

# PREDICTION OF THE OUTCOME AFTER HIP FRACTURE IN ELDERLY PATIENTS

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**We report a prospective study of 232 consecutive patients with hip fractures. All were over 64 years of age and living independently before admission to a geriatric orthopaedic ward. We assessed the value, at admission, of predicting factors for independent living at one year after injury.**

**The most important factors were: (1) preinjury function in activities of daily living (grade A or B on the Katz et al (1963) scale); (2) absence of other medical conditions which would impair rehabilitation; and (3) cognitive function better than 7 on the Pfeiffer (1975) mental questionnaire. The odds ratios (95% CI) for these three predictors were 3.5 (1.3 to 9.1), 2.9 (1.3 to 6.1) and 2.4 (1.9 to 4.9), respectively. When all predictors were positive at admission, 92% were living independently at one year; with one, two or three negative predictors, the percentages living independently were 76, 61 and 27, respectively.**

**The median values of the total number of days in hospital, irrespective of diagnosis, during the first year were 12, 24, 29 and 149 days for the four groups. The mortality at one year was predictable on admission only by the number of medical conditions: with no other diagnosis than the fracture the mortality was 0%; with one or two additional conditions the mortality was 14%; and with three or more additional diagnoses it was 24%.**

**These simple and robust predictors can be used to optimise resources for rehabilitation.**

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The increasingly large number of elderly patients who sustain hip fractures has led to advances in surgical techniques and has also encouraged the development of special rehabilitation programmes and a wide range of social support services. If a prognosis could be made for each patient at the time of admission, the better allocation of resources could result in more efficient health care.

Most previous outcome studies have identified predictors which are based on a combination of patient-related and treatment-related factors: these have identified problems and allowed general conclusions on the allocation of resources (Miller 1978; Ceder, Thorngren and Wallden 1980; Mossey et al 1989; Dolk 1990; de Palma et al 1992; Wood et al 1992). Our study focuses on the preinjury status of the patient as determined on admission: general health, mental status, and capacity to handle activities of daily living (ADL).

## PATIENTS AND METHODS

We studied patients over 64 years of age, who were living independently and who had been admitted to a 12-bed specialised orthopaedic unit for hip fractures. This unit has a higher ratio of nurses per bed than standard orthopaedic wards (1.6/bed v 1.2/bed) with the aims of preventing isolation of patients and improving both physical and mental activation. All drugs known to have effects on the central nervous system were avoided as much as possible. To establish the potential for rehabilitation, patients were treated in this unit for as long as they continued to improve or until they could be discharged to their home.

During 1991 and 1992, a total of 232 patients, 179 women and 53 men, were treated, excluding those admitted when the ordinary staff was off duty. There were 114 femoral neck and 118 trochanteric fractures. The mean age of the patients was 81 years (65 to 96).

We graded their functional level (ADL) on the scale of Katz et al (1963), which is based on independence in feeding, continence, transferring between bed and chair, going to the toilet, dressing, and full personal hygiene as grades G to A. Cognitive level was graded using the Short Portable Mental Status Questionnaire (SPMSQ) (Pfeiffer 1975), which is a ten-item questionnaire testing orientation and memory. The general medical condition on admission was classified according to whether or not there were other

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**Table I.** Distribution of 232 patients according to preinjury activities of daily living (ADL), general medical condition, and cognitive function

|                                 | Number of patients (%) | Mean age (yr; range) | Cervical fracture (%) | Mean initial hospital stay (days; sd) | Mean hospital stay during the year (days; sd) | Discharge to own home (%) | At home after one year (%) |
|---------------------------------|------------------------|----------------------|-----------------------|---------------------------------------|---|---------------------------|----------------------------|
| ADL function                    |                        |                      |                       |                                       |   |                           |                            |
| Good*                           | 205 (88)               | 80.4 (65 to 96)      | 51                    | 15 (12)                               | 43 (64)                                       | 91                        | 81                         |
| Dependent                       | 27 (12)                | 84.3 (75 to 92)      | 41                    | 20 (15)                               | 163 (149)                                     | 52                        | 33                         |
| Concomitant medical conditions† |                        |                      |                       |                                       |   |                           |                            |
| No                              | 117 (50)               | 79.9 (65 to 94)      | 54                    | 13 (8)                                | 25 (25)                                       | 97                        | 89                         |
| Yes                             | 115 (50)               | 81.7 (65 to 96)      | 45                    | 19 (15)                               | 89 (112)                                      | 75                        | 61                         |
| Cognitive function              |                        |                      |                       |                                       |   |                           |                            |
| Lucid‡                          | 153 (66)               | 79.6 (65 to 94)      | 51                    | 14 (9)                                | 39 (62)                                       | 98                        | 85                         |
| Not lucid                       | 79 (34)                | 82.7 (66 to 96)      | 47                    | 21 (16)                               | 92 (115)                                      | 52                        | 43                         |

\* the patient was at least able to dress and undress independently (A or B on the Katz et al (1963) graded scale)

† impairing rehabilitation (Ceder et al 1980)

‡ >7 points on the Pfeiffer (1975) ten-item questionnaire

medical conditions or injuries in addition to the fracture, which might impede rehabilitation (Ceder et al 1980) such as stroke, emphysema, poorly controlled diabetes, or other fractured limbs. For the prediction of mortality the number of concomitant diseases was registered.

Patients had their operations as soon as possible, but night-time surgery was avoided. After discharge from hospital, we recorded the patients' functional status, living conditions, and any new admissions to hospital or nursing home for one year after the injury.

**Statistical methods.** The ratio of patients living at home independently at one year after the fracture was analysed as a function of a number of covariates by means of logistic regression analysis (Hosmer and Lemeshow 1989). The inclusion of a covariate was made in a step-wise fashion, and we present the relative importance of the various predictors as odds ratios with 95% confidence intervals. Analysis of variance was used to find predictors for the total number of days in hospital during the year. To achieve better agreement with a normal distribution we performed a

logarithmic transformation of this variable before analysis.

**RESULTS**

The distribution of the patients with regard to ADL, general medical conditions, and cognitive function is shown in Table I. We found three independent predictors for independent living after one year (Table II): an ADL level of at least B, absence of other medical conditions impairing rehabilitation, and a SPMSQ score >7. For each of the predictors, reducing the number of categories to presence or absence showed no appreciable loss of predictive power.

All three of the variables were associated with significantly different subsets concerning the need for health care. Covariance analysis showed that by combining the scores for ADL, general health, and cognitive function we could predict the duration of the initial stay in hospital and also the total number of days in hospital during the first year after the fracture. Table III shows the proportion of the patients living in their own homes at one year after the fracture; patients who died are included among those not discharged to their own home and not living at home at one year. Only 2% of the patients who were positive for all three of our predictors required further care in an institution. We also tested the predictive value of age, gender, fracture type, size of social network, whether the patient met with a friend or relative more than once per month,

**Table II.** Predictors for independent living at one year after hip fracture

|                   | Odds ratios | 95% CI     |
|-------------------|-------------|------------|
| ADL               | 3.5         | 1.3 to 9.1 |
| General condition | 2.9         | 1.3 to 6.1 |
| Mental condition  | 2.4         | 1.9 to 4.9 |

**Table III.** Outcome and use of health-care resources during the year after fracture related to the number of positive predictors

| Positive predictors | Number of patients | Mean initial hospital stay (days; sd) | Mean hospital stay during the year (days; sd) | Discharge to own home (%) | At home after one year (%) |
|---------------------|--------------------|---------------------------------------|---|---------------------------|----------------------------|
| 0                   | 22                 | 22 (15)                               | 179 (146)                                     | 55                        | 27                         |
| 1                   | 40                 | 22 (17)                               | 76 (101)                                      | 80                        | 63                         |
| 2                   | 75                 | 17 (11)                               | 53 (74)                                       | 87                        | 76                         |
| 3                   | 95                 | 12 (7)                                | 23 (23)                                       | 96                        | 92                         |

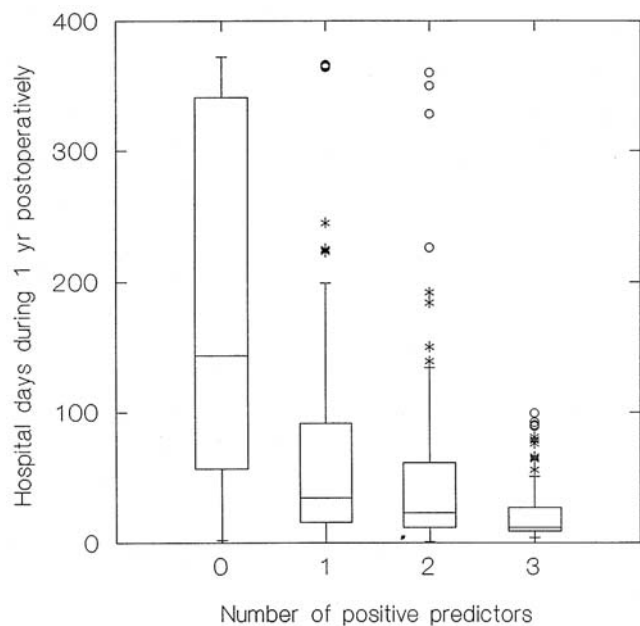


Fig. 1

The relationship between the number of positive predictors and the total number of hospital days for hip fracture patients, irrespective of diagnosis, for one year after the injury. The boxes show medians and represent 50% of the observations (interquartile range). The whiskers show lower and upper box limit  $\pm$  box width. Asterisks are outside the box limit  $\pm 1.5 \times$  box width and the circles are outside the box limit  $\pm 3.0 \times$  box width.

living alone, the use of walking aids, the receipt of home care, the ability to perform ADLs like cooking, cleaning, and short trips for shopping. None of these was more useful as predictors. Figure 1 shows the relationship between the number of positive predictors and the total number of hospital days during the first year after the fracture, giving medians and percentiles.

Thirty patients died during the year, ten during the initial hospitalisation. This mortality was predicted at the time of admission only by the number of current medical conditions. Patients with no other condition than the fracture ( $n = 56$ ) had a mortality of 0%. When one or two additional conditions were diagnosed ( $n = 125$ ) mortality was 14%, and with three or more additional diagnoses ( $n = 51$ ) it was 24% ( $p < 0.001$ ; chi-squared analysis).

## DISCUSSION

Several predictors for the outcome after a hip fracture have been described in studies which were designed to find factors of general importance, including those which are treatment-related. It has been shown that the patient's general health (Ceder et al 1980) and activity level before the fracture (Campion et al 1987; Broos et al 1988; Cheng et al 1989) both influenced the outcome. In 1969, Carroll reported that the diagnosis, the level of ADL, and the degree of orientation of the patient were important for postoperative function. Several authors have found that age

is an important determinant (Broos et al 1988; Cheng et al 1989; Bonar et al 1990; Sernbo and Johnell 1993).

In our study, the addition of age on its own did not improve the prediction of outcome based on ADL, general health and mental status. This indicates that the three components which we used already describe the patient's biological age with accuracy. Surprisingly, the postoperative and one-week assessment of ADL-function and cognitive status did not enhance the predictions. With good, modern orthopaedic treatment, it seems that the prefracture status is decisive for the prognosis.

There are many reports on factors associated with mortality in relation to hip fracture (Miller 1978; Crane and Kernek 1983; Mossey et al 1989; Dolk 1990; Fisher et al 1991; de Palma et al 1992; Wood et al 1992). As expected, age and disease have most often been found to be predictors for death, but some authors have found an association between mortality and walking ability (Miller 1978; Crane and Kernek 1983; Dolk 1990; Sernbo and Johnell 1993) and poor cognitive status has also been mentioned in this context (Mossey et al 1989).

Why is it useful to have an early prediction of the outcome after hip fracture? First, it allows better use of the resources of the rehabilitation unit: a patient with an excellent prognosis does not need the intensive treatment that may be very important for a patient who has an intermediate prognosis. Secondly, knowledge of the prognostic value of these patient-related factors allows a much better comparison between methods of treatment. However, it is important to stress that our results do not have enough precision to justify the exclusion of a patient with a bad prognosis from every effort to improve their function after the fracture.

Our three early predictors for the need for hospital or institutional care after hip fracture were not related to the occurrence of death during the first year. This correlated well with the number of additional diagnoses and suggests that the fracture and its treatment put considerable additional stresses on the patient. These may be intolerable in combination with other diseases, but are usually well tolerated in patients coming from an independent living situation, regardless of age.

At the time of admission, we recommend the use of the Katz ADL and the Pfeiffer SPMSQ forms in addition to recording the routine medical history and physical examination. These provide simple and robust information which can be used to optimise the use of available resources for rehabilitation, and may also be valuable when comparing the effect of different treatments.

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