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Recovery From Hip Fracture in Eight Areas of Function

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Background. This report describes changes in eight areas of functioning after a hip fracture, identifies the point at which maximal levels of recovery are reached in each area, and evaluates the sequence of recuperation across multiple functional domains.

Methods. Community-residing hip fracture patients ($n = 674$) admitted to eight hospitals in Baltimore, Maryland, 1990–1991, were followed prospectively for 2 years from the time of hospitalization. Eight areas of function (i.e., upper and lower extremity physical and instrumental activities of daily living; gait and balance; social, cognitive, and affective function) were measured by personal interview and direct observation during hospitalization at 2, 6, 12, 18, and 24 months. Levels of recovery are described in each area, and time to reach maximal recovery was estimated using Generalized Estimating Equations and longitudinal data.

Results. Most areas of functioning showed progressive lessening of dependence over the first postfracture year, with different levels of recovery and time to maximum levels observed for each area. New dependency in physical and instrumental tasks for those not requiring equipment or human assistance prefracture ranged from as low as 20.3% for putting on pants to as high as 89.9% for climbing five stairs. Recuperation times were specific to area of function, ranging from approximately 4 months for depressive symptoms (3.9 months), upper extremity function (4.3 months), and cognition (4.4 months) to almost a year for lower extremity function (11.2 months).

Conclusions. Functional disability following hip fracture is significant, patterns of recovery differ by area of function, and there appears to be an orderly sequence by which areas of function reach their maximal levels.

MORE than 300,000 persons over age 65 will fracture a hip in the United States during the coming year (1) at an estimated annual cost of over $5 billion (2–4); by 2040, over 650,000 hip fractures will occur annually in this group (5). Between 18%–33% of older hip fracture patients die within 1 year of their fracture, depending upon the specific population studied (6–19). Most surviving hip fracture patients experience reduced mobility and lose their ability to function independently. As many as 45% of those who are community dwelling at the time of their fracture are discharged to institutions after hospitalization, and 15%–25% remain institutionalized for a year postfracture (20). Depending upon the population studied and function being assessed, an estimated 25%–75% of those who are independent before their fracture can neither walk independently nor achieve their previous level of independent living within 1 year following their fracture (6,20–23).

Research on the functional sequelae of hip fracture has been limited by several factors. Hip fractures may affect many different areas of functioning, including mobility, physical and instrumental task performance, cognition, affect and social functioning; all are important aspects of the quality of life. Most previous studies of the functional sequelae of hip fracture have concentrated on mobility and physical and instrument functioning (20,21,24–30); few have considered affective (22,23, 31–33) and social function (19,22,32,34,35). Information contrasting patterns of recovery in different functional domains is lacking due to the limited number of domains examined in any single study. With few exceptions (19,27,30), most studies of postfracture functioning do not follow patients for more than 1 year. Although it appears that maximal recovery in the functions evaluated to date occurs by 6 months following the fracture (20–22), there is evidence to indicate that recovery continues to at least 1 year in some physical and instrumental functions (21,22) and beyond that in physical activities of daily living (36). Additional evidence indicates that a subgroup of patients who recover by 6 months subsequently decline (20,37). Previous studies are limited in other ways as well. With few exceptions (20,23,34,37), previous studies included patients admitted to a single hospital, thereby limiting generalizability; previous studies also relied on self- and proxy reports of functioning and not on measures of performance.

The present study reports on the sequelae of hip fracture in eight areas of functioning using data obtained from community-dwelling hip fracture patients entering eight Baltimore area hospitals, 1990–1991, and followed prospectively for up to 2 years. The objectives of this report are to describe changes in different aspects of functioning following a hip fracture, identify the point at which maximal levels of functioning are reached in each area, and evaluate the sequence of recuperation across multiple functional domains.

Methods

Subjects and Data Collection

Subjects are part of the Baltimore Hip Studies, a program of research prospectively investigating recovery from hip fracture. Subjects for this study were 804 patients aged 65 years and older, who were admitted from the community to one of eight Baltimore area hospitals with an acute hip fracture (ICD9 code 820) between January 1, 1990, and June 15, 1991. The eight study hospitals treated approximately two thirds of all hip fracture patients aged 65 and older admitted to Baltimore area hospitals. They included teaching and nonteaching sites, and sites with and without inpatient rehabilitation units. Hip fracture discharges from these hospitals were similar to hip fracture discharges from other metropolitan area hospitals in age, gender, race, and source of admission (home vs nursing home) (38). Patients presenting with pathological fractures or residing in a nursing home, hospital, or extended care facility at the time of fracture were excluded from this study. Twice each week, project staff contacted hospital liaisons who monitored admitting records and operating room logs to identify eligible patients. Names and eligibility were verified through review of medical records by study staff.

Study personnel trained in medical record abstracting, interviewing, and evaluation of neuromuscular performance obtained information on demographic and medical characteristics of patients from medical records in each of the study hospitals, and then invited patients to enroll in the prospective study. After obtaining informed consent, interviews were conducted during the hospital stay and again at 2, 6, 12, 18, and 24 months postfracture. Interviews were conducted directly with all patients who were able to provide information for themselves [Mini-Mental State Examination (MMSE) score >16] (39); for those unable to provide information, a proxy was interviewed. In most cases, the proxy was a spouse or caregiver of the patient. Previous studies indicate that proxies can provide reliable estimates for areas of function evaluated in this study (40–42). Interviews were conducted during the hospital stay to obtain information about demographic characteristics and prefracture medical and functional status; cognitive and affective status were evaluated postsurgery. Information about comorbidity and surgical procedure were obtained through medical chart review. Follow-up evaluations were conducted in the patient's place of residence (i.e., home, nursing home, extended care facility) and consisted of interviews about medical and functional status, as well as observation of neuromuscular function.

Of the 804 patients identified at the time of their hospitalization, 674 (83.8%) agreed to provide information during the hospital stay and to be followed prospectively. A comparison of the 674 patients enrolling in the follow-up study with the 130 patients identified but not enrolled revealed that those enrolled were less likely to have had subcapital fractures (45.7% vs 57.4%, $p < .05$) and arthroplasty surgery (36.4% vs 37.5%, $p < .05$). No statistically significant differences ($p < .05$) were detected between the groups on age, gender or race, or comorbidity as measured by the presence of 19 conditions. Of the 674 enrolled patients, 531 (84.3% of 2-month survivors) were interviewed at 2 months, 490 (83.6% of 6-month survivors) at 6 months, 461 (82.5% of 12-month survivors) at 12 months, 405 (74.6% of 18-month survivors) at 18 months, and 389 (74.2% of 24-month survivors) at 24 months.

Measures

Physical activities of daily living (PADLs).— PADLs were assessed using questions structured like those on the Functional Status Index (43). Information about 15 tasks was obtained to determine whether patients used no assistance, equipment or human assistance, or if they did not perform the task for health or other reasons during the past week. The compilation of 15 items represents activities requiring specific lower and upper extremity functions. These were divided into two groups: lower extremity physical activities of daily living (LPADLs) and upper extremity physical activites of daily living (UPADLs). LPADLs were measured as a count of the number of activities requiring lower extremity function in which the person was dependent (i.e., used either human or equipment assistance or both, or did not perform the activity due to health problems). The 11 lower extremity activities included were as follows: walking 10 feet; walking 1 block; climbing 5 stairs; getting into a car; getting in or out of bed; rising from an armless chair; putting on pants; putting socks and shoes on both feet; getting in or out of a bath or shower; taking a bath, shower, or sponge bath; and getting on or off the toilet. The LPADL scale ranges from 0 to 11, with higher scores representing greater dependency. In a like manner, disability in UPADLs was measured. The four activities included were putting on a shirt or blouse, buttoning a shirt or blouse, feeding self after food is readied, and grooming (brushing hair, teeth). The UPADL scale ranges from 0 to 4, with higher scores representing greater disability.

Instrumental activities of daily living (IADLs).—Information on IADLs was obtained using a modified version of the Older Americans Resources and Services Instrument, or OARS (44), which asks about performance of seven tasks of daily living during the preceding 2 weeks. IADLs were measured as a count of the number of activities in which the person was dependent, (i.e., required human assistance or was completely unable to perform). The seven activities included were as follows: using the telephone, getting to places out of walking distance, shopping for groceries or clothes, preparing meals, housecleaning, handling money, and taking medications. The scale ranges from 0 to 7, with higher scores representing greater disability.

Neuromuscular function.—Neuromuscular function was represented by summary measures of gait and balance, based on observations of performance of a series of neuromuscular tasks in the patient's place of residence (30,45). In addition, walking speed and time to rise from a chair were examined separately. If patients were not contacted directly or could not perform tasks, no score was obtained.

1. Gait and balance summary scores. A portable neuromuscular function assessment was used to determine how steady or unsteady the patient was while performing the following tasks: sitting down, rising from an armless chair, immediate standing balance, balance while seated, standing balance (eyes open and closed), and one-leg standing balance. Patients also were observed, timed, and graded as they walked a 3-meter course at their normal walking pace. A full description of the instrument, its reproducibility, and predictive validity are provided elsewhere (30,45). Using a similar convention to the one developed by Tinetti (46), each balance and gait task was categorized such that a zero score on each task represented instability or abnormal completion of the task. These individual tasks were then summarized, and an 11-item balance score (range, 0–17) and 8-item gait score (range, 0–11) were computed. Higher scores indicated better performance on both of these measures.
2. Walking speed. The time needed to walk up to 3 meters at normal speed was measured and divided by the distance walked to compute a walking speed (m/s). This was then categorized using quartiles derived from published sources (47) for normal elderly persons. In addition, 1 point was added to the final score for patients able to perform without needing assistance (from a cane, walker, etc.). The scale ranges from 0 to 5, with higher scores representing better walking speed.
3. Chair rise speed. The time to completely rise from an armless chair was measured in seconds and categorized using quartiles derived from unpublished sources (The Study of Osteoporotic Fractures; Principal Investigator: S.R. Cummings; Study Sites: Baltimore; Pittsburgh; Portland; and Minneapolis) for normal elderly persons who had not fractured a hip. In addition, 1 point was added to the final score for patients able to rise without using their arms. The scale ranges from 0 to 5, with higher scores representing faster rising.

Social functioning.—Social functioning was measured by report of the number of social activities the patient participated in during the 2 weeks prior to interview. The items selected derive from a measure of social functioning developed by House (48) and included the following: going to movies, concerts, plays, or sporting events; going to fairs, museums, or exhibits; attending meetings, appointments, classes, or lectures; going to church or temple services; going on pleasure drives or picnics; playing cards, bingo, and so forth with other people; going to family's or friends' homes for a meal; participating in active sports or swimming; working in the garden or yard, or at a hobby; and doing community or volunteer work. The scale ranges from 0 upwards, with higher scores indicating greater frequency of social contact.

Cognitive functioning.—Cognitive functioning was assessed using the MMSE (39). This instrument assesses orientation, registration, recall, attention, calculation, and language. Scores range from 0 to 30, with higher scores representing better cognitive status. Scores below 17 indicate severe cognitive impairment; scores between 17 and 24 indicate mild cognitive impairment. To include patients whose mental status could not be evaluated with the MMSE during their hospital stay, cognitive impairment during the acute hospitalization was also considered present if there was a history of dementia or postsurgical confusion.

Affective functioning.—Depressive symptoms were measured using the Center for Epidemiological Studies–Depression (CES-D) Scale (49), which consists of items that describe behaviors and feelings, such as feeling fearful, lonely, and sad. Patients were asked how often within the past week they behaved or felt this way (rarely, sometimes, occasionally, most of the time). This scale ranges from 0 to 60, with higher scores indicating more depressive symptomatology. Patients with scores greater than 16 were considered to have depressive symptomatology.

Analysis

To identify the point at which the maximal level of recuperation had occurred for each aspect of function, longitudinal data were analyzed using the system of Generalized Estimating Equations (GEEs) developed by Liang and Zeger (50). The fixed effect of time was modeled as $\text{Ln}(Y) = a + b(1/t)$, where Ln (Y) is the natural logarithm of the given outcome variable (or the odds of that outcome for dichotomous variables), and t is time measured in months. This model enabled the use of a straight line equation in which the intercept was indicative of the eventual recuperation level. The recuperation described by the equation is an exponential curve that approaches the recuperation level asymptotically with increasing time. To test the adequacy of the GEE modeling strategy, the observed proportions of dependent patients and the proportions predicted by the GEE modeling were compared. This model fit the actual recuperation trajectory very well (see Figure 1). Because the recuperation level predicted by the curve could not (theoretically) be reached in a finite time span, the estimated recuperation time was defined as occurring at that point in time where the instantaneous slope of the curve became less than 1% of 1 standard deviation of the outcome measure. The estimated recuperation level was determined as the antilog of the intercept. In fitting the GEE models, an identity link function was used for continuous variables and a logit link function for dichotomous dependent variables; an exchangeable covariance matrix was specified in both.

Results

Characteristics of the study sample can be found in Table 1. The participants averaged 81.1 years old and were 77.4% women and 92.6% white. The presence of 19 comorbid conditions prior to hip fracture was indicated; patients averaged 2.81 of these conditions at the time of hip fracture. Approximately half of the patients sustained intertrochanteric fractures (54.4%) and half had intracapsular fractures (45.6%). Most fractures were repaired by internal fixation (62.8%); the remainder were repaired by hemiarthroplasty (34.7%) or total hip replacement (1.2%). Patients were discharged to

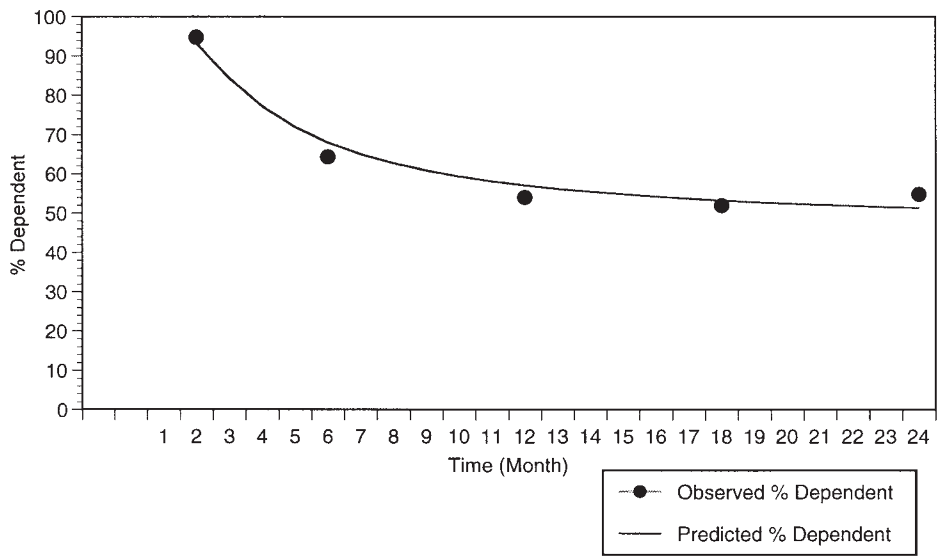

Figure 1. Observed and predicted dependency in walking 10 feet following hip fracture.

the community (32.6%), nursing home (31.4%), or inpatient rehabilitation center (36.0%) for postacute rehabilitative care. One-year mortality amounted to 16.8% and a total of 25.3% mortality was observed by 2 years postfracture.

Patterns of Recovery

Patterns of recovery in eight areas of functioning through 2 years are shown graphically in Figure 2. Compared with levels of dependence during hospitalization or at 2 months, most areas showed progressive lessening of dependence within the first year postfracture. Relative to the prefracture level, LPADL demonstrated a net change that represents dependence in three more tasks requiring lower extremity function at 1 year postfracture. This new dependency did not disappear during the 2-year follow-up. UPADL and IADL showed smaller degrees of additional dependence. Recovery in gait and balance appeared to be concentrated in the first 6 months, with little gain observed after 6 months, but recovery in social functioning was complete and appeared to exceed prefracture levels after 1 year postfracture.

Not all patients were able to have their cognitive status tested with the MMSE during the hospital stay because of the presence of dementia, confusion, or other medical factors. Counting history of dementia, postsurgical confusion, or an MMSE score of less than 24 as evidence of cognitive impairment, it was observed that 42.3% (285) of 674 enrolled patients were cognitively impaired during their hospital stay. Of the 405 patients who were testable via MMSE at the 2-month follow-up, 46.1% of those impaired during their hospital stay scored in the cognitively intact range on the MMSE (24–30) at follow-up, indicating that almost half of the patients who were impaired in hospital and then tested at 2 months showed no evidence of cognitive impairment at the later time. Clinically significant levels of depressive symptoms as evidenced by CES-D scores of 17 or higher affected 45.7% of patients tested during hospitalization, but the proportion with symptoms declined to about one fourth (24.6%) by 1 year. By 2 months postfracture, 44% of those with symptoms during their hospitalization still experienced depressive symptoms.

Postfracture Dependency Levels

The degree of prefracture and subsequent disability in specific physical and instrumental ADLs is summarized in Table 2. Prefracture disability levels ranged from as low as 11.8% (putting on pants) to as high as 64.9% (doing housework). New dependency at 12 months postfracture, for those who required no assistance prefracture, ranged from as low as 20.3% for putting on pants to as high as 89.9% for the task of climbing 5 stairs. Similar levels of new impairment were observed among survivors at 24 months. Greater than 50% of previously nondependent patients were dependent in 5 of 11 lower extremity tasks and 2 of 7 instrumental tasks 1 year after the fracture.

The Sequence of Recuperation

Evaluation of time to recuperation for each area of functioning entailed using longitudinal analysis techniques to estimate the point in time at which additional recovery could not be detected. Figure 1 shows the recuperation trajectory for the walking 10 feet task. Most recovery of function in this fundamental task of daily living occurred by approximately 1 year, although more than half of the patients were still dependent (used equipment or human assistance or did not perform for health reasons).

Figure 3 shows postfracture recuperation times for separate areas of functioning as generated by the longitudinal analyses using GEE modeling, displayed in the order in which recovery occurs. Summary measures (scales) are presented separately from individual items that are components of those summary scales. Recuperation times were specific to area of functioning, ranging from approximately 4 months for depressive symptoms (3.9 months), UPADLs

Table 1. Characteristics of Hip Fracture Patients Entering Eight Hospitals, Baltimore, Maryland, 1990–1991 ($n = 674$ recruited patients)

	n	Percent
Age		
65–74 y	135	20.0
75–84 y	302	44.8
85+ y	237	35.2
Mean (*SD*) y	81.1 (7.4)	
Women	522	77.4
Caucasian	624	92.6
Comorbidities/conditions on admission		
Mean (*SD*) (of 19 conditions)	2.89 (1.85)	
Anemia	88	13.1
Arthritis	204	30.3
Cancer	95	14.1
COPD/emphysema/asthma/bronchitis	120	17.8
Deep venous thrombosis	11	1.6
Dementia	104	15.4
Diabetes	80	11.9
Dizziness/balance problems	63	9.3
Gastrointestinal disorder and ulcers	194	28.8
Heart diseases		
Angina	80	11.9
Arrythmias	153	22.7
Congestive heart failure	91	13.5
Myocardial infarction	79	11.7
Hip fracture (previous)	58	8.6
Hypertension	306	45.4
Parkinson's disease	28	4.2
Peripheral vascular disease	45	6.7
Stroke	72	10.7
Transient ischemic attack	31	4.6
Fracture type		
Intertrochanteric	363	54.4
Intracapsular	304	45.6
Surgical procedure		
Internal fixation	423	62.8
Unipolar hemiarthroplasty	69	10.2
Bipolar hemiarthroplasty	165	24.5
Total arthroplasty	8	1.2
None	9	1.3
Mortality		
12 m	112	16.8
24 m	169	25.3

Note: COPD = chronic obstructive pulmonary disease.

(4.3 months), and cognitive status (4.4 months) to almost 1 year for performance of LPADLs (11.2 months). Considering individual tasks, recuperation times ranged from approximately 10 months for the two neuromuscular performance tasks, chair rise speed (9.9 months) and walking speed (10.8 months), to slightly over 14 months for the ability to walk 10 feet without assistance (14.1 months).

Discussion

This descriptive study of changes in functional status following hip fracture demonstrates that the degree and timing of recovery vary by functional domain, and that there is a logical pattern to the recuperation process. Regardless of domain, however, levels of functioning were lowest at the 2-month measurement, with notable improvement in most functions between 2 and 6 months postfracture, and continued improvement beyond 6 months in functions requiring lower extremities. For those functional areas where information about prefracture status was available (lower and upper extremity ADLs, IADLs, social function), postfracture status remained below prefracture levels for up to 2 years, with the exception of social function, where levels continue to increase and appear to exceed prefracture levels by 12 months postfracture.

The extent of new disability in ADLs also is task specific. Among those not relying on other people or equipment for assistance in physical activities involving lower extremities prior to their fracture, between 20% and 90% required this type of assistance (or did not perform the task due to their health) for as much as 1 year postfracture, depending on the task evaluated. Similarly, between 22% and 62% of patients experienced new postfracture dependency in instrumental tasks using this definition. Previous studies, although limited in some important ways (i.e., small samples of patients, admissions to a small number of hospitals, evaluation of a limited number of functional areas, relatively short follow-up periods), also reported increased levels of disability in physical and instrumental (20,21,24–30), cognitive, and affective (22,23,31–33) areas of function, and similar (although not identical) patterns of recovery following a fracture (20–22, 31,33). With the exception of previous reports from this cohort (30,45,51,52), we are not aware of other studies that have evaluated gait and balance with performance-based measures, which provide additional information about the recovery process.

The Recovery Process

Study data suggest a sequence by which functional areas recover, with affective function, cognition, balance, and gait reaching their maximal levels before social, instrumental, and lower extremity physical function. This pattern parallels the process of functional decline described by the World Health Organization's International Classification of Impairments, Disability, and Handicaps, or ICIDH (53,54), and elaborated by Nagi (55) and by Verbrugge and Jette (56), who refer to the process of decline as the disablement process. Using the terminology of functional limitations and disability described by Nagi and by Verbrugge and Jette, these models of loss articulate a process of decline, which begins with an underlying pathology or disease that produces impairment characterized by dysfunction and structural abnormalities in specific body systems. Impairment then leads to functional limitations or restrictions in basic physical and mental actions that ultimately result in disability or inability to perform activities of daily life (see Figure 4A).

The recovery sequence following a hip fracture observed in the present study suggests a process of repair and recuperation that parallels that of loss and disablement (see Figure 4B). Accordingly, a hip fracture, which results from osteoporosis, other chronic conditions, and falls (57), signifies the beginning point of this new process, with the impairment resulting from these pathologies being the hip fracture itself. Appropriate surgical and medical management of the fracture are critical in promoting subsequent recovery (58,59). Data from the present study describe recovery fol-

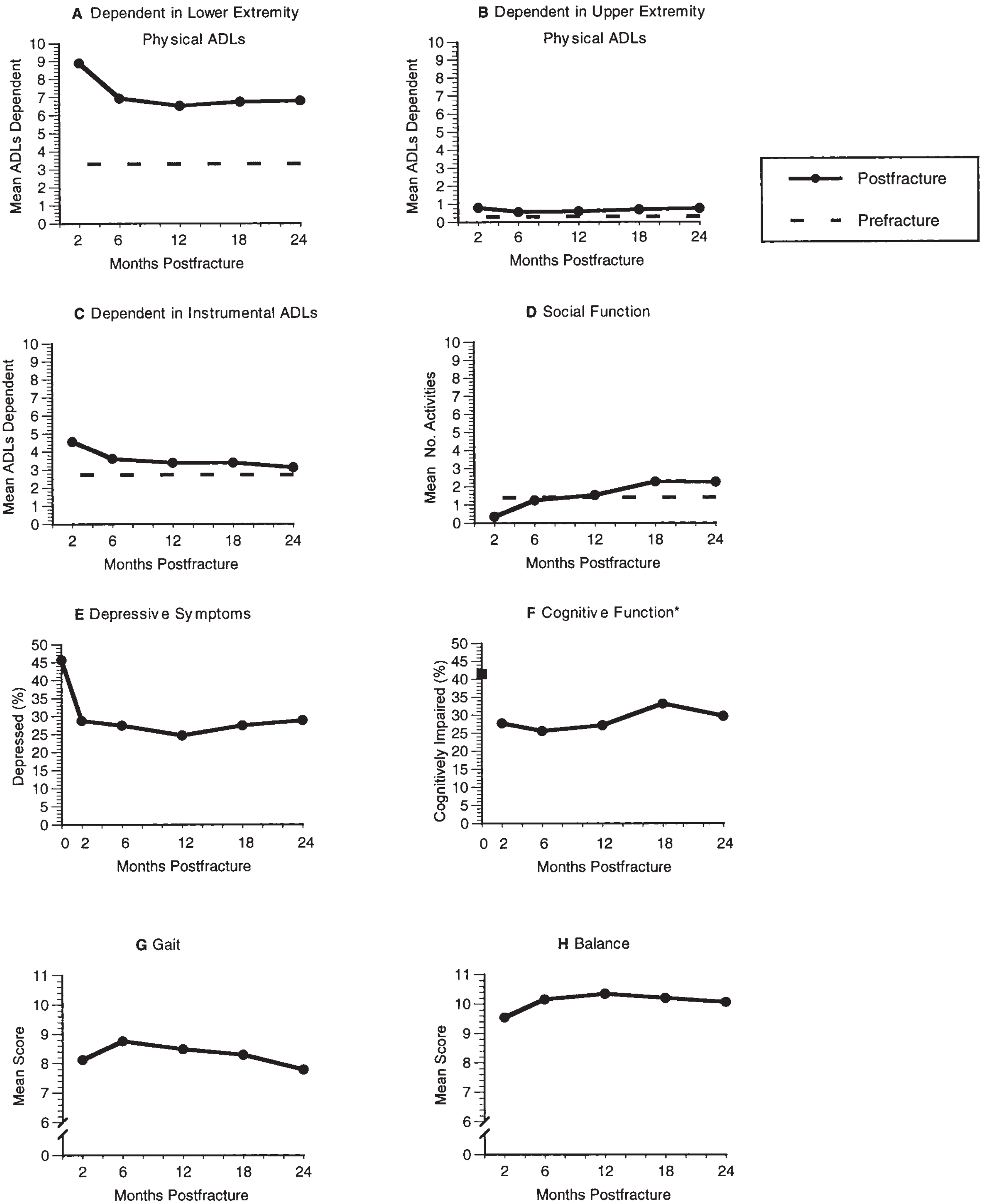

Figure 2. Patterns of change in eight areas of functioning over a 2-year period following hip fracture, **A–H**. ADLs = activities of daily living. *Cognitive impairment during hospital stay indicated by history of dementia, postsurgical confusion, or Mini-Mental State Examination score <24.

Table 2. Prefracture Dependency† in Lower Extremity Physical and Instrumental Activities of Daily Living and Postfracture Dependency at 12 and 24 Months Among Patients Who Were Independent Prefracture, Baltimore, Maryland, 1990–1991

		Dependent Postfracture Among Those Independent Prefracture (%)‡	
	Dependent Prefracture (%)	12 Mo	24 Mo
Lower extremity physical activity of daily living			
Climbing 5 stairs	55.6	89.9	90.5
Getting in/out of bath/shower	48.3	82.8	83.3
Walking 1 block	42.4	55.2	52.5
Getting into a car	38.1	44.9	50.2
Rising from an armless chair	35.5	50.2	54.4
Walking 10 feet	30.4	39.6	37.2
Taking a shower/bath/sponge bath	28.5	38.3	43.7
Getting on/off the toilet	21.8	66.2	63.3
Putting socks and shoes on	15.1	32.9	33.2
Getting in/out of bath	14.6	31.0	33.4
Putting on pants	11.8	20.3	20.4
Instrumental activities of daily living			
Housecleaning	64.9	61.8	43.1
Getting places out of walking distance	63.4	53.3	52.6
Shopping	59.4	42.3	41.0
Cooking	40.3	23.6	23.0
Handling money	36.0	31.1	30.6
Taking medications	24.3	28.4	29.0
Using the telephone	17.1	21.7	22.5

†Dependency is defined as the use of human equipment assistance or nonperformance due to health.
‡Restricted to survivors at 12 or 24 months who were independent prefracture.

lowing these surgical and acute medical interventions. Limitations characterized by poor cognition and depression are the first functions to recover. Next to recover are deficits related to performance of mobility tasks. Recovery in disabilities, such as social functions, LPADLs, and IADLs, reach their peaks last in this sequence. Looking more closely at the recovery sequence in mobility tasks, a similar pattern is observed. Recovery in chair rising speed (which entails strength) precedes recovery in walking speed; both of these "functional limitations" plateau before the ability to walk independently reaches its peak. This recuperation sequence in mobility parallels the sequence of loss reported by Jette and coworkers in which joint and muscle impairment were predictive of the development of physical disability (60).

This recovery process may be superimposed on disabling processes already progressing at the time of the fracture, which may explain why a secondary loss occurs in some areas of functioning after reaching their peak (e.g., LPADLs), an observation that also can be made from information presented elsewhere (20,22). Consistent with this, one recent report provides evidence of continued mortality in some hip fracture patients up until 4 years postfracture (61). Here, it is possible that the fracture alters other disabling processes in a way that has a detrimental outcome several years after recuperation from the fracture itself has peaked. Further study is needed to chart these and other losses and to develop strategies for understanding the role of hip fracture in the larger disablement process.

Social function appears to recover to a level beyond that of prefracture, and IADLs have additional improvement beyond 18 months (see Figure 2C and D). Social function may increase as patients engage in different (and possibly more restrictive) social activities as substitutes for activities they engaged in before their fracture. Social function also may increase as a result of family and friends initiating more contact and caregiving activities, which is consistent with results from other studies showing that acute illness and hospitalization lead to mobilization of social and emotional support for many patients (35,62). The late improvement in IADLs is consistent with some longitudinal observations of IADLs in which IADL function improves in some subjects, most notably in those who are at the highest levels initially (63,64). Following a hip fracture, this apparent improvement may reflect willingness on the part of patients to carry out tasks more independently and recognition by caregivers that this is possible. It also is possible that the healthiest individuals have survived to 18 months, and this is the group that continues to improve.

The design of the present study provides new opportunities to examine the recovery process in greater detail. Multiple areas of function were examined simultaneously in the same cohort of patients so that function-specific patterns could be evaluated; patients were followed for 2 years, which permitted evaluation of most recovery and identification of an initial recovery plateau for each functional area, and a new method for modeling the plateau and recovery level was applied. In addition, sequential admissions to eight facilities were followed, which improves generalizability over studies of patient series in a single hospital.

Among the study's limitations are that subjects came from only eight Baltimore hospitals. Although demographi-

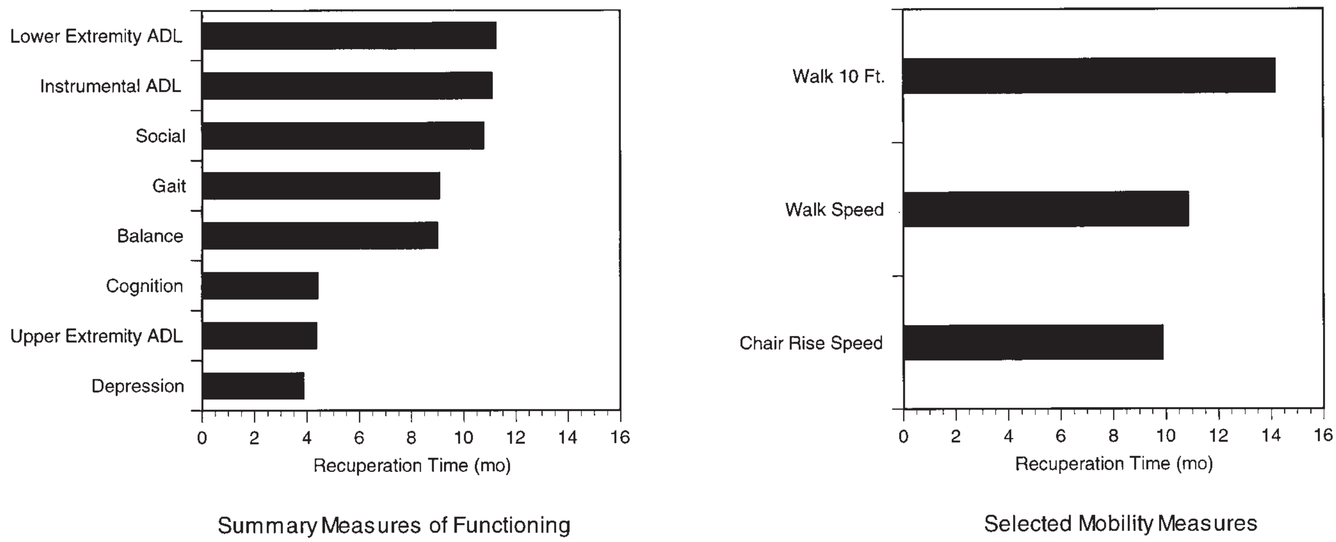

Figure 3. Time until recuperation following hip fracture in eight areas of function and three measures of mobility. ADL = activity of daily living.

cally similar to hip fracture patients treated in other hospitals (38), caution is required when generalizing beyond this group. Second, the least healthy patients dropped out earlier, and although the analytic methods account for missing information, the potential for bias from healthier survivors needs to be considered. Last, lack of a comparison group restricts the ability to determine how much of the loss in function is attributable to the hip fracture and how much other disabling processes affect the peak level and recovery time. Additional studies with similarly impaired persons who do not fracture, serving as comparisons, are required to address this limitation. It also is noteworthy that the present study relied on an inclusive definition of dependency that was based on the use of assistive devices, human assistance, or nonperformance for a health reason. Alternative definitions permitting the use of equipment to be viewed as independent, for example, would yield lower estimates of postfracture disability.

Despite these limitations and caveats, the present study provides new information on differential levels and patterns

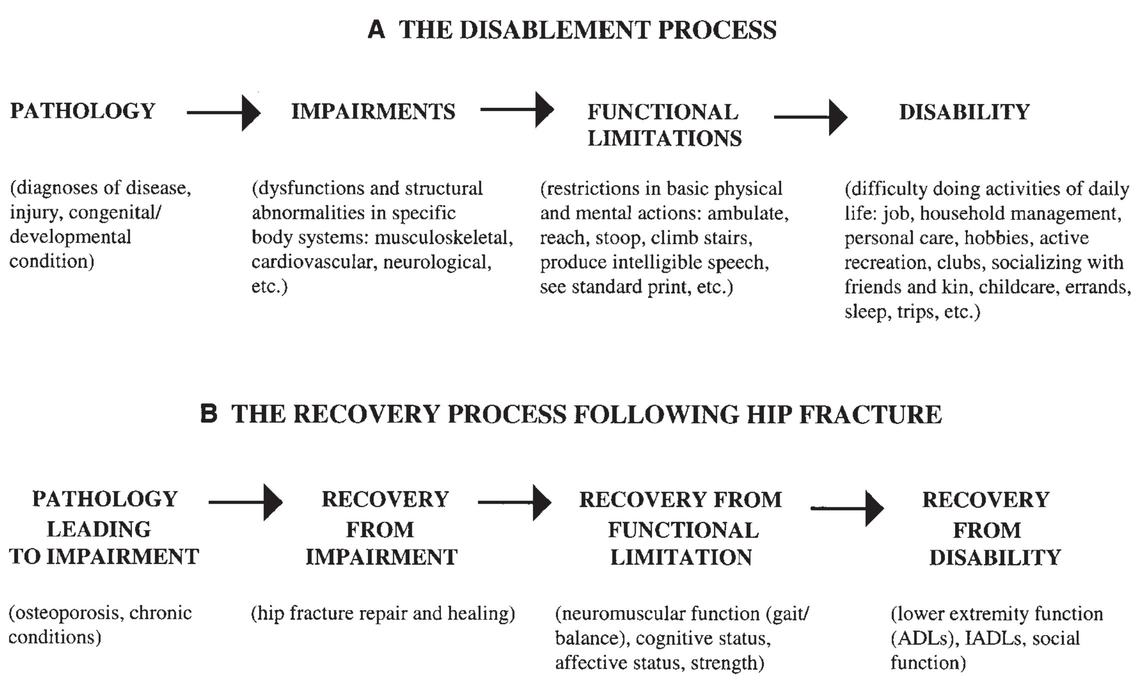

Figure 4. The disablement, **A**, [Verbrugge and Jette (55)] and recovery, **B**, processes following hip fracture. ADLs = activities of daily living; IADLs = instrumental activities of daily living.

of recovery in several important areas of function and has identified a recovery sequence that parallels the process by which function is lost. Consideration of this sequence for hip fracture, and possibly other suddenly disabling conditions, in older persons may provide valuable clues for designing interventions and developing postfracture management and rehabilitation pathways that extend beyond the acute and immediate postacute care period.

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