Postural Assessment for Stroke Scale-PASS), balance (Berg Balance Scale-BBS), and neglect severity in everyday tasks (Catherine Bergego Scale-CBS) were assessed before and after the treatment, and at the first year.

Results: The repeated measures ANOVA test was used to determine the group and time effect for all clinical variables. There was no significant time by group interaction for all outcomes, whereas time effect was significant for BI, PASS, RMI, BBS, and CBS scores (p<0.05). After one year, the scores of the BI, PASS, RMI and BBS increased significantly in both groups compared with baseline values (p<0.05). The CBS scores were highly correlated with the scores of the RMI, BBS, BI, and PASS (p<0.05).

Conclusions: The stroke patients with UVN may benefit from structured, intensive and progressive physiotherapy programs, focusing on balance and mobility rehabilitation, either supervised or home-based. These benefits may have retention when regular controls are not omitted.

Key words: Stroke, unilateral visual neglect, exercise, balance, mobility
(BBS)] ve günlük yaşam aktivitelerindeki ihmal şiddeti [Catherine Bergego Scale(CBS)] tedavi öncesinde, tedavi bitiminde ve birinci yıl kontrollerinde değerlendirildi.

**Bulgular:** Klinik değişkenler arasındaki farkın grup veya zaman etkisinden kaynaklandığını saptamak amacıyla yapılan ANOVA analizinde, gruplar arası istatistiksel anlamlı saptanamak, zaman etkisi BI, PASS, RMI, BBS ve CBS puanları için anlamlı bulundu (p<0.05). Birinci yıl sonuçları, tedavi öncesi sonuçlarla karşılaştırıldığında, BI, PASS, RMI ve BBS puanlarının her iki grupta da anlamlı olarak iyileştiği görülü (p=0.05). CBS puanları ile RMI, BBS, BI ve PASS puanları arasında negatif, güçlü ve istatistiksel olarak anlamlı korelasyon bulundu (p<0.05).

**Sonuç:** Çalışmanın sonuçları, TG'li inne hastalarının denge ve mobilitonun ve ilerleyici fizyoterapi programından yarar gördüğini desteklemektedir. Bu kazanımların kalıcı olması, düzenli kontrollerin ihmal edilmemesiyle sağlanabilir. Anahtar Kelimeler: inne, tek taraflı görsel ihmal, egzersiz, denge, mobilite

**Anahtar Kelimeler:** İnme, tek taraflı görsel ihmal, egzersiz, denge, mobilite

**INTRODUCTION**

Unilateral visual neglect (UVN, or neglect) is a clinical syndrome described as a failure to attend or respond to objects on the contra-lesion side. The incidence of neglect in stroke patients has varied from 90% to 8% and it is more common after right hemisphere lesions(5). Neglect can determine the outcome of rehabilitation by adversely affecting mobility, discharge destination, length of hospital stay, and independence in self-care skills for stroke patients(8,11). In addition, UVN is a significant source of handicap and disability for patients and associated with a greater risk for falls and poor functional recovery(16). Therefore, UVN, which is reflected in long-term functional implications by impeding the responses to therapy, need to be addressed by all the members of the stroke rehabilitation team.

In the stroke rehabilitation literature, the outcome differences between the patients having neglect or not, have paid little attention to offer physiotherapist should consider this situation. While the syndrome of neglect is associated with poor functional recovery following stroke, few studies have specifically addressed physiotherapy outcomes in relation to problem. In a study, it was stated that the motor performance of patients with neglect was worse than patients without neglect at both acute and chronic stages(6). There is also evidence to suggest that in patients where visual neglect improves, so does motor and functional recovery(15).

Different approaches have been used to improve functional status following stroke. Studies focused on training mobility and mobility related activities were demonstrated improvements and functional gains in stroke patients. Recent studies have demonstrated that exercise can improve mobility and balance in stroke patients(22,30) but it is not clearly documented what the advantages of different types of exercise programs are. It is generally well establish that supervised exercise programs (SE) administered over several weeks improve physical ability in the short term, although little is known about long-term effectiveness(12,23). In addition, there is a lack of home-based studies demonstrating the long-term influences on functional level whether they are more feasible and cost-effective than supervised training.

The purposes of this study were to compare the supervised and home physiotherapy outcomes in stroke patients with unilateral visual neglect who were performed specialized physiotherapy program during 12 weeks and to determine the follow-up results of one year
supervised and unsupervised exercise training.

MATERIAL AND METHODS

Study Design

This is a prospective, randomized, controlled clinical intervention trial between January 2006-May 2008 comparing supervised training with home exercise in stroke patients with UVN. Approval was obtained from the Dokuz Eylul University, Human Ethics Committee before commencing this study (approval number 18/15/05, protocol number 135, date 6 September 2005). Written informed consent was received from all subjects. Twenty individuals were randomly allocated to receive a 12-week physiotherapy intervention. Randomization was made into two groups, the supervised exercise group (n=10) and the home exercise group (n=10) with random card selection. Both groups were instructed the same exercise program. The supervised group (SE) patients continued with standardized regular three sessions per week in the rehabilitation room. The participants in the home exercise group (HE) were given written exercise program and were encouraged to exercise with weekly calling by the physical therapist through the intervention. All patients were evaluated by the physical therapist at the beginning, after the intervention, and at the first year.

Subjects

The study was carried out on twenty right ischemic stroke patients diagnosed on the basis of the World Health Organization's definition of stroke and brain computed tomography scan or magnetic resonance imaging. UVN was diagnosed by a neurologist and physical therapist according to the Letter Cancellation Tests which are widely used scales that were previously found highly sensitive to neglect.

Patients were admitted onto the study if they satisfied the following criteria: (1) had a single stroke only (2) were in subacute or chronic stage of stroke recovery (i.e., post-stroke duration of ≥3 months, and ≤24 months) (3) were 50 years of age or older (4) UVN diagnosis according to the Letter Cancellation Test, (5) right-handed (6) literate and achieving 23 or more on the Mini Mental State Examination (7) sufficiently healthy to participate in the evaluation (8) living with their family (9) joining the study voluntarily.

The patients with (1) transient ischemic attack or subarachnoid haemorrhage, posterior cerebral arterial infarct or haemorrhage (2) homonymous hemianopsia (4) depression according to the Beck Depression Scale were excluded.

Outcome Measures

A standardized questionnaire was administered and physical and functional performances were assessed. Demographic characteristics and medical history recorded by questionnaire included age, gender, height, weight, and body mass index.

Assessment of the Disability

Disability status on ADL was evaluated with the Barthel Index (BI), which gives a score ranging from 0 to 100. The top score implies full functional independence, but not necessarily normal status. BI comprises 10 items measuring feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, chair/bed transfer, ambulation and stair climbing. Original BI scoring varies between the ranges of 0-5, 1-10 and 0-15 points to these titles. The BI score is highly correlated with independent functional ability and the ability to return home. Additionally, the BI score before the start of rehabilitation gives an indication as to the expected rate/duration of the patient's recovery.

Functional Mobility

Mobility status was measured by the Rivermead Mobility Index (RMI), a simple scale that assesses disability status in mobility through questions about 14 activities and direct observation of 1.
These activities range from turning over in bed, standing unsupported, walking inside and outside (with and without an aid), going up stairs and picking up something from the floor to running. Scale scoring ranges from 0 to 15, with 0 indicating complete inability\(^{(9)}\).

**Postural Assessment**
For postural assessment we used a specific ordinal scale called the Postural Assessment for Stroke Scale (PASS) contains 12-four-point (from 0-3) items that grade the varying difficulty in maintaining or changing a given lying, sitting or standing posture. The scale has in addition to the total score two sub-scores, dynamic and static, all presented as outcome variables in his study\(^{3}\).

**Measurement of the Balance**
Balance was assessed using the Berg Balance Scale, a task performance test consisting of 14 items of increasing difficulty graded on a five-point ordinal scale of 0 to 4 (0= unable to perform task, 4= independent). Higher scores reflect a better level of balance ability. An overall score of less than 45 points, out of a maximum of 56, is associated with a 2.7-times increase in the risk of a future fall. Interrater and intrarater reliability of the BBS has been established with the sample of the subjects with stroke\(^{(4)}\).

**Neglect Severity in Everyday Tasks**
The Catherine Bergego Scale (CBS) was scored by the physical therapist's observation of the patient. The CBS includes 10 common everyday life items. For each item, a 4-point scale was used, ranging from 0 (no neglect) to 3 (severe neglect). A total score was calculated (range, 0–30) \(^{(2)}\).

**Intervention**
All of the participants were given basic instructions related to exercise program. Both groups received specific exercise training program aimed at preventing learned non-use and to improve functional abilities of the involved extremities\(^{(12,17,22,25)}\). Each session was divided into three parts: (1) a warm-up period comprising stool touch and step-up movements (5-10 min); (2) a training period aimed at strengthening upper and lower extremities and improving balance, mobility and coordination (30-35 min) and (3) a cool-down period devoted to flexibility and range of motion exercises performed in a seated position (10-15 min). The majority of exercises were designed to train the paretic side of the body. Functional exercises involved the following: (1) weight bearing activities (push-ups on the armrest of chair); (2) shoulder flexion without weights; (3) standing up from a chair and sit-to-stand movements; (4) walking forward and sideways over obstacles; (5) stepping forward and sideways on the exercise step (up with the paretic limb, down with non-paretic limb and vice versa); (6) partial squats; (7) maintenance of balance with paretic leg on the step and the non-paretic leg suspended off the step and vice versa; (8) standing balance and one-foot stance; (9) walking in different directions. Exercises increased progressively in difficulty based on set criteria by increasing the number of repetitions (from 2 sets of 10 to 3 sets of 15), by reducing arm support and dependent on an individual's ability. The SE group patients underwent an exercise program instructed by a physiotherapist in front of the full-length mirror. While performing these exercises, patients received extensive feedback from the physiotherapist on how to perform movements correctly and adopt a proper posture. Each participant was asked to be aware of warning signs to stop exercising, such as dizziness, pain, chest discomfort. HE group patients were given written exercise program and were encouraged to exercise with weekly calling by the physical therapist through the intervention.

**Data Management and Statistical Methods**
All statistical analyses were performed using SPSS the Statistical Package for the
Social Sciences Software (version 13). All results are reported as mean ± standard deviations (SD).

Descriptive statistics were used to summarize demographic, stroke and baseline characteristics. Potential baseline differences for demographic variables and Barthel Index, Postural Assessment for Stroke Scale, Rivermead Mobility Index, Berg Balance Scale, and Catherine Bergego Scale measurements of the patients between two groups were analyzed using Mann-Whitney U test. All analyses were performed on an intention-to-treat basis. Means and standard deviations were calculated for each clinical test. Interaction timing (baseline, after 12 week and 1 year) x group (SE group and HE group) effects was assessed by the repeated measures analysis of the variance (ANOVA) two way, with baseline to one year change in the respective scores of the Barthel Index, Rivermead Mobility Scale, Postural Assessment for Stroke Scale, Berg Balance Scale, and Catherine Bergego Scale. When appropriate, a Tukey's post hoc was performed to determine the differences. The level of significance was set at p<0.05.

Spearman's rank correlation coefficients were calculated to assess the associations among CBS score, RMI total score, PASS total score, BBS total score, BI total score. A correlation of ≤0.4 was considered poor, between 0.41–0.69 as moderate and ≥0.7 as good.

RESULTS

Twenty stroke patients with UVN participated in the study. The demographic and clinical features at baseline of the supervised exercise group and the home exercise group patients are displayed in Table 1. Table 2 shows the outcome measures in both groups at baseline, 12.weeks and the first year. At baseline, all patients had low clinical scores and there is no statistically significant outcome measures (demographic and clinical) between the SE group and HE group (p>0.05).

The mean motor function at baseline, as assessed by the Rivermead Mobility Index, was higher in the SE group (m=5.8) than in the HE group (m=3.9). The supervised SE group also had higher baseline values for activities of daily living, as measured by the Barthel Index of Activities of Daily Living (SE group m=54; HE group m=44.5) and for balance, as assessed with the BBS (SE group m=24.8, HE group m=15.8) and PASS (SE group m=6.9, HE group m=6.4) (Table 2). The differences were not significant, however.

We used the repeated measures ANOVA test to determine the group and time effect for all clinical variables. There was no significant time by group interaction for all outcomes (p>0.05), whereas time effect were significant for BI, PASS total score, RMI score, BBS score, and CBS score (p<0.05) (Table 2). After 1 year, the scores of disability (BI), posture (PASS), mobility (RMI) and balance (BBS) increased in both groups compared with baseline values (p<0.05). The CBS scores in both groups decreased slightly in one year, but this decrease was not statistically significant (p> 0.05).

The analysis of Spearman's rank correlation coefficient between scores of CBS, RMI total scores, BBS total score, BI total score and PASS total score at 1 year post-stroke was performed. The analysis showed that CBS scores were highly correlated with the total scores of RMI, BBS, BI and PASS. Negative, significant correlation were found between the PASS and CBS score (r = -0.702, p< 0.01); BBS and CBS score (r= -0.796, p< 0.01) (Table 3).
Table 1: Baseline Characteristics of Subjects (mean±SD (range))

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Supervised Group (n=10)</th>
<th>Home-Exercise Group(n= 10)</th>
<th>p -Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>61.8±9.0 (49-73)</td>
<td>63.3±10.5 (48-80)</td>
<td>0.940</td>
</tr>
<tr>
<td>Gender (F/M)</td>
<td>3 / 7</td>
<td>4 / 6</td>
<td>0.648</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>170.0 ±8.0 (152-180)</td>
<td>167.0 ±1.0 (155-180)</td>
<td>0.201</td>
</tr>
<tr>
<td>Mass (kg)</td>
<td>76.1±9.5 (60-90)</td>
<td>76.8 ±11.1 (60-95)</td>
<td>0.359</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.3±2.3 (22.0-29.4)</td>
<td>27.3± 1.9 (24.6- 30.5)</td>
<td>0.880</td>
</tr>
</tbody>
</table>

Table 2: Outcome results of disability, posture, mobility, balance and neglect severity of supervised (n=10) and home exercise (n=10) groups throughout the study at baseline, after the 12 weeks and first year assessments (mean±SD)

<table>
<thead>
<tr>
<th>Group/ Indicator</th>
<th>Baseline</th>
<th>Week 12</th>
<th>1 year</th>
<th>Absolute Change *</th>
<th>Interaction Group X Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>54.0±23.1</td>
<td>77.0±11.1</td>
<td>79.0±12.9</td>
<td>25.0±16.2</td>
<td>0.00</td>
</tr>
<tr>
<td>HE</td>
<td>44.5±22.3</td>
<td>66.0±15.2</td>
<td>70.0±15.1</td>
<td>25.5±11.4</td>
<td></td>
</tr>
<tr>
<td>PASS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>19.3±6.9</td>
<td>33.4±2.3</td>
<td>33.3±3.6</td>
<td>15.0±6.3</td>
<td>0.00</td>
</tr>
<tr>
<td>HE</td>
<td>16.2±6.5</td>
<td>27.3±4.5</td>
<td>28.3±4.9</td>
<td>12.1±5.1</td>
<td></td>
</tr>
<tr>
<td>RMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>5.8±2.6</td>
<td>11.1±1.6</td>
<td>11.5±1.9</td>
<td>5.4±2.3</td>
<td>0.00</td>
</tr>
<tr>
<td>HE</td>
<td>3.9±1.9</td>
<td>8.4±2.3</td>
<td>9.2±2.4</td>
<td>4.5±1.4</td>
<td></td>
</tr>
<tr>
<td>BBS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>24.8±7.4</td>
<td>45.7±7.4</td>
<td>45.4±8.7</td>
<td>22.6±9.4</td>
<td>0.00</td>
</tr>
<tr>
<td>HE</td>
<td>15.8±9.2</td>
<td>32.7±10.6</td>
<td>35.4±11.8</td>
<td>19.6±6.2</td>
<td></td>
</tr>
<tr>
<td>CBS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>12.7±5.4</td>
<td>8.2±5.3</td>
<td>5.4±2.7</td>
<td>-7.3±3.9</td>
<td>0.00</td>
</tr>
<tr>
<td>HE</td>
<td>14.2±7.7</td>
<td>11.2±5.2</td>
<td>10.0±4.6</td>
<td>-4.2±4.4</td>
<td></td>
</tr>
</tbody>
</table>

SE, supervised exercise group; HE, home exercise group; BI, Barthel Index; PASS, Postural Assessment for Stroke Scale; RMI, Rivermead Mobility Index; BBS, Berg Balance Scale; CBS, Catherine Bergego Scale. *Absolute change refers to (1.year, baseline values) (two-way ANOVA).
**Table 3:** Spearman correlation coefficients between BI, PASS, RMI, BBS and CBS scores in participants

<table>
<thead>
<tr>
<th></th>
<th>BI</th>
<th>PASS</th>
<th>RMI</th>
<th>BBS</th>
<th>CBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td></td>
<td>.857**</td>
<td>.858**</td>
<td>.924**</td>
<td>-.809*</td>
</tr>
<tr>
<td>PASS</td>
<td>.857**</td>
<td></td>
<td>.916**</td>
<td>.894**</td>
<td>-.702**</td>
</tr>
<tr>
<td>RMI</td>
<td>.858**</td>
<td>.916**</td>
<td></td>
<td>.925**</td>
<td>-.694*</td>
</tr>
<tr>
<td>BBS</td>
<td>.924**</td>
<td>.894**</td>
<td>.925**</td>
<td></td>
<td>-.796**</td>
</tr>
<tr>
<td>CBS</td>
<td>-.809*</td>
<td>-.702**</td>
<td>-.694*</td>
<td>-.796**</td>
<td></td>
</tr>
</tbody>
</table>

** p < .01

**BI,** Barthel Index; **PASS,** Postural Assessment for Stroke Scale; **RMI,** Rivermead Mobility Index; **BBS,** Berg Balance Scale; **CBS,** Catherine Bergego Scale.

**DISCUSSION**

We had two aims at beginning of the present study. Firstly, we aimed to investigate the supervised and home physiotherapy outcomes in stroke patients with unilateral visual neglect who were given a three-month specialised physiotherapy program. Secondly, we aimed to determine the follow-up results of one year exercise training. It was found out that balance, postural and motor abilities improved similarly in both groups after three-month exercise training. We observed that these positive gains were preserved for one-year follow-up.

In previous studies, it was demonstrated that intensive exercise has a positive influence on balance and motor abilities in stroke patients and may lead to a reduction of falls in older adults with stroke. The fact is that the neglect syndrome has been associated with reduced independence and impaired mobility, and the exercise appears to be an effective means of intervention for achieving functional independence and integration as fully as possible into a community life in stroke patients with neglect.

There are a lot of studies investigating the optimum combination of inpatient, outpatient, and/or home rehabilitation in stroke patients in literature. Some studies focused on rehabilitation at home, and the others on supervised programs. Olney et al. indicated that home exercise produced changes in physical function that are retained over one year. The results of another study contribute to the evidence supporting the benefit of supervised exercise for daily functioning and quality of life after stroke. Their intervention appears to accelerate recovery in the sub-acute phase compared with usual post-rehabilitation community care but one year later it did not provide sustained benefit. On the other hand, Langhammer et al. showed that a follow-up consultative exercise programme with encouragement gave way to improvements in motor function in stroke patients. In our study, we compared the outcomes of the SE group with the outcomes of the HE group and found similar improvements in both groups after three-month exercise training according to the absolute change scores (Table 2). Whereas HE group patients had low scores than SE group patient at baseline, there wasn't any statistically significant difference between SE group and HE group, which may be related to the small number of patients in both groups.

Paolucci et al. confirmed that absence of hemineglect is a prerequisite for excellent prognosis on both activities of daily living (BI) and mobility. There are a lot of cross-sectional studies addressing that
stroke patients with right hemisphere lesions showed more severe balance difficulties than patients with left hemisphere lesions, particularly in relation with visuospatial hemi-neglect\(^{28,31}\). It was found that CBS scores were correlated well with disability\(^1\), and functional performance\(^{80}\). Our results of correlation analysis support these findings (Table 3).

Stroke patients may learn how to adapt their balance in different situations which may lead them to fall\(^6\). However, patients with large right hemisphere lesions tend to have deficits in the arousal or vigilance system, which impairs their learning of compensatory strategies\(^{18}\). Consequently, it was not surprising that subjects with visual neglect were likely to have more diminished balance functions than persons without neglect. The baseline results of our sample were found consistent with studies which were reported as impaired balance disturbances and postural control difficulties in stroke patients with neglect\(^{10,27}\). After the intervention and at the follow-up, it was found out that exercise had positive effect on balance and motor abilities in both groups as measured by the BBS as well as the PASS. While having poor reintegration into everyday task at the baseline assessment, the participants had diminished neglect severity after the exercise program and at the follow-up. This improvement in neglect severity may be the result of the acquirements of stroke patients in disability, mobility, balance and postural functions after our specific exercise program.

Traditionally, there is a tendency to create supervised rehabilitation programs for individuals with stroke because of the great risk of falling. However, there is increased pressure to discharge individuals with stroke to the community as soon as possible. The individuals may be discharged with significant residual deficits and limitation in function. While effective home-based post-acute rehabilitation interventions are extremely important since acute and post-acute stays have been significantly decreased, our results are noteworthy due to the similar improvements in home exercise group compared with the supervised group. In our study, HE patients' adherences to exercise program were controlled by weekly phone controls, which may have influence on the functional gains in HE group. This highlights the importance of the regular controls, while providing home exercises in stroke patients. The stroke people with visual neglect may benefit from structured, intensive and progressive physiotherapy programs, focusing on balance and mobility rehabilitation, either supervised or home-based. These benefits may have retention when regular controls are not omitted. In rehabilitation, particularly care should be taken for stroke patients with neglect to achieve balance recovery and postural control.

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