# Intensive geriatric rehabilitation of hip fracture patients

## A randomized, controlled trial

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**ABSTRACT – We determined the effect of geriatric rehabilitation of hip fracture patients on mortality, length of hospital stay, and functional recovery. In a randomized, controlled intervention study, 243 community dwelling hip fracture patients over 64 years of age were randomly assigned to 2 rehabilitation groups. The intervention group (n = 120) was referred to a geriatric ward for team rehabilitation, and the controls (n = 123) to local hospital wards for standard care. The median length of total hospital stay after a hip fracture operation was 34 (95% CI 28–38) days in the intervention group and 42 (95% CI 35–48) days in the control group (p = 0.05). The intervention group recovered instrumental activities of daily living faster (p = 0.05). Direct costs of medical care during the first year did not differ remarkably.**

Previous studies provide conflicting results on the benefits for patients with hip fractures of geriatric assessment and treatment in rehabilitation hospitals (Stuck et al. 1993, Kramer et al. 1997, Cameron et al. 2001) (Table 1).

In Jyväskylä Central Hospital, the median length of stay of hip fracture patients on the orthopedic ward has diminished dramatically from 19 days to 5 days during the past decade. After surgical treatment the patients are now referred for rehabilitation to local health center hospitals (Huusko et al. 1999). The patients in local health center hospitals owned by local communities are treated by general practitioners. The average cost of one hospital day in a local hospital is about 50% of that of one hospital day in central hospitals.

We compared the effectiveness of a 2-week intensive rehabilitation on the geriatric ward of the central hospital and rehabilitation in local hospitals after hip fracture. We present the main results of the intervention study. A subgroup analysis of hip fracture patients with cognitive impairment has been reported in a previous article (Huusko et al. 2000).

## Patients and methods

From 10.10.1994 to 6.12.1998, 243 community-dwelling patients with acute hip fractures over 64 years of age were randomly assigned to two rehabilitation groups after the operation (Figure, Tables 2 and 3).

The allocation sequence was computer-generated and sealed in numbered envelopes before the study. Cervical hip fractures were usually treated by hemiendoprosthesis, and trochanteric fractures by osteosynthesis. Patients were mobilized on the first postoperative day (Thorngren 1991).

The Ethics Committee of the Central Finland Health Care District approved the study and informed consent was obtained from all study subjects on the first postoperative day.

**Table 1. Randomized intervention studies on rehabilitation after hip fracture**

| | Jette 1987 | Gilchrist 1988 | Kennie 1988<br>Reid and Kennie 1989 | Cameron 1993<br>Cameron 1994 | Galvard 1995 | Present study |
|---|---|---|---|---|---|---|
| Country | USA | UK | UK | Australia | Sweden | Finland |
| No. (in./ co.) | 35 / 40 | 97 / 125 | 54 / 55 | 127 / 125 | 179 / 192 | 120 / 123 |
| Patients | | | | | | |
| Mean age, years | 78 (all)<br>81 (co.) | 82 (in.)<br>84 (co.) | 79 (in.)<br>81–89 (co.) | 79–87 (in.)<br>79–81 (co.) | 73–79 (in.)<br>80 (co.) | 80 (in.) |
| Women (%) | 67 | 100 | 100 | 79 / 87 | 72 / 77 | 84 / 90 |
| Inclusion | age >54 yrs | age ≥65 yrs | age >65 yrs | age >50 yrs<br>Not hospitalized | Independently living | age ≥65 yrs<br>Independently living |
| Setting | | | | | | |
| Control | Orthopedic ward | Orthopedic ward | Orthopedic ward | Orthopedic ward | Orthop. ward | Health center hospital |
| Intervention | Orthopedic ward with geriatric team evaluation, weekly team meeting, family education, home visit by physical therapist, telephone contacts at discharge. | Orthopedic ward with a weekly combined ward round by a geriatrician, followed by a case conference. | General practitioner in another hospital ward and 2 weekly ward rounds with a consultant geriatrician, weekly geriatric team meeting. | Orthopedic ward with early geriatric assessment and discharge planning, 3 intervention groups. Patients with preexisting disability discharged to a special rehabilitation unit. | Local hospital ward for geriatric patients with orthopedic problems. | Geriatric ward. |
| Follow-up period | 12 months | 6 months | 12 months | 4 months | 12 months | 12 months |
| Results | | | | | | |
| Mortality | NS | NS | + | NS | NS | NS |
| Hospital stay | NS | NS | + | + | – | + |
| Discharge disposition | NS | NS | + | + | NS | NS |
| Functional recovery | NS | | + | + | NS | + |
| Costs | NS | | | + | – | NS |
| Comment | Weak intervention. Randomization by physician's emergency on-call schedule. Small number of patients. | More medical conditions diagnosed by intervention. Weak intervention. | Small number of patients. | Follow-up time 4 months. | More readmissions in control group. Intervention was not described. | |

Abbreviations: in./co., intervention / control. NS, no significant differences between groups. + / – , effects by intervention.

The geriatric unit of Jyväskylä Central Hospital has a ward for assessment and rehabilitation. The intervention group was transferred to the geriatric ward for about 2 weeks of intensive rehabilitation to promote early ambulation, self-motivation and function. An occupational therapist evaluated the need for daily living aids. Discharge and follow-up planning were checked at weekly team meetings together with the patient. Patients discharged to independent living were visited 10 times by a physiotherapist for individual exercises in the patient's home during the first 2 months after discharge.

We gathered information on the activities of daily living (ADL) (Katz et al. 1963, 1970), and the prefracture instrumental activities of daily living (IADL) (Lawton and Brody 1969). 1 week after admission, the Mini-Mental Status Examination (MMSE) test (Folstein et al. 1975) was carried out. A physician filled in a questionnaire on the patient's previously diagnosed chronic conditions, medications and complications. A physiotherapist assessed the use of walking aids, gait, ADL, and IADL 2 weeks, 3 and 12 months after surgery. Data on use of home help and home nursing were

**Table 2. Distribution of exclusion criteria. Many (n = 98) patients met several exclusion criteria**

| Exclusion criterion | Number |
|---|---|
| Pathological fracture | 11 |
| Multiple fractures | 22 |
| Living in an institution | 160 |
| Not able to walk independently | 26 |
| Terminally ill | 22 |
| Younger than 65 years of age | 38 |
| Serious early complication on the orthopedic ward (death, intensive care unit, cardiac care unit) | 50 |
| Receiving salmon calcitonin treatment | 16 |
| Declined to participate | 72 |
| Unable to communicate | 15 |
| Unknown | 24 |

**Table 3. Demographic data of the hip fracture patients in control and intervention groups**

| | Intervention n = 120 | Control n = 123 |
|---|---|---|
| Number of females | 84 | 90 |
| Mean age, years (range) | 80 (67–92) | 80 (66–97) |
| Number living alone | 62 | 70 |
| Median of chronic diseases, (range) | 3 (0–7) | 2 (0–6) |
| dementia, n | 32 | 20 |
| stroke, n | 29 | 30 |
| other neurological, n | 16 | 9 |
| musculoskeletal, n | 43 | 44 |
| cardiovascular, n | 72 | 85 |
| psychiatric disorders, n | 19 | 13 |
| neoplasms, n | 10 | 11 |
| diabetes, n | 18 | 16 |
| respiratory, n | 23 | 18 |
| other, n | 51 | 48 |
| No chronic diseases | 6 | 9 |
| Median of continuous medication (range) | 4 (0–11) | 4 (0–14) |

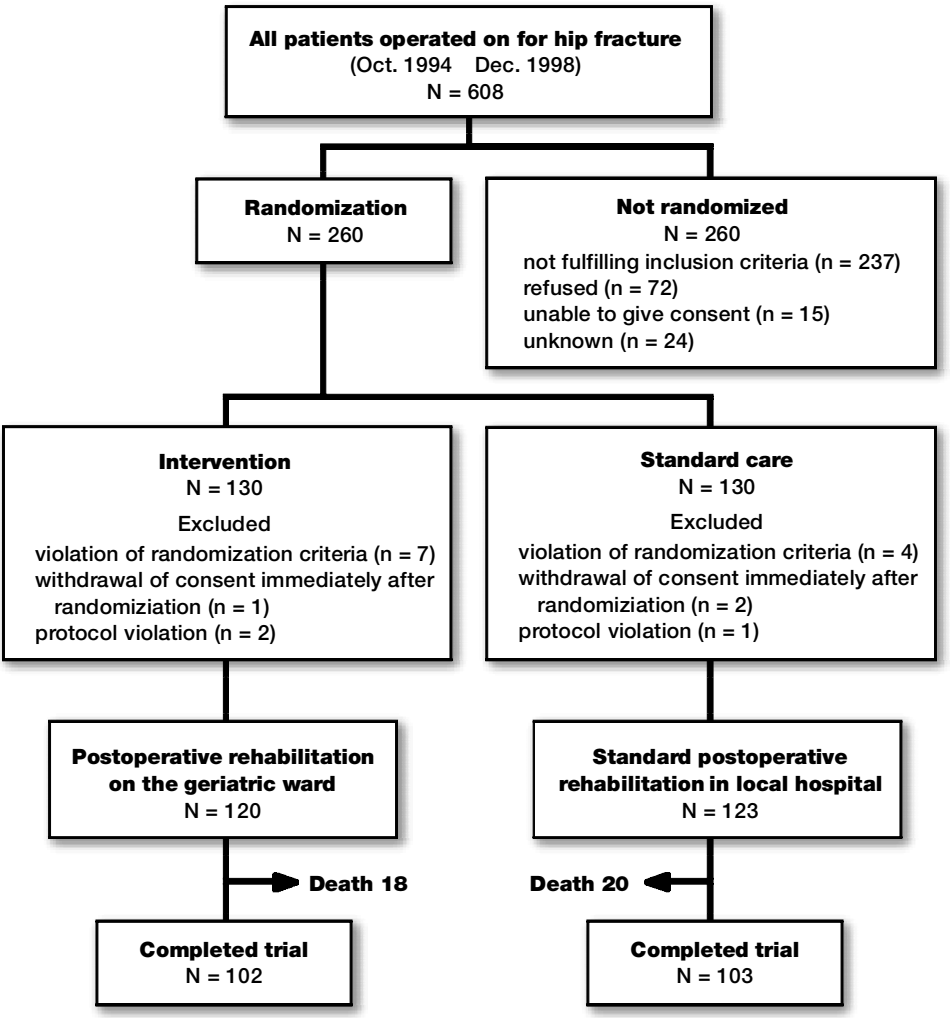
collected at a home visit. All medical records of the first 12 months after the operation were studied and data on lengths of continuous hospital stay, residence after discharge, number of hospital days during the first year after the operation, use of medical care, complications and mortality, were obtained. The aim was to compare the continuous length of hospital stay, functional recovery, mortality, and ADL and IADL before the hip fracture and during the first year after the hip fracture operation.

The target sample size of about 250 (125 in each group) was calculated to ensure the power of at least 80% to detect a difference of 20% between the treatment groups at two-side $\alpha = 0.05$. The results are expressed as mean or median, standard deviation (SD) or range or interquartile range (IQR) and 95% confidence intervals (95% CI). The results were analyzed on an intention to treat basis. Statistical comparison of changes in outcome measurements was performed with the matched pairs t-test or Wilcoxon signed ranks test and comparison between groups was made with the independent samples t-test or Mann-Whitney test. Categorical data were analyzed by the chi-square test. The normality of variables was evaluated by the Kolmogorov-Smirnov statistics, with a Lilliefors significance or Shapiro-Wilk statistics. Logistic regression analysis was used to study the risk of outcome variables. The Cox proportional Hazard Model was used to estimate the age- and sex-adjusted risk for mortality and dislocation between groups. The Standardized Mortality Ratio (SMR) was calculated using published national death rates with exact confidence interval. Kaplan-Meier curves were used to illustrate information on cumulative proportions. The cost of medical services was calculated from the actual total number of hospital days and check-ups with physicians in the central hospital, health centers, nursing homes, and in private medical care for any medical problems during the first year after the hip fracture operation. The costs were calculated with the average cost method at the different levels of health care services.

## Results

The background data in the two groups were similar (Table 3). The patients in the intervention group had lower median MMSE scores. Before the hip fracture, 41 (34% (CI 27–43)) of the patients in the intervention group and 66 (54% (CI 45–62)) of those in the control group were functionally independent (group A, $p = 0.002$) in activities of daily living (Katz et al. 1970). The MMSE scores correlated strongly with the ADL index at baseline.

The median time from the hip fracture to the operation was 1 day in both groups. The median length of time spent on the orthopedic ward after the operation was 2.5 days in the intervention group and 4 days in the control group. The median length of stay on the geriatric ward was 19 days




Flow diagram of the present intervention study

after which 53% of the patients were discharged to independent living.

The median number of physiotherapy sessions per week was 7.3 (IQR 5.8, 8.4) in the intervention and 4.5 (IQR 2.8, 5.4 ($p < 0.001$)) in the control group. In the control group, domiciliary physiotherapy was arranged after consideration by the physician for 28% of those patients who were discharged to independent living.

At the end of the follow-up, 15% of the patients in the intervention group and 16% of those in the control group had died. The age- and sex-adjusted Hazards Ratio between the intervention and control groups was 0.83 (95% CI 0.43–1.58).

In all, 61 (51% (CI 42–60)) of the patients in the intervention group and 56 (46% (37–54)) of those in the control group were reported as having had some kind of complication during the follow-up year ($p = 0.4$).

The lengths of continuous hospital stay in both groups were calculated after a successful discharge from any hospital for 2 weeks. The length of time was calculated from the operation to the day on which the patient was finally discharged. The median length of hospital stay after the hip fracture operation was 34 (95% CI 28–38) days in the intervention group and 42 (95% CI 35–48) days in the control group ($p = 0.05$). 5 patients (4%) in the

**Table 4. Comparison of costs (in ∈) during the first year after hip fracture operation**

| Services per year | Groups | |
|---|---|---|
| | Intervention | Control |
| Hospital care | | |
| Total hospital days per patient | 80 | 80 |
| Total cost per patient | 16,000 | 14,200 |
| Nursing home care | | |
| Mean, days per patient | 21 | 18 |
| Mean, total cost per patient | 1,500 | 1,300 |
| Outpatient services | | |
| Mean, appointments with physician | 3.9 | 3.8 |
| Mean, total cost per patient | 400 | 400 |
| Total cost per patient | 17,900 | 15,900 |

Cost was calculated using average cost at different levels of health care services.

intervention group and in the control group died during the hospital stay.

There were no differences in home nursing, home help, food service or help from relatives or friends. The number of hospital days and check-ups by physicians and the number of days in nursing homes during the first year after the operation (Table 4). The total direct costs per patient, including the rehabilitation period in the geriatric ward, were about 2,000 ∈ (1999) more expensive in the intervention group.

The changes in functional recovery were calculated only for patients with data both at baseline and at the follow-up. The patients in the intervention group regained their independency in the IADL functions faster ($p = 0.05$ between changes in outcome measurements 3 months after operation), but after 1 year there was no longer any significant difference between the groups (Table 5).

## Discussion

In the geriatric rehabilitation group, the median length of hospital stay after a hip fracture operation was shorter and the patients regained independency in instrumental activities of daily living faster, even though these patients were less independent in activities of daily living before the fracture. The positive results of our study are probably also lessened by the greater proportion of demented patients in the intervention group (Sernbo and Johnell 1993, Parker and Palmer 1995, Heruti et al. 1999). Active geriatric rehabilitation and mobilization did not increase the risk of complications.

More than 5 physiotherapy sessions a week have been associated with better health outcomes in elderly patients with a hip fracture (Hoenig et al. 1997). In the intervention group, the patients had significantly more physiotherapy sessions a

**Table 5. Instrumental activities of daily living (IADL) scale and activities of daily living (ADL) scale in the intervention and control groups from the baseline to 3 months and 1 year after the fracture operation**

| Measurement | | Baseline | | P-value between groups | Change[d] from baseline | | P-value between changes |
|---|---|---|---|---|---|---|---|
| | | Intervention | Control | | Intervention | Control | |
| Baseline to 3 months | | | | | | | |
| ADL | Number of patients [a] | 111 | 109 | | | | |
| | Median (IQR [b]) | 5 (5.6) | 6 (5.6) | 0.004 | 0 (–1.0) | 0 ( –1.0) | 0.5 |
| IADL | Number of patients [a] | 109 | 105 | | | | |
| | Median (IQR [c]) | 4 (2.7) | 6 (3.8) | 0.003 | –1 (–2.0) | – 2 (–3.0) | 0.05 |
| Baseline to 1 year | | | | | | | |
| ADL | Number of patients [a] | 95 | 98 | | | | |
| | Median (IQR [b]) | 5 (5.6) | 6 (5.6) | 0.008 | 0 ( –1.0) | 0 ( –1.0) | 0.5 |
| IADL | Number of patients [a] | 97 | 98 | | | | |
| | Median (IQR [c]) | 4 (2.7) | 6 (3 .8) | 0.005 | –1 (–2.0) | –1(–3.0) | 0.6 |

[a] Patients with data at both baseline and the follow-up.
[b] Median and interquartile range. Total scale 0–8, minimum value indicates worse functional status.
[c] Median and interquartile range. Total scale 0–6, minimum value indicates worse functional status.
[d] At end-point minus baseline. Negative value indicates worse outcome.

week and early ambulation and self-motivation were strongly encouraged. All patients who were discharged to independent living also continued physiotherapy for two months. Our findings are comparable to those of Nikolaus et al. (1999) who found that comprehensive geriatric assessment together with postdischarge home intervention in geriatric patients with acute illnesses improved their functional status and reduced their length of the initial hospital stay. Our results are also similar to those of previous randomized intervention studies with a similar setting of geriatric rehabilitation (Cameron et al. 2001). In 3 other randomized studies (Table 1) with negative results, the intervention was weak.

It is difficult to compare rehabilitation schemes in different countries since there can be major differences in the organization of health care, surgical methods and rehabilitation (Thorngren 1991, Berglund-Röden et al. 1994) and consequently also in the mean length of hospital stay. The lower mortality in our study than in other reports (Keene et al. 1993, Lüthje et al. 1995, Hoenig et al. 1997) may partly be caused by exclusion of institutionalized patients. In our study, the age- and sex-adjusted mortality of community dwelling hip fracture patients who were independent in ADL functions before the fracture was no greater than the mortality of the general population.

The direct costs of medical care were similar in our study in the intervention and control groups during the first year. The average cost of 1 hospital day in postoperative rehabilitation in the health centers is probably underestimated, as half of the patients in the health centers are in long-term institutional care and also the internal accounting is not as reliable as in central hospitals. In the subgroup analysis of hip fracture patients with cognitive impairment of the present study (Huusko et al. 2000), fewer patients with MMSE scores 12–17 (suspected moderate dementia) (Folstein et al. 1975) in the geriatric rehabilitation group were in institutional care 1 year after the hip fracture. The costs of long-term institutional care of demented hip fracture patients will probably increase the costs more in the control group during the next years. The follow-up time was too short to assess the costs of institutional care or reoperations.

We conclude that the length of hospital stay of community dwelling hip fracture patients can be diminished significantly by intensive geriatric rehabilitation, which continues in the patients' homes after their discharge from hospital. The present rehabilitation scheme can be improved by introducing a geriatric team approach into local hospital wards. Intensive geriatric rehabilitation in special units should be considered especially for patients who already were having problems with ADL and IADL functions before their hip fracture.

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