Motor Function and Activities of Daily Living Assessments: A Study of Three Tests for Persons With Hemiplegia

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The relationship between upper extremity motor function and independence in basic activities of daily living in subjects with hemiplegia was explored. The Barthel Index (Mahoney & Barthel, 1965) and the Fugl-Meyer Test (Fugl-Meyer, Jäderskog, Loyman, Olsson, & Stiglind, 1975) were selected as the standard instruments for the evaluation of activities of daily living and upper extremity motor function, respectively, because their validity and reliability have been demonstrated many times. The Functional Test for the Hemiplegic/Paretic Upper Extremity (Wilson, Baker, & Craddock, 1984a, 1984b) was also used for the evaluation of upper extremity motor function. The results obtained in 18 subjects with hemiplegia indicate that the scores on the Barthel Index are poorly correlated with both the Fugl-Meyer Test and the Functional Test for the Hemiplegic/Paretic Upper Extremity scores. It is suggested that variables other than motor function, such as the learning of compensatory techniques and perceptual–cognitive status, are responsible for this discrepancy because they can influence activities of daily living performance in persons with hemiplegia. The high correlation between the scores on the Fugl-Meyer Test and the Functional Test for the Hemiplegic/Paretic Upper Extremity indicates that either test may be used for the assessment of upper extremity motor function.

The rehabilitation of patients with hemiplegia following cerebrovascular accident is complex and includes many treatment goals related to sensorimotor, perceptual, and cognitive deficits as well as to disabilities encountered in many spheres of occupational performance. A typical rehabilitation program for patients with hemiplegia has two crucial objectives: (a) to improve motor function of the hemiplegic side (upper and lower extremities, neck, and trunk) and (b) to increase independence in the basic activities of daily living, such as personal care and mobility.

In the rehabilitation field, two schools of thought currently exist regarding the relationship between upper extremity motor function in hemiplegia and the level of independence reached in the basic activities of daily living. The first school maintains that there is a direct relationship between these two variables. It is supported by the fact that the upper extremities are important and involved in a bilateral manner in most activities of daily living. Some evidence of a relationship between activities of daily living and upper extremity motor function supports this view as well (Lyle, 1981). In this regard, a patient who presents a good motor function status of the impaired upper extremity is expected to also demonstrate a high level of independence in activities of daily living. Consequently, if such a relationship existed, one would need to assess only one of these two variables to predict the other one.

In contrast, the second school of thought suggests that these two parameters are not so closely related and...
that the learning of compensatory techniques is an important variable in the level of independence in activities of daily living that is reached by a person with hemiplegia (Loewen & Anderson, 1990; Wade, Langton-Hewer, Wood, Skilbeck, & Ismail, 1983). Occupational therapists are in empirical agreement with this view, because the teaching of compensatory techniques as well as the encouragement of motor recovery is included as an important part of their treatment approach, especially when motor recovery has reached a plateau. As a consequence of such training, a person with hemiplegia who has poor upper extremity motor function could be completely independent in basic activities of daily living because he or she has learned to compensate.

The first goal of the present study was to further document the relationship between upper extremity motor function and independence in activities of daily living in subjects with hemiplegia. Independence in basic activities of daily living was evaluated with the Barthel Index (Mahoney & Barthel, 1965), because many studies have shown the validity and reliability of this test (for a review, see Wade & Collin, 1988), and its appropriateness for stroke patients has been documented (Granger, Dewis, Peters, Sherwood, & Barrett, 1979; Gresham, Phillips, & Labi, 1980). The global score on the Barthel Index ranges from completely dependent (0) to completely independent (100). The upper extremity motor function section of the Fugl-Meyer Test (Fugl-Meyer, Jääskö, Leyman, Olsson, & Stegland, 1975) was chosen for the assessment of upper extremity motor function because it is a valid (Kusoftsky, Wadell, & Nilsson, 1982) and reliable (Duncan, Propst, & Nelson, 1983) instrument. It has also been used as the standard instrument in several validation studies (Arsenault, Dutil, Lambert, Corriveau, Guarna, & Drouin, 1988; Berglund & Fugl-Meyer, 1986). The Functional Test for the Hemiplegic/Paretic Upper Extremity (Wilson, Baker, & Craddock, 1984a, 1984b) was also administered as an assessment of upper extremity function.

Both the Fugl-Meyer Test and the Functional Test for the Hemiplegic/Paretic Upper Extremity are based on the motor recovery model developed by Twitchell (1951) and on Brunnstrom's (1970) view that motor recovery follows a specific sequence of organized stages. These tests, however, reflect two different assessment approaches. The Functional Test for the Hemiplegic/Paretic Upper Extremity involves the use of functional tasks, whereas the Fugl-Meyer Test involves a more systematic evaluation of motor function through movements involved in or deviating from the stereotypical synergies as defined by Brunnstrom.

The upper extremity motor function section of the Fugl-Meyer Test uses a three-grade ordinal scale that ranges from 0 to 2 for each item. A score of 0 is assigned when the details of an item cannot be performed, a score of 2 is assigned when the details are performed faultlessly. This test also uses a global score for the upper extremity motor function that ranges from absence of voluntary movement (0) to complete upper extremity motor recovery (66). The Functional Test for the Hemiplegic/Paretic Upper Extremity involves different tasks associated with daily living. It does not evaluate performance in activities of daily living, but rather, assesses the person's motor ability to use the upper extremity for purposeful tasks. This test has a seven-level scale, ranging from absence of voluntary movement (1) to selective and coordinated movement at the upper extremity (7). Each level involves different tasks that are graded on a pass-or-fail basis. A patient earns a plus for successfully completing the task or a minus for failing at the task. After the assessment, the patient is assigned to the highest level at which he or she successfully achieved all the tasks involved. Because this test is relatively new, further validation studies that use it as an instrument for upper extremity function evaluation are needed. Therefore, a second goal of the present study was to explore the validity of the Functional Test for the Hemiplegic/Paretic Upper Extremity relative to the Fugl-Meyer Test.

Method

Eighteen subjects (12 men, 6 women) with hemiplegia following a first cerebrovascular accident participated in the study during their rehabilitation program. Fifteen subjects had left-sided hemiplegia and 3 had right-sided hemiplegia. The mean age was 52.2 years (SD = 13.5) and the mean poststroke delay was 4.0 months (SD = 4.6). The Barthel Index, the upper extremity motor function section of the Fugl-Meyer Test, and the Functional Test for the Hemiplegic/Paretic Upper Extremity were administered to the subjects on three separate occasions: (a) on admission at the rehabilitation center; (b) 1 month after admission; and (c) at discharge, approximately 2 months after admission. To ensure consistent test administration, trained clinicians administered the tests.

The data were analyzed in two ways. First, an intercorrelation matrix was computed with the use of Spearman Rho coefficients. These coefficients were used to estimate the level of association between the different pairs of variables. Second, the scores of the three evaluation sessions were compared for each test with the use of Friedman's analysis of variance (ANOVA) and Kendall's coefficient of concordance (Zar, 1984). The purpose of these latter analyses was to depict the presence of changes over time on scores obtained on the three tests and the similarity of these changes across subjects.

Results

The correlations between the results obtained on the three tests were found with the use of Spearman Rho coefficients for the three sets of evaluations. These coefficients indicated that the scores from the Barthel Index
were poorly correlated with the scores obtained on the Fugl-Meyer Test and the Functional Test for the Hemiplegic/Paretic Upper Extremity at discharge, \( Rho = .60 \) and .61, respectively, \( p < .01 \). However, the scores on the Fugl-Meyer Test were highly correlated with the scores on the Functional Test for the Hemiplegic/Paretic Upper Extremity (at discharge, \( Rho = .96, p < .01 \)). Similar coefficients were obtained on admission and 1 month after admission.

Sensitivity to changes over time were also studied for the three tests. Specifically, the sensitivity of the two upper extremity motor function tests were compared. Table 1 shows the mean scores and standard deviations obtained on each test over the three evaluation sessions. The Barthel Index, Fugl-Meyer Test, and Functional Test for the Hemiplegic/Paretic Upper Extremity appeared to be sensitive to changes over time, because their scores tended to increase across assessments. For each test, the significance of trends was verified with the use of Friedman's ANOVAs for repeated measures. The results indicated that these trends were all significant (Barthel Index and Fugl-Meyer Test, \( x^2 = 13.86 \) and 14.78, respectively, \( p < .001 \); Functional Test for the Hemiplegic/Paretic Upper Extremity, \( x^2 = 7.58, p < .05 \)). Moreover, the importance of the trends observed across subjects was weighted with Kendall's coefficient of concordance (W). The values for Kendall's statistic W were approximately the same for the Barthel Index (\( W = .39 \)) and the Fugl-Meyer Test (\( W = .41 \)). However, this value was smaller for the Functional Test for the Hemiplegic/Paretic Upper Extremity (\( W = .21 \)). These values are considered rather low, because the maximal W value is 1.

### Discussion

The poor correlations found between the Barthel Index scores and those obtained on the Fugl-Meyer Test and the Functional Test for the Hemiplegic/Paretic Upper Extremity indicate a weak relationship between independence in activities of daily living and upper extremity motor function. These results, confirmed in another recent study (Auger et al., 1991), suggest that independence in activities of daily living is influenced by variables other than motor function. The learning of compensatory techniques, such as the use of an adapted toothbrush or the lacing of shoes with a unilateral technique, may be one variable that might explain the discrepancy between the scores on the Barthel Index and the other two tests. Thus, a patient could exhibit poor upper extremity motor function and be relatively independent in basic activities of daily living because he or she has learned to compensate for his or her deficits with the unimpaired upper extremity. Unfortunately, to our knowledge, no test that evaluates the effect of the learning of compensatory techniques on activities of daily living performance is currently available. Therefore, it is not possible to evaluate, with an activities of daily living test, the extent of performance resulting from adaptation rather than motor recovery. Other deficits often present in a hemiplegic profile, such as perceptual or cognitive disorders, and these deficits probably influence the performance in activities of daily living as well (Arnadottir, 1990), although these deficits would not interfere with performance in a test evaluating motor function alone. For example, a patient presenting unilateral neglect may perform poorly in dressing even if he or she has reached a satisfactory level of upper extremity motor function. Consequently, these results indicate that an assessment of upper extremity motor function cannot be used by itself to establish a patient's functional profile. Alternatively, an activities of daily living test should not be used to predict the level of motor function.

The high correlation found between the scores on the Fugl-Meyer Test and those on the Functional Test for the Hemiplegic/Paretic Upper Extremity implies that both tests similarly measure upper extremity motor function. This strong relationship also attests to the validity of the Functional Test for the Hemiplegic/Paretic Upper Extremity. It follows from these results that either test can be used to assess upper extremity motor function. However, the Functional Test for the Hemiplegic/Paretic Upper Extremity evaluates motor function through functional tasks, thus allowing the observation of other aspects of performance, whereas the Fugl-Meyer Test quantifies motor function in a more systematic manner through the evaluation of each movement involved in or deviating from the stereotypical synergies.

Both the descriptive and the inferential statistical results obtained indicate that the three tests studied are sensitive to changes over time. Nevertheless, the Barthel Index and the Fugl-Meyer Test, which have larger scales, demonstrate more sensitivity than the Functional Test for the Hemiplegic/Paretic Upper Extremity. This is reflected in their higher chi-square values as well as their higher Kendall's coefficients of concordance. Thus, the Functional Test for the Hemiplegic/Paretic Upper Extremity may benefit from a numerical scale instead of a pass-or-fail basis for scoring each item and from an enlarged

### Table 1

<table>
<thead>
<tr>
<th>Test</th>
<th>Mean Test Scores and Standard Deviations (N = 18)</th>
<th>One Month</th>
<th>At Admission</th>
<th>After Admission</th>
<th>At Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barthel Indexa</td>
<td>70.6 ± 21.8</td>
<td>79.4 ± 17.6</td>
<td>83.3 ± 15.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fugl-Meyer Testb</td>
<td>17.7 ± 20.3</td>
<td>22.1 ± 24.6</td>
<td>24.3 ± 25.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional Test for the</td>
<td>2.4 ± 2.2</td>
<td>3.1 ± 2.5</td>
<td>3.4 ± 2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemiplegic/Paretic Upper Extremityc</td>
<td></td>
<td></td>
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</tbody>
</table>

\( ^a(\text{Mahoney & Barthel, 1965}) \), \( ^b(\text{Fugl-Meyer, Įlasāko, Leyman, Olsson, & Stegland, 1975}) \), \( ^c(\text{Wilson, Baker, & Craddock, 1984a, 1984b}) \).
global score, which could increase its sensitivity to changes over time.

Kendall's coefficient of concordance, an index of concordance for repeated measures, offers further information concerning changes of subjects' scores over time. The maximum value of Kendall's statistic \( W \) is 1; such a value implies that, among subjects, the scores obtained across the three evaluation sessions increased progressively. In the present study, for a given subject, identical scores were often observed over time, either for the first and second evaluation sessions or for the second and third evaluation sessions. This would explain the low \( W \) value obtained for each test (even those with a large scale) and suggests that the lapse of time between assessments in the present study may have been too short to observe progress in upper extremity motor function and independence in basic activities of daily living.

**Conclusion**

The results of this study indicate that upper extremity motor function and independence in basic activities of daily living are poorly related variables in persons with hemiplegia. We suggest that the learning of compensatory techniques and perceptual as well as cognitive disorders are among other possible variables responsible for this discrepancy. Therefore, an assessment of upper extremity motor function or independence in activities of daily living should not be used by itself as a tool to predict the other one. The results also emphasize the need for a global evaluative approach with persons with hemiplegia. Furthermore, we have shown that the Functional Test for the Hemiplegic/Paretic Upper Extremity appears to be a valid test of upper extremity motor function due to its strong correlation with the Fugl-Meyer Test. Consequently, either the Functional Test for the Hemiplegic/Paretic Upper Extremity or the Fugl-Meyer Test may be used to evaluate upper extremity motor function. The Functional Test for the Hemiplegic/Paretic Upper Extremity is, however, less sensitive to changes over time than is the Fugl-Meyer Test because of the small range of its global score (i.e., 1 to 7). Therefore, the Functional Test for the Hemiplegic/Paretic Upper Extremity would possibly benefit from an extended global score.

Recently, a French version of the Functional Test for the Hemiplegic/Paretic Upper Extremity that has been adapted with a numerical scale (i.e., 0, 1, 2) for each task and a global score of 34 points has been published (Dutil, Filiatrault, De Serres, &Arsenault, 1990). We hope that this scale will increase the test's sensitivity to subtle changes in upper extremity motor function, because this test is of great interest for occupational therapy clinical practice. Moreover, the results of the study show that a monthly evaluation of persons with hemiplegia appears to be too short a lapse of time to observe significant changes in either motor function profile or level of independence in activities of daily living. However, further studies are needed to corroborate these conclusions.

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**References**


