DISABILITY AND REHABILITATION, 1993; VOL. 15, NO. 1, 29–34

Accelerated rehabilitation after proximal femoral fracture: a randomized controlled trial

IAN D. CAMERON, DAVID M. LYLE and SUSAN QUINE

Accepted for publication: July 1992

Keywords Hip fractures, elderly, activities of daily living, carers

Summary

This randomized controlled trial compared accelerated rehabilitation after surgical treatment of proximal femoral fracture with conventional care and was conducted in a general hospital in an outer urban area. Participating were 261 sequentially admitted patients over the age of 50 years who met predetermined inclusion criteria and all were followed up until death or 4 months after fracture. Patients who were treated with the accelerated rehabilitation programme had a 20% reduction in length of hospital stay. Improved physical independence (as measured by Barthel Index) was observed after fracture in accelerated rehabilitation programme patients with limited pre-existing disability. Non-nursing-home patients receiving accelerated rehabilitation were also less likely to be discharged to nursing-home care or die in hospital. Accelerated rehabilitation led to a substantial reduction in length of hospital stay with a modest short-term improvement in level of physical independence and accommodation status after discharge.

Introduction

Proximal femoral fracture is a major injury requiring prolonged hospital care at considerable personal disadvantage to the older person with the fracture and at great expense to the community.[1–3] Hence there is a need to offer more effective and efficient treatment to the very large and increasing number of older people sustaining proximal femoral fracture.[4,5] Important surgical advances have occurred over several decades so that the majority of patients can be mobilized immediately after surgical treatment.[6] This has focused attention on the period of disability lasting a number of weeks during which the patient has traditionally remained in hospital.

Correspondence to: Dr Ian Cameron, Hornsby Ku-ring-gai Hospital, Palmerston Road, Hornsby 2077, New South Wales, Australia.

At the time this study was planned, one randomized controlled trial investigating non-surgical treatments after proximal femoral fractures had been published.[7] Its findings were generally negative. There was some information suggesting that post-surgical treatment could be improved through organized rehabilitation programmes, but the evidence was based on non-controlled trials or trials using historical controls.[8–10] Subsequently, two randomized controlled trials[11–13] have been published from the United Kingdom. These results were encouraging but not totally conclusive regarding rehabilitation outcomes.

We wished to investigate an intervention that was applicable to a wide range of hospitals, did not require extra facilities (such as a special ward), could be conducted without additional staff if necessary, and was potentially applicable to all patients with proximal femoral fracture. This was compared with the existing arrangements which, in many hospitals, now involve some organized regime of rehabilitation or at least efforts at multidisciplinary treatment. By attempting the study in a hospital with a long-established and well-regarded geriatric and rehabilitation unit, we recognized that it would be more difficult to show benefit from a novel form of rehabilitation. We were thus attempting to study a further evolution of an early discharge type of programme initiated in Sweden[14] while also addressing the fundamental questions regarding the effectiveness of these programmes. Also, concerns that earlier discharge of patients from hospital may burden family caregivers had yet to be investigated.

For this randomized controlled trial it was hypothesized that the intervention (accelerated rehabilitation) would be associated with improved level of physical independence, a reduced length of hospital stay, improved accommodation status after discharge from hospital, and no additional burden on carers. It was expected that patients with limited disability prior to injury would experience additional benefits.

Methods

Accelerated rehabilitation as studied in this trial commenced after surgical treatment of the proximal femoral fracture. Accelerated rehabilitation was offered to patients in the intervention group.

A detailed description of accelerated rehabilitation after proximal femoral fracture follows. A nursing-care plan is commenced in the immediate post-operative period that supports early mobility and self-care. After the operation, either on the same or following day, the patient is seen by a physician experienced in rehabilitation and geriatric medicine. The aim of this consultation is to identify and treat intercurrent illness, review the patient's prior level of disability and handicap, and to assess the patient's level of social support. Often this involves contact with the patient's family or carer. This physician also liaises with the orthopaedic surgeon. Discussion covers any likely complications or precautions to be observed. The most common precaution involves limitation of weight-bearing due to unstable fixation. The physician plans the patient's rehabilitation, which varies according to the patient's pre-fracture level of disability, degree of family or social support and any limitations imposed by the fracture. Mobilization commences when the post-operative X-ray shows adequate fixation, and the patient's medical condition is stable. Usually the patient sits out of bed on the day after the operation and attempts walking the next day.

If the patient lives in a nursing home, he or she returns there as soon as is feasible given the medical condition. The rehabilitation physician contacts the nursing home and confirms arrangements for the mobilization of the patient. Mobilization is supervised by the nursing staff in consultation with a visiting physiotherapist. Progress is checked after several weeks by the rehabilitation physician and orthopaedic review is arranged according to need.

For patients other than those in nursing homes, mobilization is achieved in hospital. To be considered for discharge a patient must be able to walk (with the assistance of a walking aid) and to toilet themselves independently. The patient is encouraged to achieve this aim as quickly as possible. Mobilization is supervised by a physiotherapist. The patient receives treatment each weekday, and two sessions of physiotherapy daily are considered ideal. Mobility training is continued by the nursing staff at other times. The orthopaedic surgeon and the rehabilitation physician review the patient three or four times weekly.

Patients with limited disability prior to the fracture are discharged home directly from the surgical ward. Patients not living in nursing homes are seen by the occupational therapist before they are discharged from hospital in order to facilitate independence in activities of daily living. An occupational therapist will visit most patients' homes to ensure safety and maximum independence there. A social worker reviews some patients identified by other staff as requiring social-work intervention and a nutritionist will also see some patients.

Efforts are made to inform and educate the patient and his or her family about proximal femoral fracture and its consequences. Written information is provided for patients and their relatives. For many patients a formal family interview is held to discuss treatment and obtain feedback.

Patients with moderate to severe disability prior to the fracture (but living outside nursing homes) usually require additional treatment to recover mobility and independence. At the study hospital, once basic mobility is regained (walking with the assistance of a walking frame and an assistant for a short distance) the patient is transferred to the rehabilitation ward. All patients in this ward participate in an interdisciplinary rehabilitation programme and have regular contact with nursing, medical, physiotherapy, occupational therapy and social-work staff.

Discharge from hospital, for non-nursing-home patients, is arranged when the patient's mobility and self-care abilities have reached a level that suggests support in the home from family or other resources is feasible. Additional assistance is arranged at home, if necessary, using home support services — nursing, household help and delivered meals. Equipment required for safety at home is provided prior to discharge.

After discharge the patient's rehabilitation programme continues. The patient may be treated at home by a physiotherapist or attend the day hospital. Patients continue treatment until they have reached their pre-morbid level of functioning or plateau at a lower level of function.

Patients in the control group received the standard treatment provided at the study hospital at the time of the trial. Patients living in nursing homes and those patients with limited disability were discharged when deemed orthopaedically appropriate. Patients who were likely to need additional assistance to return home were referred to the Rehabilitation and Geriatric Service several days after surgery. Many were then transferred to a rehabilitation ward.

In summary, accelerated rehabilitation differs from conventional care in its early assessment of

rehabilitation goals, early commencement (usually within 24 hours of surgery), greater emphasis on retraining physical independence, closer family caregiver contact and more detailed discharge planning.

The study was conducted at a general hospital of 304 beds serving an outer urban population in Sydney, Australia. The study protocol was approved by the local ethics committee and informed consent was obtained for each subject.

Sample-size calculations indicated that 110 subjects in each group were required to detect a 9-day reduction in the length of hospital stay of 28 days (SD 24 days) noted prior to the start of the study (with $p < 0{\cdot}05$ and power of 0·80). The study also had sufficient power (0·80) to detect a 10-point increase in Barthel Index[2] (15) at 1-month post-injury. The mean Barthel Index at 1 month was estimated to be 60 from data obtained prior to the study.

During a 21-month period between 31 January 1989 and 31 October 1990, 358 patients over 50 years of age presented with proximal femoral fracture to the study hospital. Eligibility criteria for the study included presence of an uncomplicated proximal femoral fracture (non-pathological, no additional fractures), surgical intervention within 7 days of injury and residence in the district. All but 77 patients satisfied these criteria. Another 20 patients were excluded because they either sustained their fracture while a hospital inpatient or were transferred to another hospital for surgical treatment.

Of the 261 eligible patients, 252 (97%) consented to participate in the study. A stratified randomization procedure was used to allocate patients to accelerated and conventional care groups. Patients were divided into three groups according to their living arrangements and level of disability prior to the injury. The three groups were persons living in nursing homes, those with moderate to severe disability living outside nursing homes and those with limited disability living outside nursing homes. Patients were considered to have moderate to severe disability if they either had a pre-injury Barthel Index ≤ 60, or an admission Short Portable Mental Status Questionnaire[2] (16) error score ≥ 4. The surgeon was blind to the outcome of randomization, which was performed at the time of surgery.

Information concerning the fracture and the patients' pre-morbid physical independence and living circumstances was collected on admission to hospital prior to randomization. Functional ability of patients was assessed by a trained research nurse using the Barthel Index at 2 weeks, 1 and 4 months following injury and at discharge from hospital. Data were also recorded on complications of treatment, length of hospital stay, accommodation on discharge from hospital, readmissions and vital status 4 months post-injury. All 252 patients were successfully followed until death or 4 months after injury.

Assessment for inter-observer reliability of Barthel Index scores was undertaken on a subset of 10 patients using an occupational therapist who was blind to the patient's allocation and nurse's assessment. There was high agreement between the two observers ($r = 0{\cdot}98$).

The burden on identified family caregivers was measured using a disruption score, which was structured to indicate changes in the caregiver's lifestyle due to the provision of support to the patient with proximal femoral fracture and also by the professional assessment of the research social worker. Interviews with the social worker were arranged as soon as practicable after hospital admission (to establish baseline data), 1 week after the patient was discharged from hospital and at 1 and 4 months after injury. The total change in disruption score and the social worker's assessment of burden over the period of the study were calculated and categorized either as an increase in burden or as a combination of no change or decrease.

Differences between the accelerated and conventional groups were assessed using Student's t-test for continuous variables and chi-square statistic for categorical data. Multiple regression models were then employed to adjust for pre-morbid disability and the effects of other extraneous variables in determining treatment effects. Significance testing was two-tailed with $p < 0{\cdot}05$ accepted as statistically significant. All analyses were performed on an intention-to-treat basis and done by means of the SAS/STAT package.

Results

Table 1 gives details of the study population. The accelerated rehabilitation and conventional care groups were similar at randomization on all relevant factors, except for mean age, which was significantly lower ($t = 2{\cdot}89$, df = 250, $p = 0{\cdot}0042$) in the accelerated rehabilitation group largely due to differences in the subgroup from nursing homes. Multiple regression models controlling for age give results very similar to the univariate analyses presented below.

Length of hospital stay was significantly shorter in the accelerated group (after logarithmic transformation $t = 2{\cdot}13$, df = 250, $p = < 0{\cdot}05$). The magnitude of the reduction was 20% (see Tables 2 and 3 for further details). The mean length of hospital stay was 19·5 days

Table 1 Characteristics of the 252 patients

	Randomization stratum and group					
	Nursing home		Non-nursing home			
			Moderate to severe disability		Limited disability	
	A* $n=48$	C† $n=46$	A* $n=21$	C† $n=22$	A* $n=58$	C† $n=57$
Demographics						
Age (mean, years)	84·2	88·5	87·2	89·3	79·2	81·4
Gender (% female)	79	87	81	86	79	88
Pre-injury situation						
Living alone (%)	na	na	5	14	29	42
Barthel Index (mean)	57·9	53·3	80·0	81·4	97·1	94·6
Cognitively impaired (%)	83	84	81	81	5	9
Injury details						
Intracapsular fracture (%)	46	46	52	45	50	63
Days to surgery (mean)	1·7	1·7	2·0	2·1	2·0	1·6

*A = accelerated rehabilitation; †C = conventional care; ‡na = not applicable.

Table 2 Length of hospital stay of patients after proximal femoral fracture

	Randomization group					
	A* $n=127$		C† $n=125$			
Residence and disability prior to injury	Median length of stay, days [Interquartile range]				p‡	CI§
Nursing home	6·5	[5–8]	7	[5–12]	0·252	0·71–1·10
Moderate to severe disability, non-nursing home	20	[13–33]	30·5	[18–60]	0·324	0·50–1·27
Limited disability, non-nursing home	20	[14–29]	32	[15–55]	0·024	0·55–0·96
Combined groups	13	[7–25]	15	[8–44]	0·034	0·63–0·98

*A = accelerated rehabilitation; †C = conventional care; ‡For logarithmic transformed data; §95% confidence interval for ratio of length of stay accelerated/conventional.

Table 3 Distribution of length of hospital stay (after Kennie *et al.*[12])

	Accelerated rehabilitation		Conventional care	
	n	(%)	n	(%)
≤1 week	36	(28)	27	(22)
–1 month	71	(56)	57	(45)
–3 months	18	(14)	36	(29)
≥3 months	2	(2)	5	(4)

(median 13 days) for the accelerated rehabilitation group and 28·1 days (median 15 days) for the conventional care group.

Regression models suggested that accelerated rehabilitation was more effective in regaining physical independence for persons with limited disability prior to injury than those from nursing homes. For patients with limited pre-existing disability in the accelerated group, Barthel Index at 2 weeks after injury ($t=2·52$, df = 111, $p=<0·05$) and at 1 month ($t=2·34$, df = 110, $p=<0·05$) was superior to the conventional group. The level of physical independence was similar for the accelerated and conventional groups at discharge from hospital (mean Barthel Index 52·9, 55·6, respectively, $p=0·53$) (Table 4).

All patients receiving accelerated rehabilitation showed a trend to an improved rate of recovery of physical independence, but this failed to reach statistical significance ($t=1·56$, df = 24, $p=0·121$ at 2 weeks, and $t=1·84$, df = 231, $p=0·068$ at 1 month).

All persons from nursing homes returned there after discharge from hospital. Of those patients living outside nursing homes prior to the injury, significantly fewer of the accelerated rehabilitation patients were discharged to nursing homes or died; 21·5% compared with 38·0% ($\chi^2=5·12$, df = 1, $p=<0·05$, 95% confidence interval (CI) for difference in proportions −2·5% to −30·5%). The difference in nursing-home-placement rates was less pronounced 4 months after injury; 16% of surviving patients from the accelerated group compared with 26% from the conventional care group ($\chi^2=2·13$, df = 1, $p=0·14$, CI −3·3% to 23·4%).

There was no major increase in burden on identified family caregivers in the accelerated group as measured by the disruption score and the social worker's assessment of burden.

Physical independence at 4 months following injury did not differ significantly between the two treatment groups. Twenty-nine per cent of the accelerated rehabilitation group regained the level of physical independence experienced prior to the proximal femoral fracture, as measured by Barthel Index, as did 26% of the conventional care patients.

Case fatality rates, readmission and complications were not significantly different between the treatment groups to 4 months after injury. No complications were observed that could be directly attributed to the accelerated rehabilitation programme. Multiple regression models gave results broadly similar to the analyses presented above.

Table 4 Physical independence after fracture, Mean Barthel Index

Residence and disability prior to injury	2 weeks after injury				1 month after injury			
	A*	C†	*p*	CI‡	A*	C†	*p*	CI‡
Nursing home	26·3	25·7	0·877	−6·9 to 8·0	32·4	26·2	0·187	− 3·1 to 5·5
Moderate to severe disability, non-nursing home	47·0	43·3	0·476	−8·5 to 17·8	50·4	46·9	0·655	−12·2 to 19·1
Limited disability, non-nursing home	72·1	62·7	0·013	2·0 to 16·8	81·8	72·8	0·021	1·4 to 16·6
Combined groups	51·1	45·7	0·121	−1·4 to 12·2	59·2	51·9	0·068	− 0·5 to 15·2

*A = accelerated rehabilitation; †C = conventional care; ‡95% confidence interval for differences between groups (accelerated minus conventional).

Discussion

The accelerated rehabilitation programme undertaken in a general hospital achieved its goals of reduced length of hospital stay for all categories of patient, with improved rate of recovery of physical independence and better residential outcomes for persons living outside nursing homes prior to their injury. This benefit was not, however, reflected in the longer-term recovery and, in general, the accelerated patients did not plateau at a higher level of physical recovery than patients receiving conventional care at the study hospital.

It is probable that reduced length of stay resulted from improved physical independence, better discharge planning and possibly different expectations of staff and patients. The accelerated rehabilitation programme did not require additional staffing and made use of existing hospital resources. There was no detectable disadvantage to other patients as the mean length of hospital stay for patients in the conventional care group was similar to that recorded during the immediate pre-study period.

The improved rate of recovery of physical independence in the patients with limited disability suggests that the rehabilitation efforts were more effective in the accelerated group. This is consistent with the programme objectives of earlier mobilization and more intensive treatment for disabilities resulting from the injury. Although the clinical assessor was not blind to the group assignment of the patients, real differences are likely to be present because of the high correlation with the independent blind assessor in the validation study and the lack of differences between the groups at discharge from hospital and 4 months after fracture.

Patients from nursing-home accommodation fared poorly. It was likely that the intervention as structured had limited opportunity to assist those patients owing to the short length of stay and limited rehabilitative resources available in some nursing homes.

This study's results are broadly similar to those from the randomized controlled trial of Kennie *et al.*[12,13] and the patients are roughly comparable. However, the magnitude of some of the effects of rehabilitation is different. Kennie *et al.* appear to show superior results in physical independence and domicile, which could plausibly be due to differences in treatment received by the control groups. In our study the control group may have received greater geriatric rehabilitative input.

The components of the accelerated rehabilitation programme which were primarily responsible for the improvement in outcomes for patients were not explicitly identified. The major difference in treatment between the accelerated and conventional care groups was the concentrated input of an experienced physician with training in geriatric and rehabilitation medicine, who may have been the catalyst for the changes observed between the treatment groups.

Accelerated rehabilitation is potentially applicable to most hospitals providing acute and rehabilitative care for patients with proximal femoral fracture. It uses staff that are generally available and requires no specialized equipment or facilities. It does require co-operation between physicians with expertise in geriatric rehabilitation and orthopaedic surgeons, well-developed geriatric rehabilitation services and close links with home support services. It is also necessary to have a staff member committed to the overall organization and delivery of the programme.

More impressive results may be seen if accelerated rehabilitation is commenced immediately after fracture, that is, before surgery, and if additional staff were assigned to the programme. The potential applications of accelerated rehabilitation include other common disabling conditions affecting older people such as stroke.

Acknowledgements

This project was supported by a grant from the Australian Department of Health, Housing and Community Services. We wish to thank Stephanie Bathgate, research nurse, for conducting the patient assessments.

References

1 Currie CT. Hip fractures in the elderly: beyond the metalwork. *British Medical Journal* 1989; **298**: 473–474.
2 Ford AB. Reducing the threat of hip fracture. *American Journal of Public Health* 1989; **79**: 269–270.
3 Mossey JM, Mutran E, Knott K, Craik R. Determinants of recovery 12 months after hip fracture. The importance of phychosocial factors. *American Journal of Public Health* 1989; **79**: 279–286.
4 The Royal College of Physicians of London. Fractured neck of femur: prevention and management. London: Royal College of Physicians, 1989: 2–3.
5 Spector TD, Cooper C, Fenton Lewis A. Trends in admissions for hip fracture in England and Wales 1968–85. *British Medical Journal* 1990; **300**: 1173–1174.
6 Ceder L, Stroqvist B, Hansson LI. Effects of strategy changes in the treatment of femoral fractures during a 17 year period. *Clinical Orthopaedics and Related Research* 1987; **218**: 53–57.
7 Fordham R, Thompson R, Holmes J, Hodkinson C. A cost–benefit study of geriatric-orthopaedic management of patients with fractured neck of femur. York: University of York, 1986. (Centre For Health Economics discussion paper 14.)
8 Jarnlo GB, Ceder L, Thorngren KG. Early rehabilitation at home of elderly patients with hip fractures and consumption of resources in primary care. *Scandinavian Journal of Primary Health Care* 1984; **3**: 103–109.
9 Sikorski JM, Davis NJ, Senior J. The rapid transit system for patients with fractures of the proximal femur. *British Medical Journal* 1985; **1**: 439–443.
10 Pryor GA, Williams DRR, Myles JW, Annand JK. Team management of the elderly patient with hip fracture. *Lancet* 1988; **i**: 401–403.
11 Gilchrist WJ, Newman RJ, Hamblen DL, Williams BO. Prospective randomised study of an orthopaedic geriatric in-patient service. *British Medical Journal* 1988; **297**: 1116–1118.
12 Kennie DC, Reid J, Richardson IR, Kiamari AA, Kelt C. Effectiveness of geriatric rehabilitative care after fractures of the proximal femur in elderly women: a randomised controlled trial. *British Medical Journal* 1988; **297**: 1083–1086.
13 Reid J, Kennie DC. Geriatric rehabilitative care after fractures of the proximal femur: one year follow up of a randomised clinical trial. *British Medical Journal* 1989; **299**: 25–26.
14 Ceder L, Thorngren KG, Wallden B. Prognostic indicators and early home rehabilitation in elderly patients with hip fractures. *Clinical Orthopaedics and Related Research* 1980; **152**: 173–184.
15 Mahoney FL, Barthel DW. Functional Evaluation: The Barthel Index. *Maryland State Medical Journal* 1965; **14**: 61–65.
16 Pfeiffer E. A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *Journal of the American Geriatric Society* 1975; **23**: 433–441.