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Recovery after stroke—The first 3 months

DERICK T WADE, VICTORINE A WOOD, RICHARD LANGTON HEWER

From the Department of Neurology, Frenchay Hospital, Bristol, UK

SUMMARY Ninety-nine patients had their function recorded regularly over the first 13 weeks after their stroke. Five functional areas were studied: urinary continence, mobility, the ability to dress, feeding, and the ability to transfer from bed to chair. Thirty-two patients died before 13 weeks. Forty-five of the 67 survivors had assessments twice weekly from within 4 days of their stroke. Recovery in these 45 patients occurred fastest in the first 2 weeks, by which time at least 50% of recovery had occurred, but it was still continuing at 13 weeks. Urinary incontinence present between 7 and 10 days after stroke was the most important adverse prognostic factor both for survival and for recovery of function. Age was the second most important factor. Hospital discharge seemed to occur once recovery had stopped, although four of the 49 patients discharged had been fully independent for at least 12 days prior to discharge. It is suggested that rehabilitative therapy should concentrate less on physical function and more on cognitive ability.

Most stroke patients show considerable recovery of function over the first few months,[1-4] although the exact extent and duration of this recovery is less certain. Studies are usually based on infrequent assessments undertaken over the first few months after stroke. Little information is available concerning the details of recovery in the first few weeks after stroke. There is also little information available relating to the patient's status at the time of discharge from hospital, although one study[5] has shown that, not surprisingly, the level of disability is an important factor.

In this study we have investigated the rate and extent of functional recovery in a group of consecutive stroke patients admitted to our hospital. The study was set up to answer the following questions:

1. How much recovery is there over the first 13 weeks after stroke?
2. How fast is that recovery?
3. Does recovery plateau within 13 weeks?
4. What factors are of prognostic importance?
5. What is the relationship between the extent of recovery and discharge from hospital?

Patients and methods

One investigator (VW) visited the medical wards of Frenchay hospital twice a week and compiled a register of all patients admitted with an acute stroke; only patients still alive when the ward was visited were registered with this study, but all those alive were accepted even if they appeared moribund. Each patient was then seen and examined by another investigator (DW), both to confirm that the clinical diagnosis of stroke was correct and to delineate the extent of any neurological deficits. The patient's ability was recorded for five functions: urinary continence, mobility, the ability to transfer from bed to chair, the ability to dress and the ability to feed. The categories used are shown in table 1. It should be stressed that information was recorded on the patient's actual function over the preceding day. Patients were not specifically tested, nor was any account taken of what a

Table 1 *Functions assessed and categories*

Activity	*Categories*
Walking (approx 25 metres)	1 = Totally independent 2 = With aid (for example Zimmer frame) 3 = With 1 person 4 = With 2 people 5 = Unable
Transferring (bed to chair)	1 = Independent 2 = 1 person with patient doing most of the work 3 = 2 people needed with little help from patient 4 = Bedbound or hoist into chair
Dressing	1 = Totally independent 2 = Only needs help with buttons/zips/laces 3 = Can but needs major help 4 = Unable
Feeding	1 = Normal 2 = Can eat food that has been cut up 3 = Can drink on own, but not eat 4 = Unable
Incontinence of Urine	1 = Continent 2 = Occasional incontinence (for example at night 3 = Wet most of the time 4 = Incontinent (catheterised, coma included)

Address for reprint requests: Dr R Langton Hewer, Department of Neurology, Frenchay Hospital, Bristol BS16 1LE, UK.

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patient might have achieved "if he had tried". Information was gathered from the nurses or other caring person as appropriate (rarely from the patient). Each patient's function was recorded twice a week either until the patient died or until 13 weeks after stroke. For patients who had left hospital, information was obtained either from the therapist still seeing the patient, or by telephoning the patient or his spouse. If a patient had been fully normal on all functions for three consecutive assessments, then it was assumed that all further assessments were normal.

Most of the other variables were assessed clinically, and the number who were unassessable (usually because of confusion or coma) is shown. Motor function was measured using two items (sitting balance and ability to sit up) from the Northwick Park assessment schedule,[6] and the "Motricity Index",[7] a recently published scale based upon the MRC grading of muscle strength. The latter considers three movements in each limb, and statistically derived weights give a 0–100 scale for each limb, with 100 representing normality.

Results

Patient characteristics

One hundred and one patients were identified, but two of these were lost to follow-up at five and six weeks, leaving 99 for analysis. Seventy-one patients were seen within three days of their stroke, 11 more were seen before seven days and 14 more before 11 days after stroke, leaving three who were first seen after 10 days. Forty-five patients were first seen within four days of their stroke and survived for 13 weeks, thus having information at all 26 points: these will be called the "*Core Group*". Thirty-two patients died by 13 weeks, many (19) within the first two weeks, leaving 67 survivors (including the 45 Core Group patients).

The important characteristics of the patients, including their initial neurological status, are shown in table 2, which compares those who died with the survivors. It also shows details on the 45 Core Group patients. One patient died before his full clinical examination, which means that only 31 of those who died have complete neurological information. The table confirms that we included a wide spectrum of patients and shows that the more severely affected patients, for example those not assessable, are more likely to die. The low number of left hemiplegic patients amongst the survivors, and the Core Group, is interesting but probably due to chance as the differences are not statistically significant.

Table 2 *Characteristics of patients*

	Died (*n* = 32)	*Survived* (*n* = 67)	*Core group* (*n* = 45)
Age—Mean (range yr)	72·9 (47–93)	68·4 (47–89)	68·7 (47–89)
Female	17	31	23
Side of weakness			
Left	16	26	16
Right	13	36	28
None	1	5	1
Both	2	0	0
Days until first seen (Mean)	3·1	5·2	2·4
	Motor (initial status)		
Sitting Up			
1 = Normal	4	24	14
2 = Minimal assistance	0	11	8
3 = Major help	0	12	7
4 = Unable	9	18	14
5 = Unassessable	18	2	2
Sitting Balance			
1 = Normal	4	32	22
2 = Minimal assistance	0	6	4
3 = Major help	0	10	5
4 = Unable	9	17	12
5 = Unassessable	18	2	2
Motricity Score			
Arm—mean	38·33	50·83	42·11
Leg—mean	39·0	59·31	51·84
Dysarthria			
1 = None	7	25	14
2 = Mild	1	18	14
3 = Moderate	2	8	6
4 = Severe	2	3	1
5 = Unassessable	19	3	10
Aphasia			
1 = None	8	41	24
2 = Mild	0	3	2
3 = Moderate	0	3	2
4 = Severe	4	17	15
5 = Unassessable	19	3	2
	Sensory (initial status)		
Hemianopia			
1 = Normal	3	37	27
2 = Minor disturbance	0	7	5
3 = Visual inattention	2	8	5
4 = Complete Hemianopia	6	9	4
5 = Unassessable	20	6	4
Sensory Inattention			
1 = No	4	42	29
2 = Yes	6	13	7
3 = Unassessable	21	12	9
Subjective Loss			
1 = No	6	28	15
2 = Yes	4	21	17
3 = Unassessable	21	18	13
Proprioceptive Loss			
1 = No	4	37	23
2 = Yes	2	7	5
3 = Unassessable	25	23	17

Rate and extent of recovery

The 45 Core Group patients who had assessments at every point form the basis of the information presented in figures 1–5, which illustrate recovery of mobility, transferring, dressing, feeding and continence. These figures show "*cumulative ability*": for example, patients below the line marked "with one person" in fig 1 are all able to walk at least with the help of one person, although many (those below line "with an aid") only need an aid or are totally independent (if below "alone"), while those above may manage with two people or, if above line "with two people", be totally unable to walk. For each function, recovery is most rapid in the first two weeks, but it continues slowly throughout the 90 days. There is no obvious plateau in recovery. By 3 months 25 (64%) of

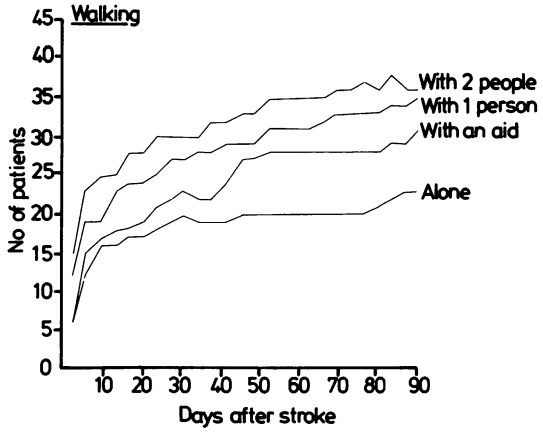

Fig 1 *Graph illustrates cumulative ability—see text.*

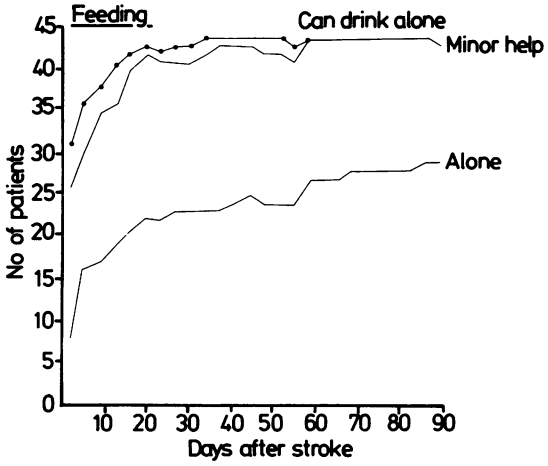

Fig 2 *Graph illustrates cumulative ability—see text.*

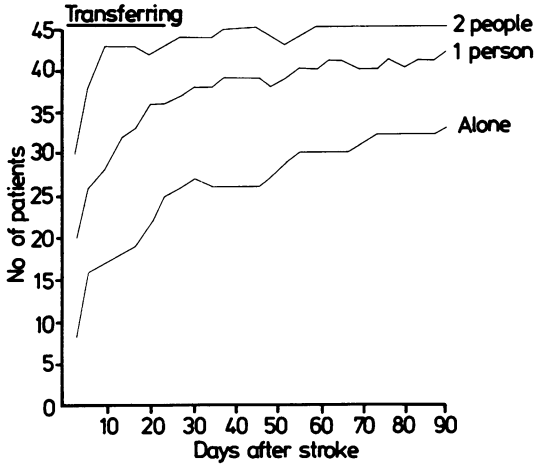

Fig 3 *Graph illustrates cumulative ability—see text.*

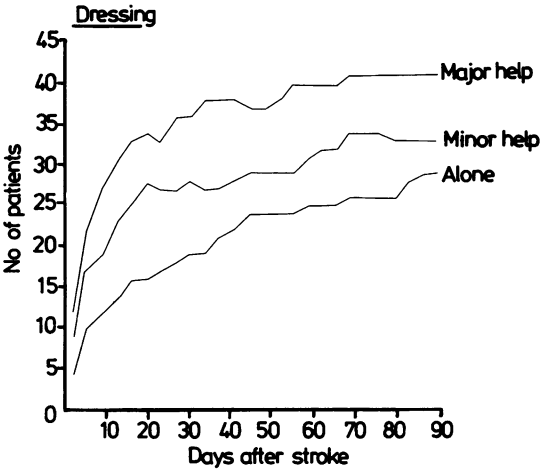

Fig 4 *Graph illustrates cumulative ability—see text.*

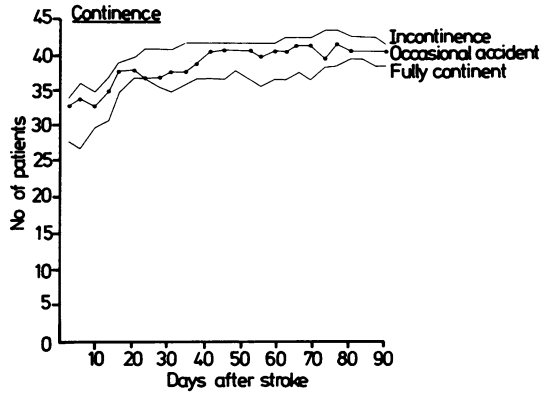

Fig 5 *Graph illustrates cumulative ability—see text.*

39 patients who were initially dependent for walking had regained independence. For dressing, 25 of 41 initially dependent recovered (61%), for feeding 20 of 37 recovered (54%), for incontinence 11 of 17 recovered (65%), and for transferring 25 of 37 recovered (68%).

Further analysis was conducted by considering, on their own, those surviving patients who finally achieved independence in any one activity (for example all those finally able to walk alone or with an aid, including those initially independent). Thus we were able to investigate what proportion had achieved independence at each assessment point after stroke. The results were put on a graph, and the figures shown in table 3 are some examples read off these graphs. This table shows how long it took for 50% and 80% of those finally achieving independence to do so. For

Table 3 *Surviving patients (n = 67)—achievement of independence*

Function	*Continence*	*Feeding*	*Transferring*	*Walking*	*Dressing*
Number indep.	57(85%)	42(63%)	50(75%)	47(70%)	40(60%)
Days until 50% indep.	0	6	9	12	14
Days until 80% indep.	14	32	47	42	42

example, 50% of patients who were independent in walking by 3 months had achieved their independence within 12 days and 80% by 42 days. This table suggests that continence of urine, and the ability to feed independently both recover rapidly, whereas the ability to dress or walk independently recovers more slowly. For independence in transferring from bed to chair, there is a rapid initial recovery (50% in 9 days) but a slower recovery thereafter (80% by 47 days).

Prognosis

The technique of step-wise multiple regression analysis using the Wherry-Doolitle method[8] was used to identify the important independent prognostic factors. The outcome chosen was a summed score of the five functions at the final assessment; this gave a scale of disability ranging from 5 (normal) to 26 (fully dependent). Sixty-three of the 67 survivors were seen on or before the third assessment point at 7–10 days, and data on these 63 patients were used. All the information was coded numerically, using the scales shown in table 1 (for the functional data taken from assessment point 3) and table 2 (for the clinical data collected when the patient was first seen). The computer program was first run considering solely the clinical data (that is only that on table 1). Four variables were selected: sitting balance, age, subjective sensory loss and aphasia. The multiple correlation coefficient (R) was 0·60, and the equation accounted for 36% of the total variance.

Next, all variables were considered, including the five individual functions being monitored. Only three variables were selected: (1) the presence of urinary incontinence at the third assessment point which was between day 7 and 10 after stroke, (2) the age of the patient, and (3) the presence of proprioceptive sensory loss in the thumb. The multiple correlation was 0·80 and it accounted for 64% of the variance, with urinary incontinence accounting for 50% of the variance, age for 13% and proprioception for 1%. The equation derived was:

Summed score (5–26) = 2·36 × Urinary Incontinence + 0·13 × Age − 0·5 × Proprioception − 4·35

Study of the complete intercorrelation table showed that early urinary incontinence had a correlation coefficient of 0·71 with 3 month disability, and that sitting up and sitting balance were the only other "clinical" variables to have correlation coefficients of over 0·4 with the final disability. Most other "clinical" variables had low correlation coefficients with the 3 month disability score—the sensory modalities, including hemianopia, had correlation coefficients of between 0·18 and 0·28 and the motor scores had coefficients of under 0·1, which is very low. On the other hand, the other four functions correlated at about 0·4 with the final disability score.

The importance of urinary incontinence is well demonstrated by considering the fate of those still incontinent 7–10 days after stroke. At the third assessment point, 44 patients were fully continent and 34 had some incontinence. By 13 weeks, three of the 44 continent patients had died whereas 12 of the 34 incontinent patients had died (chi square = 5·3; $p < 0·05$). Table 4 compares the initial (7–10 day) and final functional ability of those surviving from each group. This shows, first, that those who were incontinent were also more dependent in all other functions ($p < 0·05$ for all functions). However, many of the continent group were initially severely disabled but few remained so. The one continent patient unable to walk at 13 weeks had had her second leg amputated

Table 4 *Status of survivors, divided by continence at 7–10 days.*

	At Assessment 3		*At Assessment 26*	
	Continent (n = 41)	*Incontinent (n = 22)*	*Continent (n = 41)*	*Incontinent (n = 22)*
Mobility				
Independent	19	0	29	3
With aid	2	0	11	2
1 Person	3	0	0	6
2 People	5	3	0	1
Unable	12	19	1	10
Transferring				
Independent	24	0	40	8
1 Person	9	4	1	10
2 People	7	15	0	4
Bedbound	1	3	0	0
Dressing				
Independent	16	0	34	5
Minimal help	9	0	5	3
Major help	7	3	2	10
Unable	9	19	0	4
Feeding				
Normal	24	1	36	5
If cut up	14	10	5	15
Drink	1	4	0	0
Unable	2	7	0	2
Continence				
Continent	41	0	41	14
Occasional incont.	0	5	0	3
Wet most of time	0	4	0	1
Incontinent	0	13	0	4

Table 5 *Status of patient pre-discharge (n = 49)*

Walking		*Dressing*	
Independent	26	Independent	30
With an aid	11	Minimal help	14
With 1 person	9	Major help	4
With 2 people	1	Unable	1
Unable	2		
Transferring		*Feeding*	
Independent	41	Normal	34
With 1 person	8	Needs food cut up	15
Continence			
Continent	46		
Occasional accident	3		

during the course of the study, but by 26 weeks she was fully independent, even for walking. Because few of the initially continent patients are finally in the dependent categories, chi square analysis could only compare those dependent in some way against those independent. Each such analysis was highly significant ($p < 0.001$). Only three patients were incontinent before their stroke, although two of these were in the group of 21 incontinent patients who survived.

Hospital discharge

Forty-nine patients were discharged home from hospital within the first 13 weeks, and the functional status of these 49 patients at the assessment immediately preceding their discharge is shown in table 5. Again the importance of urinary incontinence is obvious, as only three patients were incontinent at discharge and then only mildly so (one of these three was continent by the next assessment, the other two remained occasionally incontinent). Ease of transferring and the ability to feed seem to be the next most important factors, whereas more patients were dependent for dressing or mobility. It seems that patients were rarely discharged before they had achieved all the recovery expected, as only five of these patients showed any further recovery after discharge, usually of a minor nature. None showed any deterioration.

There was sometimes a delay between a patient achieving his "predischarge ability" and being discharged. While 24 patients had only just reached their discharge level at the assessment immediately preceding discharge and 12 had reached it the assessment before that, six patients (12%) had been at their discharge level for 7–10 days before leaving, and a further five (10%) for 2 weeks or more. More surprising was the observation that four patients had been fully independent in every activity for at least 12 days before they were finally discharged—one patient had been fully independent for seven assessment points, equivalent to at least 3·5 weeks. Perusal of their notes revealed that one patient developed bronchopneumonia, one patient was kept in four days simply for an echo-cardiogram, while the other two lived alone, with no clear reason for their prolonged stay.

Discussion

This study highlights four aspects of recovery after stroke. First, it confirms the clinical impression that recovery is fastest in the first few weeks after a stroke, but suggests that it can continue beyond the first 3 months. Second, it demonstrates the extreme prognostic importance of urinary incontinence present 7–10 days post-stroke both for survival and for functional recovery. Third, the study suggests that discharge from hospital coincides with a slowing or stopping of recovery. Last, our study suggests that there may be some patients who remain in hospital for longer than their physical disability warrants. Before discussing the findings in any more detail, it is important to consider the methodology of the study, and the selection of patients.

The study deliberately included each and every patient admitted with a stroke, only excluding those who had been admitted and died in the intervals between visits to the wards (maximum delay = 4 days). The intention was to include both the mildly and the severely disabled. The early high death rate indicates that we have included many severely affected patients. Similarly, the study has included patients of a wide age range (47–93 yr). The preponderance of patients with right sided weakness is probably coincidence.

The means of ascertaining a patient's ability are obviously open to some criticism. It could be suggested that each patient should have been tested on each occasion. Apart from the obvious difficulty of "testing" for incontinence, it would have been impractical to test each patient on every occasion. The commonest sources of information were the ward sisters or staff nurses. Although we have not conducted any estimate of the reliability of our data, there were very few instances of patients fluctuating from one category to another over time which suggests that different observers gave consistent answers.

It is also possible that a patient's function was influenced by the expectations of the ward staff. For example, some patients may have been deliberately restricted for "medical reasons", leading to an appearance that function was less good than it might have been. In fact, patients are usually mobilised as soon as possible in this hospital, making it unlikely that initial disability was much exaggerated. It might be argued that a patient improves his function in order to conform to the expectation of the ward staff. There is no evidence to suggest that recovery can, in fact, be influenced by such a mechanism.

This method of collecting data has two advantages. First, its simplicity makes it possible to have relatively complete information on a wide range of patients. Second, we were interested in a patient's actual functioning rather than his potential, and this method concentrates upon observed function. It needs to be stressed again that we were measuring functional recovery, which must include a large element of adaptation by the patient to his disability and this does not necessarily reflect neuronal recovery.

Two other limitations need to be stressed. First, the quantification of function was relatively crude and could not detect change at the upper range of ability. Recovery might well have continued undetected once the patient was fully independent. The second factor to be remembered is that the results refer to the performance of a group of patients, not to individual patients. In other words, in a group of patients most recovery is seen early but it does not necessarily follow that individual patients will follow this average pattern. This explains one apparent anomaly in the results, namely that recovery continues throughout the 13 weeks yet the 49 patients who left hospital showed little or no further recovery after discharge. The explanation is that the 18 patients left in hospital continued to improve, thus influencing the overall functional level of the whole group. Follow-up was terminated at 13 weeks so we do not know when the last 18 patients stopped recovering.

The speed of recovery found in this study is similar to that recorded in other smaller studies. Newman[1] followed 39 patients over 20 weeks, and noted that 80% of recovery was complete by 6 weeks, with little recovery occurring during 12 weeks after stroke. In another study[2] on 31 patients, there was no statistically detectable recovery after 8 weeks, and a third study[3] noted that 72% of those still disabled at two weeks had made their maximum recovery by 8 weeks. Our study does not detemine when recovery finishes, because no assessments were carried out after 13 weeks.

One interesting finding is the relative unimportance of neurological loss, particularly motor loss, from a prognostic point of view. Rather it is a "general feature", incontinence, which divides those who do well from those who do badly. Most of the other variables have a low correlation with functional outcome. Early incontinence has previously been identified as an important prognostic indicator of functional ability at 6 months.[9] Other studies[10 11] have also found incontinence to be associated with poor functional recovery, one of these[10] suggesting that it was through a close association with motor deficit. In our study, incontinence was relatively highly correlated ($r = +0{\cdot}54$) with the major prognostic neurological variable identified, sitting balance, but not with limb function ($r < 0{\cdot}1$). The only other variable of prognostic importance was age. Again, age has previously been found to be of importance in predictive equations[9].

Other variables, including the degree of weakness in the limbs, are not of prognostic importance, which leads to a speculative conclusion that perhaps the whole direction of therapy after stroke is misdirected. At present physical therapy largely aims at improving motor function. Incontinence is rarely the direct consequence of specific brain damage after stroke, and it is at least possible that incontinence is usually secondary to poor cognitive function. If this is so, then it could be argued that therapy should be aimed at improving this, rather than the (associated) poor motor function. In support of this argument, there is a little evidence that general cognitive stimulation, such as training patients to perform better on a specific psychological test (Block Design), does generalise to improve other functional abilities.[12 13] Certainly, incontinence is more than just a marker of motor loss, because there was only a low correlation (0·21 at most) between incontinence and limb motor power.

The second interesting finding from this study relates to hospital discharge. Few patients improved after discharge, which could have two interpretations. First, being in hospital may promote recovery, and discharge may prevent continuation of recovery. This seems inherently unlikely, especially since patients usually continued to have therapy as out-patients if necessary. Second, the patients may not be discharged until recovery has stopped. This seems more likely.

While it is reasonable to keep a patient in hospital until he is able to manage at home, it must be asked whether they need to stay until all recovery has stopped. For example, it seems unnecessary to keep patients in for 12 days or more after achieving complete independence, not even needing a walking stick, yet this happened in 8% of cases. We have recently found (in preparation) that stroke patients occupy 20% of general medical beds within this hospital. As a CT scan can be arranged within 24 hours, the long stay is not needed for diagnostic or therapeutic reasons. A general medical bed cost £67 per day at the time of this study, and the hospital is often very short of acute medical beds. It seems possible that we are keeping patients in hospital too long and that more could be discharged sooner, to continue recovery at home.

References

[1] Newman M. The process of recovery after stroke. *Stroke* 1972;3:702–710.

[2] Kinsella G, Ford B. Acute recovery patterns in stroke

patients. *Med J Aust* 1980;**2**:663–6.
[3] Andrews K, Brocklehurst JC, Richards B, Laycock PJ. The rate of recovery after stroke—and its measurement. *Int Rehab Med* 1981;**3**:155–61.
[4] Skilbeck CE, Wade DT, Langton Hewer R, Wood VA. Recovery after stroke. *J Neurol Neurosurg Psychiatry* 1983;**46**:5–8.
[5] Granger CV, Sherwood CC, Greer DS. Functional status measures in a comprehensive stroke care program. *Arch Phys Med Rehabil* 1977;**58**:555–61.
[6] Sheikh K, Smith DS, Meade TW, Brennan PJ, Ide L. Assessment of motor function in studies of chronic disability. *Rheumatol Rehabil* 1980;**19**:83–90.
[7] Demeurisse G, Demol O, Robaye E. Motor evaluation in vascular hemiplegia. *Eur Neurol* 1980;**19**:382–89.
[8] Garrett HE. *Statistics in Psychology and Education*. Ch 16 *London:* Longmans 1958.
[9] Wade DT, Skilbeck CE, Langton Hewer R. Predicting Barthel ADL score at 6 months after an acute stroke. *Arch Phys Med Rehabil* 1983;**64**:24–28.
[10] Jimenez J, Morgan PP. Predicting improvement in stroke patients referred for inpatient rehabilitation. *Can Med Assoc J* 1979;**121**:1481–4.
[11] Bourestomm NC. Predictors of long-term recovery in cerebrovascular disease. *Arch Phys Med Rehabil* 1967;**48**:415–19.
[12] Young GC, Collins D, Hren M. Effect of pairing scanning training with Block Design Training in the Remediation of Perceptual Problems in Left Hemiplegics. *J Clin Neuropsychol* 1983;**5**:201–12.
[13] Diller L, Ben-Yishay Y, Gerstman LJ, Goodkin R, Gordon W, Weinberg J. *Studies in Cognition and Rehabilitation in Hemiplegia. Rehabilitation Monograph No. 50*. New York. New York University Medical Center 1974.