

# Secular change of the incidence of four fracture types associated with senile osteoporosis in Sado, Japan: the results of a 3-year survey

Takeo Oinuma · Mayumi Sakuma ·  
Naoto Endo

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**Abstract** We conducted a three-year survey of fracture incidences associated with senile osteoporosis—compression fractures of the spine, femoral neck fractures, distal radius fractures, and fractures of the proximal end of the humerus—to examine secular change. The survey was conducted between 2004 and 2006 on patients in Sado City. We calculated the incidence of each fracture based on the population of Sado City (per 100,000 person-years). Only clinical or incident fractures were diagnosed as new fractures for compression fractures of the spine. Incidence of compression fracture of the spine was the highest, followed by femoral neck fracture, distal radius fracture, and fracture of the proximal end of the humerus. The incidence of femoral neck fracture increased annually from 2004 to 2006, significantly among the elderly in their 80s ( $P < 0.05$ ). Compression fracture of the spine also increased but not significantly. The incidences of distal radius fracture and fracture of the proximal end of the humerus did not increase. This increase in incidence of

femoral neck fractures associated with senile osteoporosis will become an important issue for an aging society such as Japan.

**Keywords** Fracture · Osteoporosis · Incidence

## Introduction

Japan has an increasingly aging society which is expected to experience an increasing number of fractures associated with senile osteoporosis; namely, compression fracture of the spine, femoral neck fracture, distal radius fracture, and fracture of the proximal end of the humerus. In fact, the incidence of femoral neck fractures is reportedly on the rise [1, 2]. However, the incidences of other fracture types are not entirely clear, nor are the relationships among these fracture types. Moreover, there are currently few reports on any consecutive surveys of the incidence of four kinds of fractures associated with senile osteoporosis which were conducted simultaneously and in a defined geographic area. Therefore, we conducted a survey on the incidences of four fracture types associated with senile osteoporosis in the city of Sado, Japan for three consecutive years.

## Patients and methods

We conducted a survey of patients at Sado General Hospital (inpatients and outpatients) between 2004 and 2006 for compression fractures of the spine, femoral neck fractures, distal radius fractures, and fractures of the proximal end of the humerus. Sado General Hospital is the only hospital on Sado Island capable of treating fractures and manages 95% of all such cases in Sado. In 2004, a few

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Data represented in the Journal of Bone and Mineral Metabolism [2] are included in a table and figures in this article, to examine secular change from 2004.

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T. Oinuma (✉) · M. Sakuma  
Department of Orthopedic Surgery, Sado General Hospital,  
113-1 Chigusa, Sado 952-1209, Japan  
e-mail: takerara@par.odn.ne.jp

N. Endo  
Division of Orthopedic Surgery, Department of Regenerative  
and Transplant Medicine, Niigata University Graduate School  
of Medical and Dental Sciences, Niigata, Japan

M. Sakuma · N. Endo  
Division of Rehabilitation Medicine, Department of Community  
Preventive Medicine, Niigata University Graduate School  
of Medical and Dental Sciences, Niigata, Japan

other medical institutions in Sado City were included in this study, but as they contributed only a small percentage of all cases, these were eliminated from the study in 2005. All fractures were examined by X-ray. Diagnosis of compression fractures was based on dimensions of the vertebral body and diagnostic criteria issued by The Japanese Society for Bone and Mineral Research, used widely in Japan [3]. We diagnosed clinical or incident fractures as new fractures. These were found in patients who visited the hospital for symptoms such as back pain and were judged by the orthopedic doctor based on X-ray and physical examination to have a new vertebral fracture. Prevalent fractures and asymptomatic older fractures observed accidentally by X-ray were excluded from the analysis.

We first counted the number of patients with each fracture type for each year and then calculated the incidences based on the Sado City population for each year (per 100,000 person-years). We also calculated the incidences in 2004 adjusted to the population structure of Japan in 2005. Patients were divided into groups according to age (10-year intervals). The incidence of each fracture type per age group per study year was calculated according to the population of each age group in Sado City for a given study year (per 100,000 person-years). We focused on patients who resided in Sado, an island, as it is unlikely that patients would go elsewhere for treatment, and thus would remain on the island for the duration of the survey. We excluded any fractures experienced by tourists to Sado. The population of Sado was 70,011 in 2004, 68,045 in 2005, and 66,592 in 2006. At the same time, the aging rate (ratio of population  $\geq 65$  years relative to total population) for these three years was 34.0, 34.7, and 35.2%, respectively (Table 1). The fracture incidences surveyed in 2004 were reported in a previous paper [4]; however, these are also included in this report in order to illustrate changes over three consecutive years, from 2004 to 2006 in Sado City.

## Statistical analysis

Chi-square test followed by Tukey's multiple comparison was used to compare the incidence of each fracture across all observation years.

## Results

The combined number of compression fractures of the spine, femoral neck fractures, distal radius fractures, and fractures of the proximal end of the humerus was 350 patients in 2004, 369 in 2005, and 405 in 2006. The incidence per 100,000 people was 499.9 in 2004, 542.3 in 2005, and 608.2 in 2006. Therefore, both the number of fractures and incidence increased every year from 2004 to 2006 (Table 1) (N.S.). We analyzed the result by classifying the incidences for the four fracture types by year and by age.

### Compression fractures of the spine

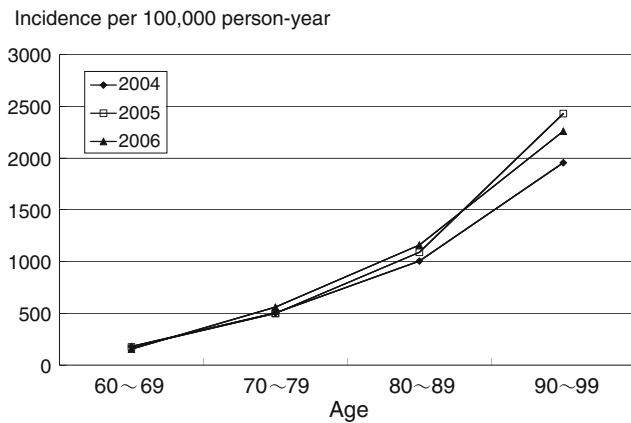
The incidence per 100,000 was 232.8 in 2004, 246.9 in 2005, and 282.3 in 2006, indicating an annual increase (N.S.). In age group analysis the annual increase in incidences from 2004 to 2006 was shown in octogenarian patients (N.S.) (Fig. 1).

### Femoral neck fractures

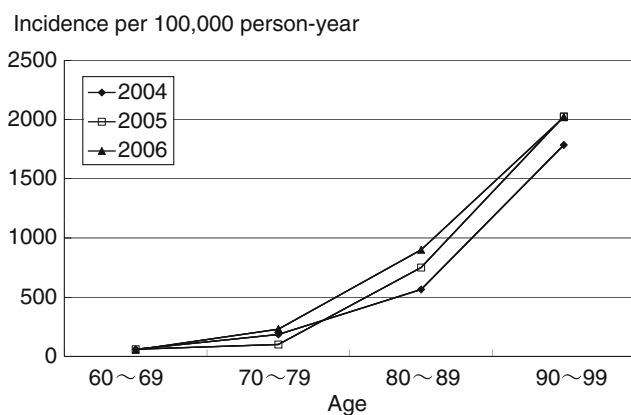
The incidence per 100,000 was 121.4 in 2004, 141.1 in 2005, and 177.2 in 2006, also indicating an annual increase (N.S.). In particular, there was a significant increase in incidence of femoral neck fractures among octogenarian patients between 2004 and 2006 ( $P < 0.05$ ) (Fig. 2).

**Table 1** Number and incidence of each fracture in Sado

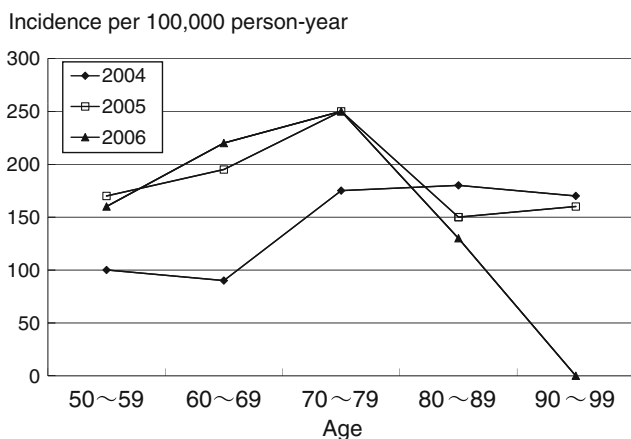
Year	2004		2005		2006		
Total population	70,011		68,045		66,592		
Aging rate	34.00%		34.70%		35.20%		
	2004		2005		2006		
	Number	Incidence	Incidence adjusted for Japanese population	Number	Incidence	Number	Incidence
Spine	163	232.8	138.4	168	246.9	188	282.3
Femoral neck	85	121.4	69.8	96	141.1	118	177.2
Distal radius	76	108.6	76.9	84	123.4	74	111.1
Proximal end of humerus	26	37.1	37.3	21	30.9	25	37.5
Total	350	499.9	322.4	369	542.3	405	608.2



**Fig. 1** Incidence of compression fractures of spine



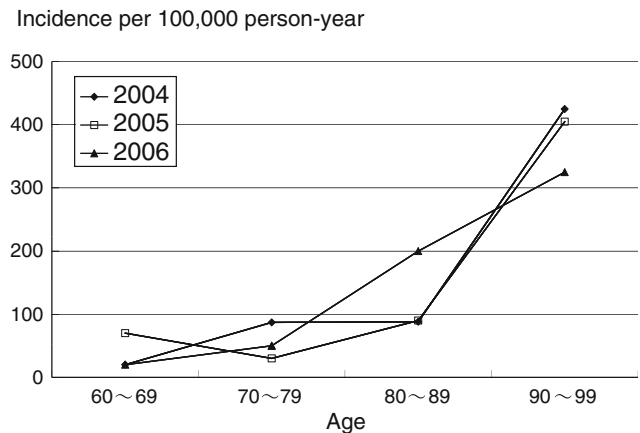
**Fig. 2** Incidence of femoral neck fractures



**Fig. 3** Incidence of distal radius fractures

**Distal radius fractures**

The incidence per 100,000 was 108.6 in 2004, 123.4 in 2005, and 111.1 in 2006, indicating a plateau. The incidence was highest among septuagenarian patients each year (Fig. 3).



**Fig. 4** Incidence of proximal end of humerus fractures

There was no significant age-dependent difference in incidence across all years.

**Fractures of the proximal end of the humerus**

The incidence per 100,000 was 37.1 in 2004, 30.9 in 2005 and 37.5 in 2006, also indicating a plateau. Nonagenarian patients had the highest incidence each year (Fig. 4).

There was no significant age-dependent difference in incidence across all years.

**Discussion**

Sado is an island city whose residents attend the Sado General Hospital, which allows us to conduct a complete survey of four types of fractures associated with senile osteoporosis within the same location and at the same time. Furthermore, since Sado has a high aging rate of 35%, we believe that it represents a good indication of future trends in Japan.

The incidence of compression fractures of the spine and femoral neck fractures increased most markedly among octogenarian patients, particularly in 2006 ( $P < 0.05$ ; between 2004 and 2006 on femoral neck fracture).

One reason for the increased hip fracture incidence may be that the elderly population over 80 years of age in Sado grew by approximately 300 people each year, despite a decline in the total population from 2004 to 2006. Other studies reported similar increases in hip fracture with time [1, 2, 5–7]. In the current study, the incidence increased 1.46-fold in 3 years—a steep increase rate compared to the 1.4-fold increase observed in other Asian regions in a recent decade [6]. In addition, pre-existing compression fractures of the spine have been suggested as risk factors for femoral neck fractures [8]. Eighty percent of patients with femoral neck fractures reportedly have a history of

compression fractures of the spine, and femoral neck fractures are thought to occur 3–5 years after patients have been diagnosed with a compression fracture [9, 10]. We are therefore confident that the increase in compression fractures of the spine is associated with later increases in femoral neck fractures. Osteoporosis patients should be educated and enlightened about these issues, and we recommend that physicians also take this into consideration in their treatment of such patients.

Studies from Northern Europe and North America have reported that fracture incidences have decreased in recent years. Initially, these regions had higher incidences than Japan, but these have since declined, most likely as a result of proper osteoporosis diagnoses and the use of osteoporosis drugs [11, 12].

This survey revealed that distal radius fractures have a different incidence pattern compared to compression fractures of the spine and femoral neck fractures. The incidence of distal radius fractures did not increase by age or by year. Hagino et al. [5] reported that the fracture of upper extremities increased significantly with time in their study of 1986–1995, but in the current study we did not observe such an obvious increase (Table 1, Figs. 3, 4). It is possible that the shorter observation period and fewer fractures in upper extremities contributed to this discrepancy.

Some studies report that while the elderly must remain sufficiently active in order to prevent distal radius fractures by using their hands during a fall, it may not be possible to prevent the other types of fractures [5, 13]. Unmistakably, one of the contributing factors, other than an increasingly aging population, is reduced physical ability, as seen in individuals who are unable to use their hands during a fall to prevent fractures or those who fall while being transferred onto a bed or a wheelchair. The elderly who are over 80 years of age clearly have a lower physical activity level and, therefore, a decreased ability to walk and an increased likelihood to stumble or fall, a condition which necessitates assistance [5, 13].

A survey conducted in 2004 reported that patients who suffered femoral neck fractures reported low levels of serum vitamin 25(OH)D and albumin [9, 10]. A drop in serum vitamin 25(OH)D levels generally suggests reduced torso flexibility [14] and, therefore, an increased risk of falling [15], which can also be related to dementia [16]. Levels of 25(OH)D are significantly related to vitamin D levels, and also correlate with low levels of albumin, indicating the important role of nutrition among the elderly, particularly those over 80 years of age. We believe that decreased activity and poor nutrition may have contributed to the increased incidence of fractures.

The increase in bone fractures among the elderly is an important concern for Japan's aging society, and indicates a disparity between long life expectancy and a high quality

of life. The decline in activity and the rise in assisted living increase the risk of falls and are linked to increased rates of bone fractures. The increase in bone fractures, especially femoral neck fractures, indicates the need for increased care. Moreover, it is reported that only 55% of patients with femoral neck fractures return home after leaving the hospital [4], which creates a large burden of medical care expenses.

The results of our survey on the incidence of fractures associated with senile osteoporosis, particularly among the elderly over 80 years old, should serve as a warning to our society. A national survey on femoral neck fractures also indicates increasing incidence of bone fractures among those 80 years and older [17]. We believe that it is critical to implement comprehensive bone fracture prevention programs, including fall prevention, nutrition, and the appropriate use of osteoporosis therapy drugs to rehabilitate the current generation.

We conclude that reducing the risk of falls among the elderly will have a significant impact on the incidence of fractures associated with senile osteoporosis.

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