



# Recent Epidemiology of Hip Fractures in South Korea

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The aging of the Korean population is expected to result in an increase in the prevalence of hip fractures. The aim of this review is to evaluate potential hip-fracture trends in Korea during the last few decades. Data from a hip fracture-related epidemiology study informed by: (1) a cohort study; (2) hospital-based cohort study; and (3) claims database, were reviewed and summarized. The incidence of hip fractures rose from 159.1/100,000 in 2008 to 181.5/100,000 in 2012, and the total number of hip fractures is estimated to increase by 1.4 times over the next 10 years (35,729 in 2016 to 51,259 in 2025). The use of intramedullary nails has greatly surpassed the use of plates for the treatment of intertrochanteric fractures. The 1-year cumulative mortality rates in patients aged  $\geq 50$  years after hip fractures based on National Health Insurance Service data were 17.2% (3,575/20,849) in 2008 and 16.0% (4,547/28,426) in 2012; the decrease was mainly observed among women. In addition, the mean 1-year mortality rates were 21% for men and 15% for women, indicating that mortality was 1.4 times higher in men than in women. The number of hip fractures is rapidly increasing, and the incidence of hip fractures demonstrated a slightly increasing trend until 2012. Trends in the use of varying surgical options for treatments for femoral neck and intertrochanteric fractures follow global trends. Although the high mortality rate after hip fractures in Korea remains concerning, a decrease in these rates over the study period was observed.

**Key Words:** Hip fractures, Incidence, Mortality, Republic of Korea, Therapeutics

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## INTRODUCTION

Osteoporosis is a common musculoskeletal disease in elderly populations that increases the risk and frequency of low-trauma fractures<sup>1)</sup>. Among osteoporotic fractures (e.g., spine, hip, wrist, and humerus), hip fractures are the most serious cause of morbidity, disability, mortality, and increased economic burden in elderly patients<sup>2,3)</sup>. Although the age-adjusted incidence rate of hip fractures is reportedly steady or declining in many countries, the total number of hip fractures is increasing due to the increase in elderly populations<sup>4,6)</sup>.

According to the national age-specific mortality and life expectancy in 35 industrialized countries with high-quality

ity vital statistics data, there is a high probability that life expectancy will continue to increase by more than 50%, meaning that by 2030, the national life expectancy of females in South Korea will break the 90-year barrier<sup>7</sup>. In addition, in 2018, South Korea became an aged society (defined as having an elderly population  $\geq 14\%$  of the total population); in 2026, it is expected to become a super-aged society (elderly population  $\geq 20\%$  of the total population)<sup>8</sup>. Through these reports, the proportion of the population with age-related frailty and the number of hip fractures in South Korea are anticipated to show increasing trends.

To estimate and establish preventive and therapeutic strategies for minimizing complications after hip fracture in elderly populations, an epidemiology study of hip fractures is mandatory. Currently, a hip fracture-related epidemiology study is continuously being updated using: (1) a cohort study; (2) hospital-based cohort study; and (3) claims database<sup>3,8,9</sup>. The aim of this review is to report changes in the trends of the incidence, treatment, morbidity, and mortality of hip fractures in South Korea.

## INCIDENCE OF HIP FRACTURES

Examples of the well-documented incidence rates of hip fractures were those in Gwangju city and Jeollanam-do, which have been reported every decade since 1991<sup>10,11</sup>. The hip fracture incidence in patients aged  $\geq 50$  years is increasing and reported to be 33/100,000 (1991), 133/100,000 (2001), and 140/100,000 (2011)<sup>12</sup>. A prospective longitudinal hospital-based study based on a cohort study in Jeju Island aimed to investigating the hip fracture incidence in patients aged  $\geq 50$  years between 2002 and 2011<sup>8</sup>. During the study period, the number of hip fractures increased two-fold (from 151 in 2002 to 304 in 2011). The crude incidence of hip fractures in the population of Jeju aged  $\geq 50$  years increased from 126.6/100,000 to 183.7/100,000. The annual increase in the incidence rate of hip fracture was 4.3% (5.3% in women and 2.2% in men) according to the Trend in Hip Fracture Incidence and Mortality in Korea<sup>8</sup>. However, data from these studies are not representative of the actual incidence because of the small area and differences in the distribution of the elderly populations.

The recently reported nationwide incidence of hip fractures in patients aged  $\geq 50$  years was based on the data from the National Health Insurance Service (NHIS) nationwide database. From 2008 to 2012, the number of hip fractures in patients aged  $\geq 50$  years increased by 36.9% in 5 years (20,849 in 2008 and 28,426 in 2012)<sup>9</sup>. The incidence

of hip fractures increased from 159.1/100,000 (209.9/100,000 in women and 99.6/100,000 in men) in 2008 to 181.5/100,000 (243.1/100,000 in women and 110.5/100,000 in men) in 2012. Notably, between 2008 and 2012, the increase in the incidence of hip fractures in women (15.8%) was greater when compared to men (10.9%). Nevertheless, according to a systematic review in 2017, the change of age-adjusted incidence of hip fractures in Korea was not statistically significant in either gender between 2001 and 2010. This difference could be due to the change in demographic features of population which is reflected in the general incidence but not in the age-adjusted incidence.

Projections of the incidence of hip fractures using the Poisson distribution from 2016 to 2025 in Korea indicated that over the 10-year period, the population in Korea is expected to increase by 2.3%, but the population aged  $\geq 50$  years will increase more substantially (27.0%), and the populations aged  $\geq 70$  and  $\geq 90$  years will exponentially increase by 42.2% and 101.7%, respectively<sup>9</sup>. The authors of this study concluded that the incidence of hip fractures continues to increase, and the socioeconomic burden of hip fractures is expected to increase in Korea along with the increased estimated number of fractures.

The incidence of fractures in the population, standardized to the 2008 population in the United States, increased from 100.6/100,000 (men) and 194.4/100,000 (women) in 2002 to 114.2/100,000 (men) and 278.4/100,000 (women) in 2011. The incidence rate of hip fractures in Korea is similar to the reports from population-based studies in South East Asia (Thailand and Malaysia) and Mexico, higher than that in Thailand and Malaysia, and still lower than those from other advanced Asian countries (Japan, Hong Kong, and Singapore), Norway, Australia, Switzerland, England, and the United States (Table 1)<sup>8,13-20</sup>.

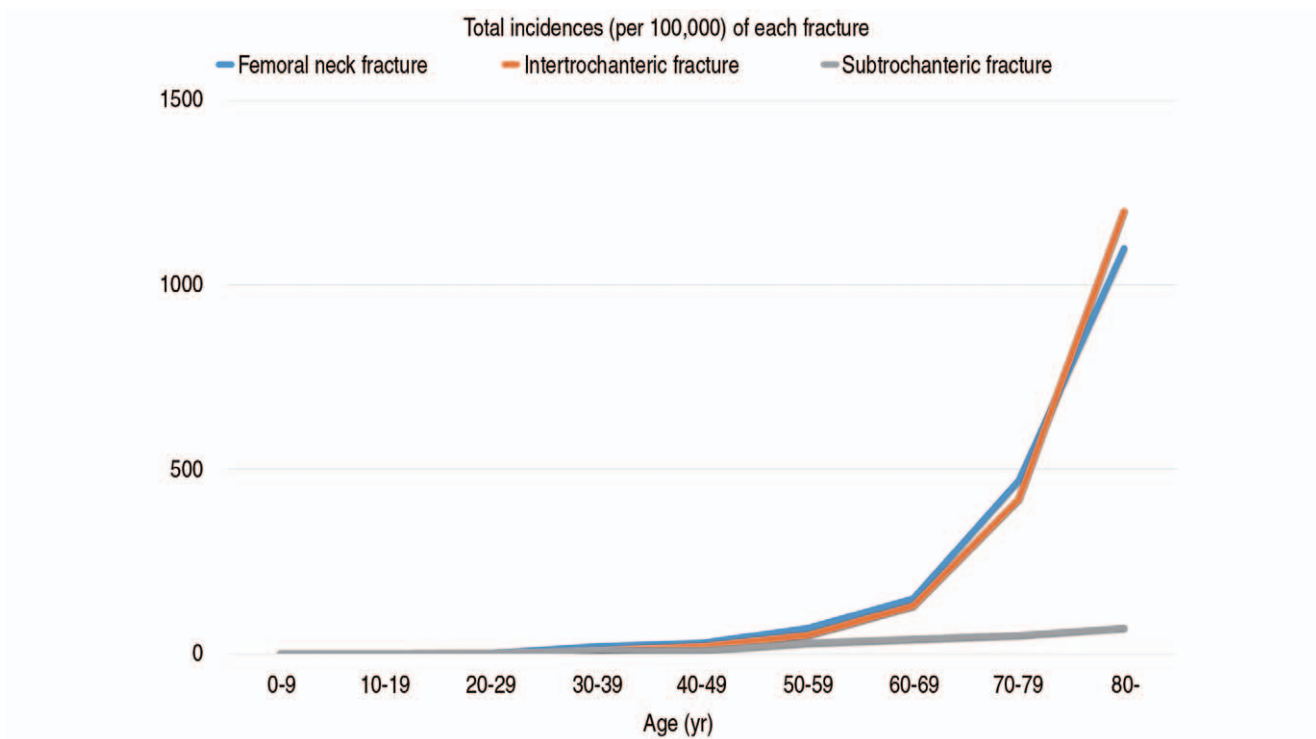
## TRENDS IN TREATMENT CHOICES

According to nationwide data from the Health Insurance Review Assessment Service (HIRA) in 2010, among proximal femoral fractures, 14,330 were femoral neck fractures, 13,089 were intertrochanteric fractures, and 974 were subtrochanteric fractures. The female-to-male ratio was 2.534 for femoral neck fractures, 2.165 for intertrochanteric fractures, and 1.435 for subtrochanteric fractures<sup>21</sup>. Subtrochanteric fractures accounted for 3.4% of all proximal femoral fractures. By age, the absolute numbers of femoral neck and intertrochanteric fractures increased exponentially after 60 years of age and peaked for both sexes<sup>21</sup>. The incidence of

**Table 1.** Age-adjusted Incidence (per 100,000) of Hip Fractures in Subjects Aged >50 Years in Different Populations

Author	Region	Study periods (year)	Men (n)	Women (n)
Falch et al. <sup>14)</sup>	Norway	1988-1989	382	885
Lippuner et al. <sup>18)</sup>	Switzerland	2000	235	576
Ho et al. <sup>16)</sup>	United States	1988-1989	204	535
Sanders et al. <sup>19)</sup>	Australia	1996	193	490
Balasegaram et al. <sup>13)</sup>	England	1997	177	488
Lau et al. <sup>17)</sup>	Hong Kong	1997-1998	195	468
Hagino et al. <sup>15)</sup>	Japan	2006	128	413
Lau et al. <sup>17)</sup>	Singapore	1997-1998	154	395
Lau et al. <sup>17)</sup>	Thailand	1988-1989	112	241
Lau et al. <sup>17)</sup>	Malaysia	1997-1998	83	195
Ha et al. <sup>20)</sup>	Korea (Jeju Island)	2002	101	194
Ha et al. <sup>20)</sup>	Korea (Jeju Island)	2011	114	278

Standardized to the Unites States population in 2008. Reproduced from Ha et al. (J Korean Med Sci. 2015;30:483-8)<sup>20)</sup>.



**Fig. 1.** The incidences (per 100,000) of each type of hip fracture type by age in Korea in 2010.

subtrochanteric fractures increased after 70 years of age, while the incidence rates of femoral neck and intertrochanteric fractures exponentially increased with age in both sexes (Fig. 1)<sup>21)</sup>.

Trends in the surgical treatment approaches used for femoral neck fractures, including internal fixation and hip arthroplasty, were assessed in patients aged ≥50 years using HIRA data from 2006 to 2011<sup>22)</sup>. Overall, the proportion of patients who underwent internal fixation diminished from 34.2% in 2006 to 29.9% in 2011, whereas the proportions

of patients who underwent hemiarthroplasty and total hip arthroplasty increased, respectively, from 62.2% and 3.6% in 2006 to 65.1% and 5.0% in 2011 ( $P<0.001$  for both, Fig. 2)<sup>22)</sup>. The trends in the utilization of cemented and cementless hemiarthroplasty for femoral neck fractures revealed that the proportion of cementless hemiarthroplasty increased from 42.7% of all surgical procedures in 2007 to 61.4% of all surgical procedures in 2011 ( $P<0.001$ ), while the use of cemented hemiarthroplasty demonstrated a corresponding decrease in South Korea<sup>23)</sup>.

Trends in the surgical treatment of intertrochanteric fractures were assessed in patients aged  $\geq 50$  years using HIRA data from 2006 to 2011, and the ratio of intramedullary nailing increased from 27.9% in 2006 to 64.3% in 2011 ( $P < 0.001$ ), while the ratio of plate fixation decreased<sup>24</sup>. During the most recent 5 years, the utilization of intramedullary nailing for intertrochanteric fractures doubled in clinical practice in Korea (Fig. 3)<sup>24</sup>.

The present data on intertrochanteric fractures revealed a shift from plate fixation to intramedullary nailing, a trend that mirrors the situation in the United States<sup>25</sup>.

### MORTALITY AND MORBIDITY AFTER HIP FRACTURE

A recent study on mortality after hip fracture consistently

confirmed the excessively high mortality after hip fractures in short-term follow-up. From 2008 to 2012, the 1-year cumulative mortality rate in patients aged  $\geq 50$  years after hip fractures using NHIS data was 17.2% (3,575/20,849) in 2008 and 16.0% (4,547/28,426) in 2012; the decrease was mainly observed among women<sup>9</sup>. In addition, the mean 1-year mortality rate was 21% for men and 15% for women, indicating that the incidence in men was 1.4 times higher than that in women (Fig. 4)<sup>9</sup>. The mean standardized morbidity ratio (SMR) for hip fractures in patients aged  $\geq 50$  years was higher for men (11.93; 95% confidence interval [CI], 11.66-12.21) compared with women (11.22; 95% CI, 11.03-11.42) and gradually declined with age<sup>9</sup>. In the younger age group (50-69 years), however, the mean SMR was higher in women. The SMRs were observed to be higher in all age groups compared with the general population<sup>9</sup>.

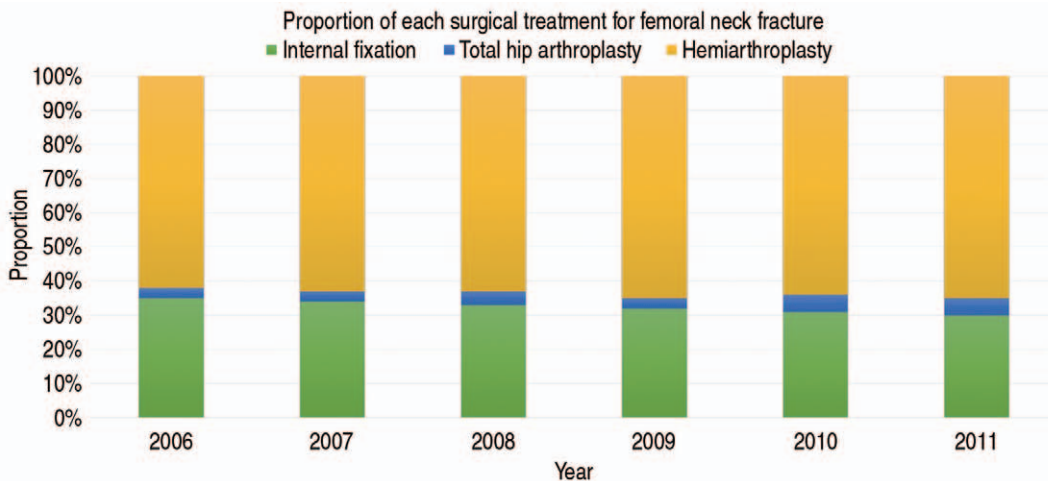


Fig. 2. The proportion of each surgical treatment for femoral neck fractures from 2006 to 2011.

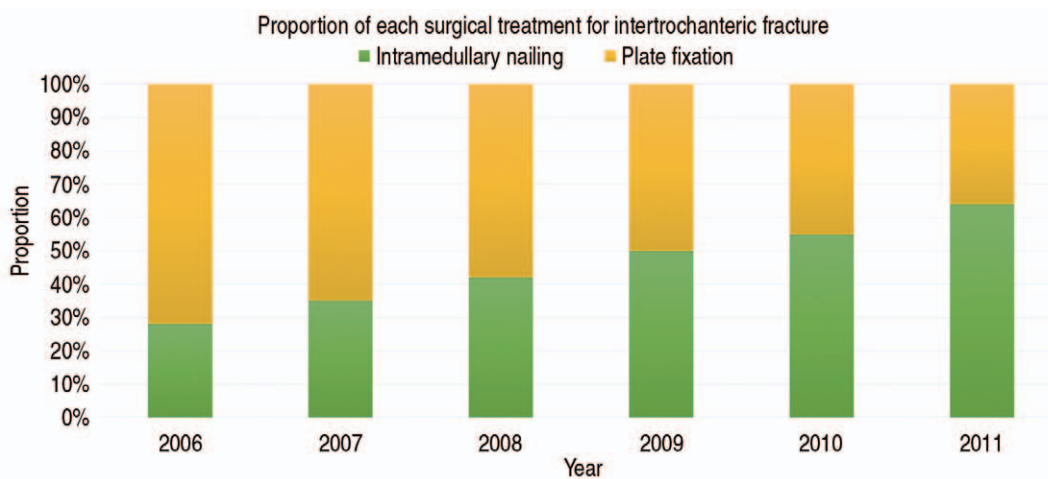


Fig. 3. Proportion of each surgical treatment for intertrochanteric fractures from 2006 to 2011. Reproduced from Lee et al. (J Korean Med Sci. 2013;28:1407-8)<sup>24</sup>.

A prospective cohort study assessing mid- to long-term mortality and morbidity rates after hip fracture was conducted to estimate the morbidity and mortality in 790 patients aged  $\geq 50$  years who sustained hip fractures and were followed up for a mean of 6 years<sup>3</sup>. Accumulated mortality was 16.7% (132 patients) in 1 year, 45.8% (337 patients) in 5 years, and 60% (372 patients) in 8 years. The SMR at 5 years after injury was 1.3 times greater when compared with the general population<sup>3</sup>. Among the 389 patients who remained alive at the final follow-up and agreed to activity evaluation, 199 of the 293 patients (68%) with preinjury outdoor activity levels of grades I and II achieved the same outdoor activity levels at final follow-up ( $P < 0.001$ )<sup>3</sup>. In addition, only 59 out of the 150 previous outdoor ambulators (39.3%) retained same activity level at a mean of 6 years after fracture (range, 4-9 years) (Table 2)<sup>3</sup>.

**CONCLUSION**

Considering the rapid aging of the South Korean population, the number of hip fractures is rapidly increasing; the incidence of hip fractures trended slightly up until 2012. Trends for in the use of different surgical options for femoral neck and intertrochanteric fractures in Korea are in line with the global trends. Although the high post-hip fracture mortality remains concerning, the mortality rate following hip fractures in Koreans decreased during the study period.

**CONFLICT OF INTEREST**

The authors declare that there is no potential conflict of interest relevant to this article.

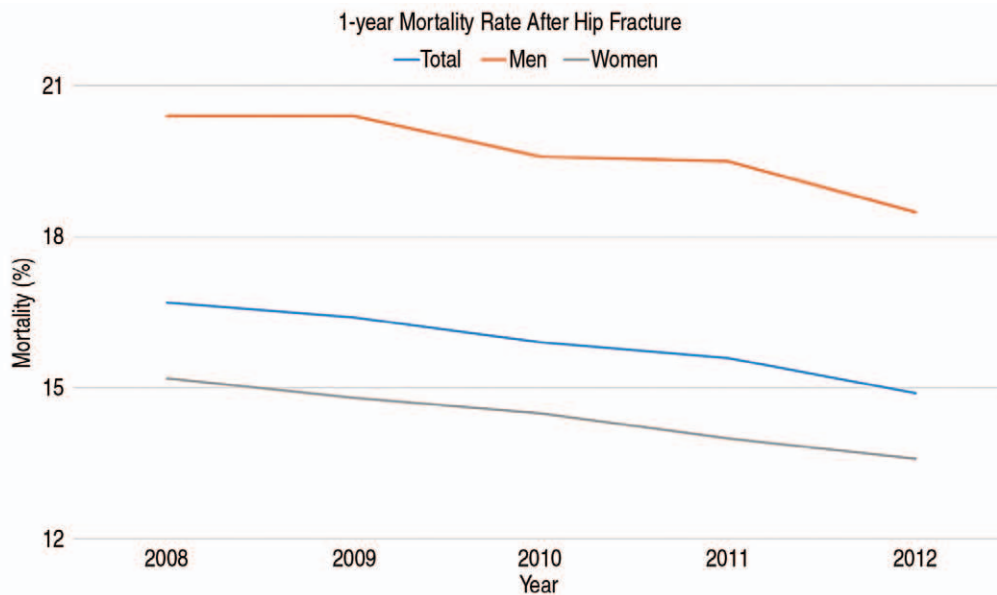


Fig. 4. 1-year mortality rate after hip fracture from 2008 to 2012.

**Table 2.** Changes in Activity Levels at a Mean 6 Years after Hip Fracture

Activity level	Preinjury activity (n)	Postinjury activity (n)	P-value
Grade I	150	59	<0.001
Grade II	143	140	<0.001
Grade III	86	136	<0.001
Grade IV	10	54	<0.001

Activity levels were defined as follows: Grade I, normal; Grade II, essentially independent outdoors but requiring help with some activities; Grade III, independent indoors but always requiring help outdoors; Grade IV, not independent indoors but able to walk independently; and Grade V, confined to a bed or chair and not ambulatory. Chi-square test was used to analyze categorical variables. Reproduced from Lee et al. [J Korean Med Sci. 2013;28:1089-94]<sup>3</sup>.

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