Scand J Rehab Med 18: 155–157, 1986

UPPER EXTREMITY FUNCTION IN HEMIPLEGIA

A Cross-validation Study of Two Assessment Methods

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ABSTRACT. The methods devised by DeSouza et al. (2) and by Fugl-Meyer et al. (6) for description of upper extremity function after stroke were compared by parallel assessments in a consecutive series of 50 patients with hemimotor deficit. Very close positive associations between both methods indicated a high degree of cross-validity. As both methods appear to be externally valid, have good inter-rater reliability and as the time needed for assessing the arm function of a hemiplegic or hemiparetic patient rarely exceeds 10 min, it appears that the two methods possess about equal descriptive power.

Key words: stroke, hemiplegia, assessment, upper extremity

This investigation was designed to compare two methods for assessment of upper extremity function after stroke with unilateral motor impairment. Method A is that described by Fugl-Meyer et al. (6) while method B is that presented by DeSouza et al. (2).

Method A is based on the concept of Twitchell (11) that after stroke with hemiplegia, motor recovery, if occurring, follows an obligatory path. A concept which later was used by Reynolds et al. (9) and thereafter by Brunnström (1) for description of motor recovery and for treatment of motor function in hemiplegia. Fugl-Meyer et al. (6) used a scoring method which for the motor function of the upper extremity reaches from 0 (flaccid paralysis) to 66 (normal motor function). Scores for joint position sense are 0–8 and for passive joint movement and pain during such movements between 0 and 24 each, while exteroception is between 0–4. Thus, maximum score is 126. For the experienced physician or therapist the total assessment time for the upper extremity is about 8–12 min.

Method B is designed to take into account "the possible differential neural control of arm movements and the proximal to distal pattern of functional recovery" after stroke (2). The assessment of motor function includes evaluation of muscle tone and uses functional tests for arm and trunk movement (turning cranked wheel) and for hand function. Passive range of joint movement and occurrence of pain during such manoeuvres are also assessed. The total score is 25, of which the maximum motor score is 19, while the cumulated score for assessment of sensory and joint function is six.

PROCEDURE

Out of a total number of 170 consecutive patients discharged with a diagnosis of stroke (12), 88 of the survivors fitted the criteria of having had only one stroke and having no previous upper extremity impairments. Only those in whom the upper extremity showed at least some motor impairment ($n=50$) were included in this validation study. All assessments were performed in the domiciles of the patients by one and the same occupational therapist (K. B.) who was well acquainted with both methods. The detailed manual given by the authors of both methods were rigidly followed. This implies that for both methods and throughout the assessment procedure the subjects were seated.

For comparison both parametric (linear regression) and non-parametric (Spearman's r_s) statistics were used.

RESULTS

The total scores for A and B covariated closely (Fig. 1), explaining more than 90% of the variance. Comparing only the *motor* assessments these were also closely associated, explaining more than 80% of the variance (Fig. 2). For none of the assessment methods were there significant right/left differences in total and in motor scores.

There was however a certain tendency towards clustering of maximum and minimum scores using method B. In fact, 6 subjects obtained maximum motor score and 3 maximum total score according to this method. Also using method B, 10 subjects clustered at the lowest motor score while no such cluster-

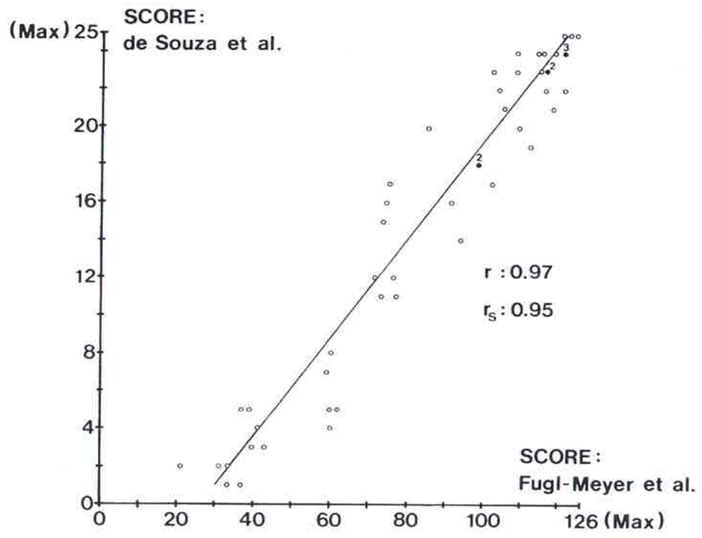

Fig. 1. Relationship of two numerical scoring methods for assessment of upper extremity function after stroke with hemi-motor impairment; 50 subjects were evaluated. r, denotes linear regression coefficient; r_s is Spearman's non-parametric regression coefficient.

ings occurred for method A. Thus indicating less discriminative power towards scale end-points for method B than for method A.

DISCUSSION

The principle findings are the very good cross-validity for the two methods. It is particularly intriguing that performance of practical motor tasks (i.e. method B) reflects the ontogenetic stage of motor development which method A has been shown to describe (6). DeSouza et al. (3) also have found a close correlation between method A and a pursuit tracking task using elbow movements. Concerning method A, De Weerdt & Harrison (4) recently demonstrated good cross-validity with yet another test of arm/hand practical performance. These associations imply that it may be possible to construct assessment methods built upon every-day activities but still reflecting the actual stage of motor development.

Validity, reliability, reproducibility and reasonable time consumption are basic requirements for any evaluation method. Method A has previously been shown to be internally valid, i.e. measures what it is hypothesized to measure (6). Both methods appear to be externally valid. For instance, for method A, significant positive co-relations between degree of motor impairment and ADL capacity (7), leisure time activities (10) and occupational return (8) have been found. Both methods also possess high degrees of inter-rater reliability (2, 5). They are also reproducible. As they, moreover, require only rather short time for individual assessments (about 10 min each) they both fulfill basic demands for clinical tests of this kind. Both tests appear to be relatively insensitive to perceptual disorders. About 50% of all subjects with left motor deficit due to stroke have perceptual dysfunctions, always including disturbances in the body scheme. There were, though, no significant right/left differences in total or in motor performance using any of the two tests.

We conclude that both methods adequately describe the performance of the affected upper extremity after a stroke with hemiplegia/-paresis. The

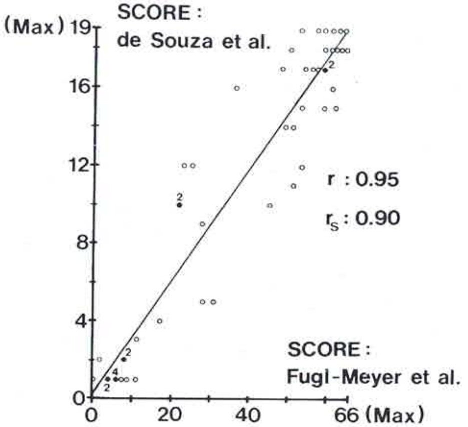

Fig. 2. Relationship of two numerical scoring methods for assessment of upper extremity *motor* function after stroke with hemimotor impairment; 50 subjects were evaluated. r, denotes linear regression coefficient; r_s is Spearman's non-parametric regression coefficient.

methods appear to be of equal value for clinical use, although the method with the greater scale-width (A) may discriminate best when dealing with extremely low or near normal upper extremity performance.

REFERENCES

1. Brunnström, S.: Movement Therapy in Hemiplegia. Harper & Row, 1970.
2. DeSouza, L. H., Langton Hewer, R. & Miller, S.: Assessment of recovery of arm control in hemiplegic stroke patients. Arm function test. Int Rehab Med *2:* 3, 1980.
3. DeSouza, L. H., Langton Hewer, R., Lynn, P. A., Miller, S. & Reed, G. A. L.: Assessment of recovery of arm control in hemiplegic stroke patients. 2. Comparison of arm function tests and pursuit tracking in relation to clinical recovery. Int Rehab Med *2:* 10, 1980.
4. De Weerdt, W. J. G. & Harrison, M. A.: Measuring recovery of arm–hand function in stroke patients: A comparison of the Brunnström–Fugl-Meyer test and the Action Research Arm test. Physiotherapy (Canada) *7:* 65, 1985.
5. Duncan, P. W., Propst, M. & Nelson, S. G.: Reliability of the Fugl-Meyer assessment of sensimotor recovery following cerebrovascular accident. Physical Therapy *63:* 1606, 1983.
6. Fugl-Meyer, A. R., Jääskö, L., Leyman, I., Olsson, S. & Steglind, S.: The post-stroke hemiplegic patient. I. A method for evaluation of physical performance. Scand J Rehab Med *7:* 13, 1975.
7. Fugl-Meyer, A. R. & Jääskö, L.: Post-stroke hemiplegia and ADL-performance. Scand J Rehab Med, Suppl *7:* 140–152, 1980.
8. Fugl-Meyer, A. R., Steger, H. G., Jääskö, L. & Loid, M.: Return to work with hemiplegia. Proc. IRMA II (Mexico City, 1974); 703, 1976.
9. Reynolds, G., Archibald, K. C., Brunnström, S. & Thompson, N.: Preliminary report on neuromuscular function testing of the upper extremity in adult hemiplegic patients. Arch Phys Med *9:* 303, 1958.
10. Sjögren, K. & Fugl-Meyer, A. R.: Adjustment to life after stroke. With special reference to sexual intercourse and leisure. J Psychosom Res *26:* 409, 1982.
11. Twitchell, T. E.: The restoration of motor function following hemiplegia in man. Brain *74:* 443, 1951.
12. WHO, Cerebrovascular diseases. Prevention, treatment and rehabilitation. Techn Rep Ser 469, Geneva, 1971.

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