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WALKING AFTER STROKE

Measurement and Recovery over the First 3 Months

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ABSTRACT. **Sixty surviving patients had their walking ability and speed assessed regularly over the first 3 months after an acute stroke. Sixty-four matched controls were studied to allow categorisation of speed as 'slow' or 'normal'. Fourteen patients never had any significant loss of walking speed; fifteen patients never recovered the ability to walk and one patient remained dependent upon verbal support. Of the 30 showing significant recovery, only 10 regained normal speed, and 8 remained dependent upon a physical aid at 3 months. Plotting individual recovery curves of walking speed over time showed the wide range of change which may be expected. It is argued that timing of gait over 10 metres is a valid reliable measure that is currently underused.**

Key words: Speed, recovery, walking, stroke.

Clinicians and physiotherapists often disagree about the gait of patients seen after stroke. The former note that someone is up and about without help, the latter that the gait is clinically abnormal. One reason for this disagreement is the absence of any commonly acceptable measurement of walking ability.

On the other hand, there is general agreement that after a stroke 50–80% of surviviors will be walking independently (3, 13) and that 64% of those initially dependent in walking regain their independence (15). It has also been found that speed of walking improves over the first 12 weeks at least, although the change in individuals is variable (10). We have found that this apparent success hides the fact that many 'independent' patients walk slowly and rarely venture outdoors (14).

This study records recovery of walking ability in the first 3 months after a stroke and sets out to evaluate a standard approach to assessing gait. It adds detail to the more general results we have previously published (13, 15).

PATIENTS AND METHODS

The study was based upon 3-month follow-up of 117 consecutive admissions to a district general hospital of patients with an initial diagnosis of an acute stroke. Every patient was assessed clinically by a doctor to confirm the diagnosis of stroke (using the WHO definition (1)). Each surviving patient was then tested frequently (where possible, weekly while in hospital and every two weeks after discharge) until 3 months after the onset of the stroke. In addition, 64 controls were studied to generate normal values for walking speed. In the main these were people who attended local Social Clubs, and were not known to have had a stroke.

The major assessments of gait were the speed of walking, and the 'Functional Ambulation Classification' (FAC) from the Massachusetts General Hospital (6). Speed was tested by asking the subject to walk 10 metres on the level, using any aid they wished and at their own preferred speed: their time (seconds) was recorded. Obviously they realised their speed was being measured. The walking aid used was recorded—if no aid was used, the observer rated gait as clinically normal or abnormal. The categories of the FAC are shown in the Appendix: full definitions are given in the original paper (6).

Reliability of measurement of speed was assessed on a sub-sample of 19 patients from the 'recovery' study. Each was tested on four occasions, being allowed several minutes' rest if required between attempts, and being timed independently by two observers (both therapists) who recorded their results separately.

The 19 patients were also assessed clinically (by J. M.) for normality of gait. The aspects recorded were: safety, placement of one foot in front of the other, equality of step length, increased or decreased tone in the leg, weight-bearing through the affected heel, hyperextension of affected knee when weight-bearing, retraction of the pelvis on the affected side, shoulder girdle retraction and increase in tone in the arm when walking.

NORMATIVE DATA

The average age of the 64 controls studied was 69.52 years (range 41–89) and the numbers in four age bands (i.e.<60, 60–69, 70–79 and 80+ years) matched the stroke survivors forming the basis of the study of recovery. The time taken by the controls of various ages to walk 10 metres is shown in Table I. People below 60 years (n=12) walked faster than 1 m/sec, those aged 60–69 years (n=18)

Table I. *Time to walk 10 m; normal controls*

Time (sec)	Age group <60 yr (n=12)	60–69 yr (n=18)	70–79 yr (n=23)	80+ yr (n=11)
7 or less	6	4	6	0
8	3	4	3	1
9	3	8	3	2
10	0	1	2	3
11	0	1	0	3
12	0	0	2	1
13	0	0	2	1
14	0	0	1	0
15	0	0	3[a]	0
16	0	0	0	0
21	0	0	1[a]	0

[a] 2 subjects used a walking stick.

walked faster than 0.8 m/sec and all but one of those aged over 70 (n=34) walked faster than 0.6 m/sec. Therefore, these values were used to classify patients as 'normal' or 'slow'.

Reliability of timing

The 19 patients studied to assess reliability of timing walking were seen at an average of 167 days post-stroke (SD 38.38; range 109–232). The correlation coefficient (Pearson's r) between the two observers was 0.99 on all four occasions. Further, the correlation coefficient between the patients' first and last times was 0.89 (observer 1), 0.90 (observer 2). All these coefficients were statistically significant ($p<0.001$). There was little change in speed over the four assessments. For the whole group the average time was 14.74 sec (SD 9.93; range 5–47) for the first test, and 13.53 (SD 7.28; range 5–30) on the last. We conclude that timing walking over 10 m is reliable with little inter-observer or test–retest variability.

Clinical assessment of gait/speed

A comparison between clinical assessment of gait and speed was made on the 19 patients studied for reliability of timing. Nine patients were judged to have at least one gait abnormality: 6 of these were slow and 3 walked at normal speed. Of the 3 walking at normal speed, two had a noticeable increase in arm tone and shoulder girdle retraction when walking and one of the two also had an increase in tone in the leg; the other patient did not weight-bear through the heel of the affected side. Three 'slow' patients were judged to walk with a normal gait. Thus, although clinical judgement and assessment of speed frequently concurred, in 32% of patients there was a discrepancy.

RESULTS—RECOVERY

Sixty of the 117 patients registered form the basis of the study of recovery: 40 had died before 3 months, 12 were lost to follow-up, 3 were found to have cerebral tumors, 1 was uncooperative throughout and 1 had a myocardial infarction after 7 weeks. The 60 patients studied comprised 28 men and 32 women; 26 patients had left-sided weakness, 30 right-sided weakness and 4 had no unilateral weakness; the average age of the group was 67.6 years (range 26–89); and the average number of days to first assessment was 4.5 (SD 6.0).

Fifteen (25%) of the 60 were unable to walk either at initial or at final assessment; they did not recover within the first 13 weeks. Another 14 (23%) walked independently and at a normal speed for their age at both their initial and final assessments—their gait was never significantly affected. One patient showed no recovery: he needed verbal supervision (FAC category 3) throughout.

Thirty patients (50%) showed some recovery by three months. Initially 16 of these were immobile, 6 needed physical help (3 @ FAC 1; 3 @ FAC 2), 2 needed supervision, 5 could only walk on the level and one was simply slow. Every patient who recovered regained independence from personal support. At 13 weeks, 8 could not manage uneven ground (FAC 4), 12 were slow and 10 walked at a normal speed; 8 needed an aid—3 a Zimmer frame, 3 a rolator and 2 a walking stick. Improvement in FAC category was usually accompanied by improvement in speed, but one patient walked at the same speed at final assessment as at initial assessment and one demonstrated a gradual slowing throughout.

Patients using an aid walked slowly. Not every patient used an aid, and the time an aid was used varied between patients. Therefore the data have been analysed by taking the average speed walked by a patient using an aid recorded over the time he used that aid. The results shown in Table 2 are derived from 48 surviving patients who walked at some point over the first 13 weeks; data comes from many assessments, and some patients may have information in more than one category. It is clear that patients using an aid walked slowly, and

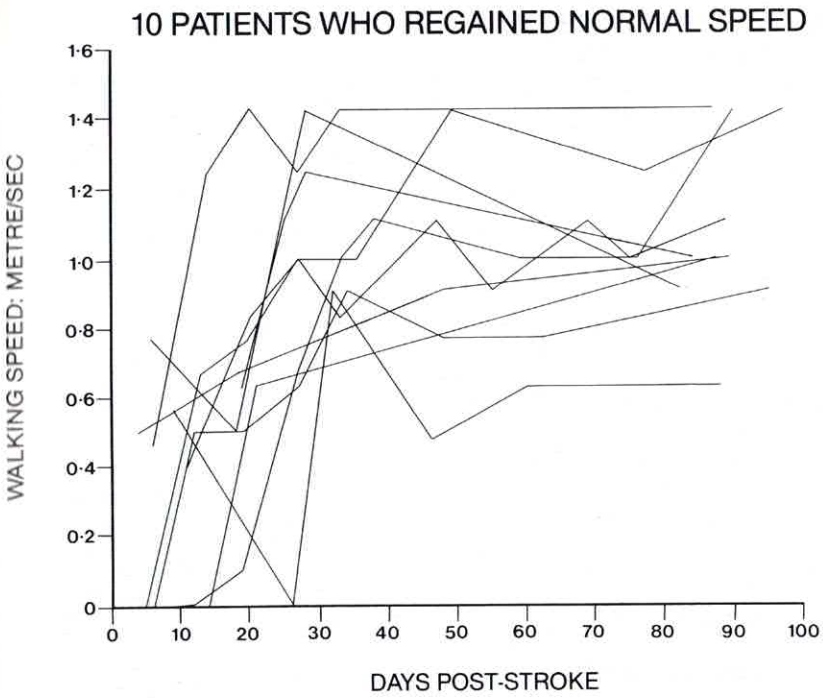

Fig. 1. Recovery of walking speed. Ten patients walking at normal speed at 3 months.

that patients judged to have an abnormal gait walked more slowly than those judged to be normal. There was some overlap between the groups. Excluding one observation of 67.5 sec to walk 10 m, the longest time taken by someone walking unaided was 27 sec; one person using a stick took less time (24 sec) and one person using a rolator took less time (22 sec). The separation in times between patients using a stick and those using a frame was less good—three people walked more slowly using a stick than the fastest patient using a Zimmer frame.

To illustrate the pattern of recovery of walking over the first 13 weeks post-stroke, the time taken by each patient to walk 10 m was converted to metres per second (0 being recorded for those unable to walk). Our normative data was not extensive enough to allow accurate normalisation of the speed for each patient's age. Fig. 1 shows the individual recovery cures (m/sec at each assessment point) for the 10 patients who regained normal walking speed for their age, Fig. 2 the individual plots for patients who were slow at the end (n=12), and Fig. 3 the individual plots of patients still using a walking aid at final assessment (n=8).

The graphs demonstrate quite clearly the considerable fluctuation seen in performance over time; that all patients going to recover had started their recovery by 62 days post-stroke; that the longer a patient took to start walking the less likely he was to regain normal speed within 13 weeks; and that

Table II. *Average time (sec) taken to walk 10 m by patients when using various aids*

			No aid	
	Zimmer/rolator	Stick	Abnormal	Normal
Patients	n=12	n=9	n=20	n=24
Observations	n=41	n=20	n=66	n=103
Mean (SD)	51.1 (19.5)	32.5 (13.3)	24.7 (14.3)	10.7 (2.4)
Range	22–95	24–67	12–67	7–17
Median	48	27	20	10
Speed (m/sec)	0.21 m/sec	0.37 m/sec	0.5 m/sec	1 m/sec

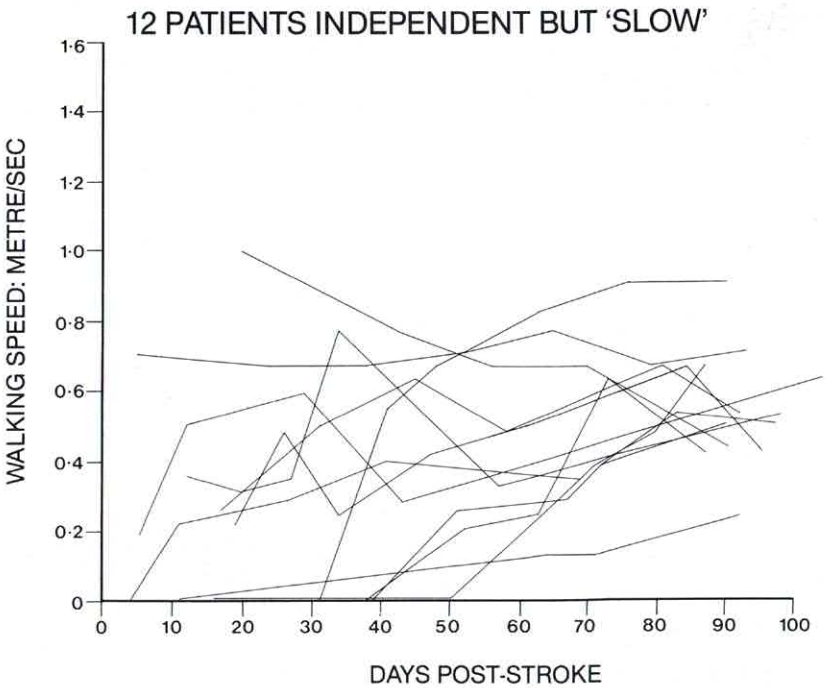

Fig. 2. Recovery of walking speed. Twelve patients walking slowly at 3 months.

fourteen patients showed improvement between 67 and 104 days. All of the 10 patients who walked at a normal speed at 3 months post-stroke did so by 76 days and all made most of their recovery within 5 weeks.

Change after 3 months post-stroke was investigated in 19 patients who were recalled 1–5 months later to establish reliability of timing walking. In this group 7 patients showed a slight increase in

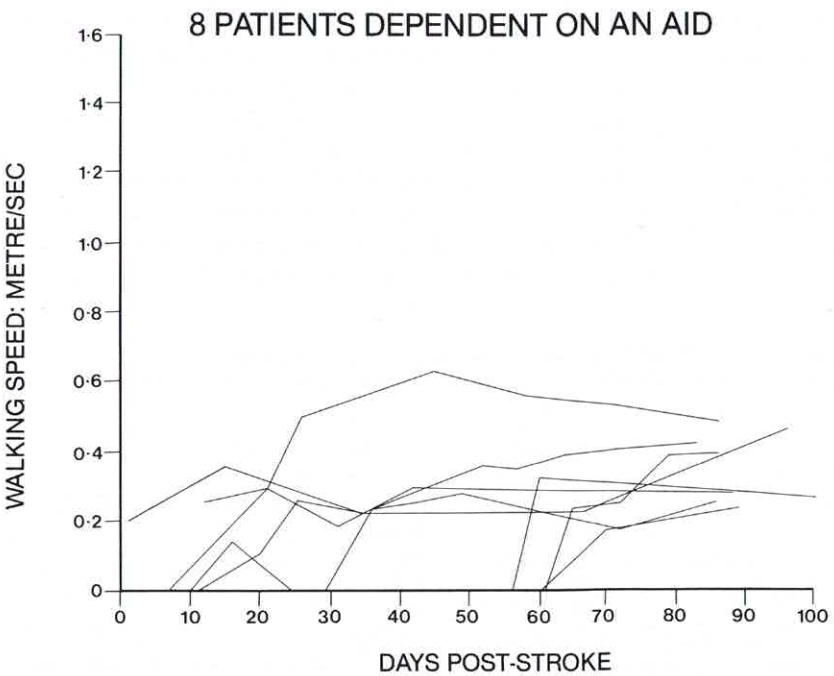

Fig. 3. Recovery of walking speed. Eight patients using an aid at 3 months.

speed (0.1–0.7 m/sec) and 6 patients showed a slight decrease (0.1–0.4 m/sec), with 6 remaining the same. One patient had regained normal speed, but 2 patients showed deterioration from a normal to a 'slow' speed for their age. We conclude that there was little consistent improvement in walking speed after 3 months.

DISCUSSION

This study illustrates the pattern of recovery of walking ability in the early weeks after stroke and shows that, of the 45 patients who lost the ability to walk due to stroke, only 22% (10) returned to normal walking speed within 3 months. Indeed, the gait was still slow four to eight months later in some patients. Although measuring walking speed will not necessarily help guide therapy, our results suggest that measuring speed over ten meters is a reasonably reliable and objective measure of recovery of walking ability after stroke, and could be used to judge the effectiveness of therapy aimed at improving walking.

The patients included in this study were selected by virtue of being admitted to hospital, surviving for 3 months and not being lost to follow-up. They covered a wide range of ages and severities, and we feel that they are probably representative of most patients whose gait is disturbed by an acute stroke.

Despite its simplicity, measurement of walking speed in patients surviving a stroke has not achieved any popularity. Previous studies (2, 6, 7, 11) have shown that velocity is a reliable and valid measure which correlates well with other aspects of walking, such as the propensity to fall, cadence and dependence upon aids or support. This study confirms the reliability of measuring walking speed. Previous studies have shown that walking speed decreases with age, hence the need to allow for age when judging normal speed (11).

A diagnostic assessment of a patient's difficulties is still needed when planning treatment, although there is evidence that clinical judgement is not reliable (5). Our results show that many patients judged abnormal clinically walked with a normal speed and, more importantly, that many patients judged to be clinically normal walked slowly. Nevertheless there was a general association between abnormal gait or the use of an aid and a slow gait. Simple ways of analysing gait have been described (12), but electronic computerised aids might help analyse the abnormalities more reliably. For example, Knutsson & Richards (8) found that patients tended to have one of three disturbances—enhanced stretch reflexes, reduced muscle activation, or abnormal co-contraction of muscles.

The apparently good recovery of walking after stroke previously reported obviously belies the true state of affairs. The number of patients recovering independence after losing it (22/45; 49%) is a little lower than we found in our earlier study (on different patients) (15), but the proportion of patients 'independent' at 3 months in this study (36/60; 60%) is similar to that found in other studies (3, 13). This study shows quite clearly that many patients regaining independence remain disabled: they walk more slowly than their friends. Only 10 (22%) of those losing their independence (n=45) in walking regain a normal speed by 3 months and only 24 (40%) of the 60 survivors walked at normal speed.

We conclude that the measurement of the time taken to walk 10 m could be a simple objective measure of walking ability after stroke. We agree that "Velocity, together with endurance, expresses the sum of all those functions necessary for gait" (9). Walking speed should be used as an outcome measure: it should be easily understood and acceptable to both therapists and doctors, and it can be used to judge the results of therapy or the value of appliances, such as a splint. Measuring speed does not help diagnose the underlying physiological disturbance needing treatment. The use of this measure shows that although many patients regained independence fewer patients recovered the ability to walk normally after a stroke.

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APPENDIX. FUNCTIONAL AMBULATION CATEGORIES

No.	Category	Guidance
0	Non-functional ('Unable')	Patient cannot walk, or requires assistance from more than 1 person
1	Dependent—level 2	Patient requires continuous firm support from 1 person to support weight as well as balance
2	Dependent—level 1	Patient needs continuous or intermittent contact of 1 person to assist balance or co-ordination
3	Dependent—supervision	Patient requires verbal supervision or 'standby' help of 1 person, but no physical contact
4	Independent—level surfaces	Patient can walk independently on level surfaces but needs help for stairs, slopes or uneven surfaces
5	Independent	Patient can walk independently—any surface

Note: This categorisation does not take into account the use of any aids.