Mortality and mobility after hip fracture in Japan

A TEN-YEAR FOLLOW-UP

We studied prospectively the change over ten years in mortality, walking ability and place of residence after a hip fracture in 753 patients in Japan. We compared the deaths observed in these patients with those expected in the general population, matched for age, gender and calendar year at the time of fracture. The survival rate decreased dramatically for two years after the event and the mortality risk remained higher for ten years. This risk was approximately double that of the general population, even at ten years after fracture. The risk was higher, and remained so for longer, in younger rather than in older patients.

The proportion of patients who were able to walk outdoors alone, with or without an assistive device, was 68% (514) before fracture. This decreased to 56% (340) by one year after and remained stable at approximately 63% (125) until ten years. The proportion of patients living in their own home was 84% (629) before fracture, 81% (491) one year later, and then remained stable at approximately 86% (171) until ten years after the event.

As the size of the elderly population increases rapidly it is predicted that the number of hip fractures will continue to rise globally. It has been estimated that the total number of such fractures in 1990 was 1.26 million worldwide, which is expected to rise to 2.6 million by 2025 and to 4.5 million by 2050.\(^1\) Approximately 90 000 new hip fractures occur annually in Japan,\(^2\) a number which is likely to more than double by 2025.\(^3\) The elderly population is also increasing rapidly in Japan, leading to increased medical costs and social problems.

Hip fracture is an osteoporosis-related event which is known to be a major cause of morbidity and mortality in the elderly.\(^4\)-\(^6\) Although it is known to be associated with an increased mortality,\(^6\)-\(^8\) few reports have dealt with long-term survival after this fracture.\(^18\)-\(^21\) Many earlier accounts showed that the survival curves declined dramatically soon after hip fracture, but thereafter ran parallel to the expected survival curves for the general population.\(^6\)-\(^12\)\(^,\)^\(^16\) However, because of improvements in medical technology, even patients with poor underlying health may now live longer. They can easily sustain a hip fracture, so it is possible that this might influence long-term mortality. Previous reports have shown that low bone mineral density is a risk factor for death.\(^22\),\(^23\) Even if these patients do not die, they may be unable to cope with the activities of daily life, thereby creating a social problem which needs to be addressed.

There are no long-term follow-up studies into the activities of daily life for these patients.

We have studied the annual changes in mortality, walking ability and place of residence over a period of ten years following a hip fracture.

Patients and Methods

Between January and December 1992 we treated 1169 hip fracture patients who were 50 years of age or older in a multicentre study involving 74 hospitals affiliated to Nagoya University. We were able to follow-up all patients, whether they were dead or alive, until 120 days after fracture. We excluded 230 patients who did not agree to participate in the study beyond the 120-day point, together with three with pathological fractures. Thus a total of 936 patients gave informed consent to participate in the study. Of these, 183 (20%) were excluded because of either their lack of response or their later withdrawal of consent to participate. The remaining 753 patients were the subject of the study. They were treated in 70 hospitals, 20 of which were private (57 patients) and 50 which were general (696 patients). Each of the 70 hospitals was a trauma centre. The mean age of the patients at the time of fracture was 78.2 years (50 to 104), with 191 men and 562 women (Table I). Each
year for ten years a questionnaire was sent to the patient's home asking about survival, walking ability and place of residence after the fracture. The Lund University questionnaire, which was designed for multicentre studies, was used for both initial and follow-up evaluation. This assesses functional capacity before and after injury, including independence in activities of daily living, walking ability, and the length of stay in hospital.

We related our findings to a general population group matched for age, gender and calendar year at the time of the hip fracture. We compared the annual observed deaths of our subjects with those calculated from the death rate of the general population in Japan, based on a life table published by the Ministry of Health, Labour and Welfare. We examined separately those patients aged less than 80 years of age and those aged 80 or more. There were 377 patients aged less than 80 years and 376 aged 80 or over (Table I). These groups were also compared with the general population.

Walking ability was classified into six categories: able to walk outdoors alone with or without an assistive device, able to walk outdoors with a helper, able to walk indoors alone with or without an assistive device, able to walk indoors with a helper, unable to walk but able to sit on a chair, and bedridden. The place of residence was classified into five categories as either their own home, a general hospital, a geriatric hospital, an old-age home, or a primary hospital (for acute care).

**Statistical analysis.** We calculated the Observation/Estimation ratio (O/E ratio) of the annual observed deaths to the annual expected deaths matched for age, gender and calendar year in order to compare the mortality between the study subjects and the general population in Japan.

The 95% confidence interval (95% CI) was obtained assuming a Poisson distribution of the data. All analyses were performed using SAS version 8.2 (SAS Institute Inc., Cary, North Carolina).

**Results**

The overall survival rates at one, two, five and ten years after fracture were 81%, 67%, 49% and 26%, respectively. The survival curves for the study population and those expected for the general population are shown in Figure 1. The survival curve for the study group declined dramatically two years after surgery and then levelled out slightly, but continued to diverge from the expected curve to the ten-year point.

The O/E ratios matched for age, gender and calendar year at each year after hip fracture are shown in Table II. This shows that the mortality risk for patients with a hip fracture increases significantly compared with that of the general population for ten years after fracture.

The survival rates for patients under 80 years of age were 86%, 78%, 66% and 44% at one, two, five, and ten years after fracture, respectively. The survival curve for patients aged under 80 years of age and the expected survival curve for the general population are shown in Figure 2. This younger group also had a large decline in survival rate for the first two years after fracture. The curves continued to diverge from each other for ten years. The difference between this younger group and the general population was

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**Table I. Characteristics of the study population**

<table>
<thead>
<tr>
<th>Study group</th>
<th>&lt; 80 years of age</th>
<th>≥80 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>753</td>
<td>377</td>
</tr>
<tr>
<td>Gender (number (%))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>191 (25.4)</td>
<td>114 (30.2)</td>
</tr>
<tr>
<td>Female</td>
<td>562 (74.6)</td>
<td>263 (69.8)</td>
</tr>
<tr>
<td>Mean age in years (range)</td>
<td>78.2 (50 to 104)</td>
<td>70.6 (50 to 79)</td>
</tr>
<tr>
<td>Side of fracture (number (%))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>355 (47.1)</td>
<td>172 (45.6)</td>
</tr>
<tr>
<td>Left</td>
<td>398 (52.9)</td>
<td>205 (54.4)</td>
</tr>
<tr>
<td>Types of fracture (number (%))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undisplaced femoral neck</td>
<td>120 (15.9)</td>
<td>78 (20.7)</td>
</tr>
<tr>
<td>Displaced femoral neck</td>
<td>246 (32.7)</td>
<td>145 (38.5)</td>
</tr>
<tr>
<td>Stable intertrochanteric</td>
<td>272 (36.1)</td>
<td>103 (27.3)</td>
</tr>
<tr>
<td>Unstable intertrochanteric</td>
<td>85 (11.3)</td>
<td>39 (10.3)</td>
</tr>
<tr>
<td>Subtrochanteric</td>
<td>30 (4.0)</td>
<td>12 (3.2)</td>
</tr>
<tr>
<td>Treatment number (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td>52 (6.9)</td>
<td>21 (5.6)</td>
</tr>
<tr>
<td>Operative</td>
<td>701 (93.1)</td>
<td>356 (94.4)</td>
</tr>
<tr>
<td>Days from injury to surgery (range)</td>
<td>7.2 (0 to 39)</td>
<td>7.4 (0 to 29)</td>
</tr>
<tr>
<td>Length of hospital stay in days (range)</td>
<td>68.0 (2 to 284)</td>
<td>71.1 (2 to 224)</td>
</tr>
</tbody>
</table>
greater than the difference between the entire study group and the general population.

Table II shows that the increased mortality risk for patients aged under 80 years persists for ten years. This risk increases by more than five times in the first year and remains high thereafter. The risk is higher than for the whole patient group.

The survival rate for patients aged 80 years or over was 75%, 56%, 31% and 9% at one, two, five, and ten years after fracture, respectively. The survival curve for these patients and that for the general population are shown in Figure 3. In this older patient group, the decrease in survival rate was greater than for the general population in the first two years. However, the difference gradually decreased thereafter with the survival curve roughly paralleling the expected one.

Table II also shows that the risk of a higher mortality for patients aged 80 years or over persists for up to five years after fracture. After six years no statistically significant difference was observed between these patients and the general population. The risk is higher than for the whole patient group.

The proportion of patients who were able to walk outdoors alone with or without an assistive device was 68% (514) before the fracture, reducing to 51% (358) by 120 days after fracture, but improving to 56% (340) at one year, thereafter remaining steady at approximately 63% (123) for ten years.

The proportion of patients living in their own home was 84% (629) before fracture, reducing to 60% (421) by 120 days after fracture, but improving to 81% (491) by one year, thereafter remaining steady at approximately 86% (171) for ten years.

**Discussion**

**Mortality.** Many reports have followed the outcome of patients with hip fractures, but few for longer than one year. Many earlier studies found the survival rate at one year after fracture to be between 60% and 70%. In recent papers the survival rate at one year has improved to approximately 80%, similar to our figure of 81%. However, only a few studies have followed patients for ten years. Borgquist et al noted a survival rate of 36% in 103 patients, Schroder and Erlandsen 22% in 389, and Poor et al 25% in 131 ten years after fracture. These results are similar to our own of 26% in 753. However, studies into survival rate after hip fracture show a wide diversity in patient population. Karagiannis et al reported a ten-year survival rate of 24% in patients with intertrochanteric fractures, compared with 42% for those with fractures of the femoral neck. It is therefore difficult to compare our study with these. Poor et al had a survival rate at one year after fracture, for male patients only, of 58%, and Kyo, Takaoka and Ono found the survival rate at one year for patients with a fracture of the femoral neck to be 56%. Many of these earlier reports showed survival curves after hip fracture that declined dramatically at the beginning but which thereafter ran parallel to the expected curves for the general population.

There have been many reports describing the period when the survival curves declined dramatically, between three months and two years after fracture. However, more recent accounts indicate that there may be an increased mortality that persists for several years after fracture. Our study agrees with these reports, and shows the mortality risk to persist for ten years. We found that the patients with hip fractures had double the risk of mortality compared with the general population, even after ten years of follow-up. An earlier study by Richmond et al found the increased mortality to be 1.4-fold at two years, White et al gave a figure of 1.5-fold at two years, and Center et al a figure of 2.2-fold in women and 3.2-fold in men five years after fracture. The mortality risk was higher and the period of risk longer for younger rather than older patients in this study. Johnell et al observed that five years after fracture patients aged 60 years had a 5.8-fold increased risk of death for men and a 5.4-fold increase for
women; patients aged 80 years had a 2.2-fold increase for men but 1.6-fold for women. The difference from the general population was greater at the age of 60 years than at 80. The follow-up period for Center et al was five years after fracture, although our study showed a similar trend up to ten years and an increased risk of mortality for patients aged 80 years or older was 1.57 at five years, but the general population. In contrast, the increased risk for 2.41 at ten years. This risk was statistically higher than for the general population increases. However, a few authors have noted the difference between patients with hip fractures and the general population to be significant for an increased long-term risk of mortality. Indeed, they suggest that the younger age groups are associated with an increased mortality after hip fracture compared with the general population. It has been suggested that up to 24% of deaths are related either directly or indirectly to the fracture itself. Consequently, the prevention of a fracture is the key to reducing deaths related to this condition. However, long-term survival is also affected by a patient’s general condition, a factor which will not significantly decrease.

Another problem is the disability after fracture. There are no previous long-term follow-up studies on the activities of daily life after hip fracture. We studied the change in walking ability after fracture for ten years. The percentage of patients who were able to walk outdoors alone with or without an assistive device, was stable at approximately 60%. This long-term result was similar to previous studies, where most of the functional recovery occurred within the first four to six months after fracture and was stable thereafter. We did not investigate the relationship between recovery in walking ability and mortality. Others have demonstrated that one of the factors affecting mortality is the walking ability soon after surgery and at the time of discharge from hospital. It appears that the restoration of walking ability affects not only the functional prognosis but also lifespan. Our study identified that most functional recovery occurred within the first four to six months after fracture and remained stable thereafter, highlighting the need to restore walking ability and functional status at an early stage. We believe that a system is needed whereby patients with hip fracture can receive continuous, intensive rehabilitation after an early discharge from a primary hospital.

The place of residence for our patients remained generally stable by one year after fracture. Thörngren, Ceder and Svensson showed the proportion of patients who lived in their own home to be 86%, 76% and 84% at one, five, and ten years after fracture, respectively, results similar to our own. However, the length of hospital stay in our patients was longer than in earlier studies, although this did not relate solely to their medical status. In Japan, there

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**Table II.** The ratio (O/E) of the annually observed deaths of the study group to the annually expected deaths of the general population matched for age, gender and calendar year, and 95% confidence intervals (95% CI) for all patients, for those aged <80 years, and for those aged ≥80 years.

<table>
<thead>
<tr>
<th>Years after fracture</th>
<th>Total subject</th>
<th>&lt; 80 years</th>
<th>≥ 80 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O/E ratio</td>
<td>95% CI</td>
<td>O/E ratio</td>
</tr>
<tr>
<td>1</td>
<td>2.72*</td>
<td>2.27 to 3.17</td>
<td>5.22*</td>
</tr>
<tr>
<td>2</td>
<td>2.02*</td>
<td>1.60 to 2.44</td>
<td>2.92*</td>
</tr>
<tr>
<td>3</td>
<td>2.31*</td>
<td>1.83 to 2.78</td>
<td>2.83*</td>
</tr>
<tr>
<td>4</td>
<td>1.98*</td>
<td>1.50 to 2.47</td>
<td>1.94*</td>
</tr>
<tr>
<td>5</td>
<td>1.72*</td>
<td>1.24 to 2.20</td>
<td>2.03*</td>
</tr>
<tr>
<td>6</td>
<td>2.11*</td>
<td>1.55 to 2.68</td>
<td>3.17*</td>
</tr>
<tr>
<td>7</td>
<td>2.33*</td>
<td>1.70 to 2.95</td>
<td>3.00*</td>
</tr>
<tr>
<td>8</td>
<td>1.90*</td>
<td>1.30 to 2.50</td>
<td>2.20*</td>
</tr>
<tr>
<td>9</td>
<td>1.47</td>
<td>0.88 to 2.06</td>
<td>1.14</td>
</tr>
<tr>
<td>10</td>
<td>1.94*</td>
<td>1.22 to 2.65</td>
<td>2.41*</td>
</tr>
</tbody>
</table>

* statistically significant
is a shortage of rehabilitation hospitals and facilities for home rehabilitation. Patients tend to remain in hospital until certain rehabilitation goals are reached. The length of hospital stay for older patients was shorter than for the younger individuals, as older patients tended to transfer to rehabilitation hospitals and facilities. The time from injury to surgery in our patients was longer than in earlier studies.11,13,31 In Japan, there was no system of emergency surgery for hip fracture in the 1990s, with most operations being performed between three and seven days after injury. Whether this longer hospital stay and delayed surgery influenced mortality, walking ability or place of residence after fracture is uncertain.

To date, no reports have investigated the change in either mortality or functional status for ten years on a large scale. Our ten-year follow-up rate was reduced to 80%. It is possible that this may bias our sample and be a limitation of the study. Although 183 patients failed to respond after agreeing to participate in this study, we were able to confirm, by telephone or medical records, whether or not 86 of these patients were still alive ten years after fracture (Table I). Of these, 19 were alive, giving a rate of survival of 22%, similar to the results for the 753 patients in our study group. Consequently, we believe that the survival rate for the 183 patients who were lost to follow-up was similar to that of our study group.

A further limitation was that we do not know whether the patients themselves responded to our posted questionnaire or if a family member did so on their behalf.

Our results show that the survival rate after hip fracture decreases dramatically for two years after the event, but stabilises thereafter, albeit still well below that of the general population for up to ten years. The increased mortality risk was approximately double that of the general population ten years after fracture, a risk that was higher and remained so for longer in younger, rather than older patients. Meanwhile, walking ability and the place of residence at one year after fracture remained stable for up to ten years after the event.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References