A Missed Opportunity to Prevent Subsequent Fractures Confirmed through Trends in the Treatment of Osteoporosis in Patients with Distal Radius and Hip Fractures

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Abstract

Background

A history of osteoporotic fracture (OF) is strongly associated with subsequent OFs. It is important to treat osteoporosis following OFs to prevent subsequent fractures. A distal radius fracture (DRF) is the most common type of OF in people in their 50s and could be a hallmark of future OFs. We compared the rate of osteoporosis treatment within 6 months post-DRF with hip fracture (HF).

Methods

We used data from the Korean Health Insurance Review and Assessment Service nationwide claims database from 2010 to 2016. International Classification of Diseases 10th revision (ICD-10) codes and procedures codes were used to identify patients older than 50 years with newly diagnosed DRFs and HFs. Then the rate of prescription and kinds of osteoporosis medications in these patients were analysed. We also compared the trends in both groups using the Cochran–Armitage trend test.

Results

A database search identified 77,209 DRFs and 72,044 HFs in patient aged 50 years or older from 2011 to 2016. Insufficient DRF and HF patients had osteoporosis medications (17.2% and 34.5%) and the numbers of osteoporosis medication for both DRFs and HFs decreased significantly annually ($P < 0.0001$). Bisphosphonates were used most often, although the use of selective oestrogen receptor modifiers (SERMs) increased gradually in both groups.

Conclusions

Clinicians who treat OFs should treat osteoporosis to prevent subsequent fractures and pay more attention to DRF patients who fail to get proper osteoporosis treatment.

Background

Osteoporosis is an increasing problem, particularly in the elderly [1, 2]. The elderly population growth rate is extremely high in Korea, where the life expectancy of those born in 2015 is close to 85 years for women and 80 for men [3]. Hip fractures (HFs) have high mortality and morbidity and the future [4]. HF prediction model for Korea shows that the elderly HF rate will increase 1.4 times by 2025 [5]. Therefore, physicians who treat osteoporotic fracture (OF) patients should be concerned about treating osteoporosis after OFs. That is one of the reasons for the fracture liaison service (FLS). Half of all potential HFs could be new and prior fragility fractures, affecting about 16% of the population [6]. The FLS defined adequate treatment and services for patients over 50 years old with fragility fractures, enabling systematic identification and decreasing the risk for subsequent OFs [7].

A distal radius fracture (DRF) is the earliest type of OFs in the fracture cascade and is the most common OF in those in their 50 s [8, 9]. Low-energy DRFs are hallmarks of osteoporosis. Therefore, proper management

of osteoporosis after DRF is the first step in preventing subsequent OFs in the FLS concept.

Previously, we found that only one-fourth of DRF patients underwent diagnostic examinations for osteoporosis and the annual number of osteoporosis examinations increased slightly, but insignificantly [10]. We wondered how many patients received osteoporosis medication after a DRF compared to HF patients.

In this study, we evaluated the prescription rate and kinds of osteoporosis medications, as proper management of osteoporosis, among Korean patients with DRFs and HFs from 2011 to 2016.

Methods

We used healthcare utilization data from the Korean Health Insurance Review and Assessment Service (HIRA) nationwide claims database, which covers about 97% of the Korean population [11, 12]. The International Classification of Diseases 10th revision (ICD-10) codes and procedure codes were used to identify patients over 50 years old with newly diagnosed DRFs and HFs from 2010 to 2016, as in past studies.

The ICD-10 codes and procedure codes used for DRFs and HFs were as follows. For HRs, the diagnosis codes were S72.0 (fracture of neck of femur) and S72.1 (pertrochanteric fracture) and seven procedures were used: open reduction of fractured extremity-femur, closed pinning-femur, external fixation-pelvis/femur, closed reduction of fractured extremity-pelvis/femur, bone traction, skin traction, and hemiarthroplasty-hip. For DRFs, the diagnosis codes were S52.5 (fracture of lower end of radius) and S52.6 (fracture of lower end of both ulna and radius) and six procedures were used: open reduction of ulna or radius, open reduction of ulna and radius, closed pinning of ulnar or radius, closed pinning of ulnar and radius, external fixation of forearm bone, and closed reduction of forearm bone.

We included only one record per patient and set the wash-out period to 1 year (2010). Exclusion criteria were multiple fractures, which means high-energy trauma, Paget disease, cancers, and those who had received an osteoporosis medication before the fracture.

The prescription rate and kinds of osteoporosis medications after DRFs and HFs were analysed with using the codes within 6 months post-fracture. We divided these osteoporosis medications into types, such as bisphosphonates and SERMs. We did not include parathyroid hormone or denosumab because these drugs were not covered by the Korean HIRA at that time. We compared the annually sorted result of HFs and DRFs.

Baseline characteristics were analysed with the χ^2 test. We used the Cochran–Armitage trend test to examine trends in osteoporosis diagnosis. The statistical analyses were performed using SAS for Windows (ver. 9.4; SAS Institute, Cary, NC, USA).

Results

The HIRA database search revealed 453,231 HFs from 2010 to 2016; of these, 279,034 were excluded due to duplicated data, death, or patient age under 50 years. After applying the 1-year washout period, 160,487 HFs

remained, of which 72,044 that met all of the inclusion criteria were included in the final analyses (Fig. 1). Similarly, we obtained 702,001 DRFs from 2010 to 2016 and 374,073 were excluded for the aforementioned reasons. Applying the washout period, 297,911 DRFs remained, of which 77,209 that met all of the inclusion criteria were included (Fig. 2).

The number of DRFs treated annually decreased over time, from 15,206 in 2011 to 10,778 in 2016 and a similar decreasing trend was observed in HFs, from 14,915 in 2011 to 9,682 in 2016. Of the 77,209 DRF cases, 13,242 (17.2%) received osteoporosis medication within 6 months post-fracture, whereas 24,877 (34.5%) of the 72,044 HF cases received osteoporosis medication. From 2011 to 2016, the prescription rates of osteoporosis medication for both HFs and DRFs decreased significantly ($P < 0.0001$) (Table 1).

Table 1
The prescription rates for osteoporosis medications in hip and distal radius fracture patients older than 50 years within 6 months after the fracture, from 2011 to 2016

	Hip fractures				**Distal radius fractures**			
Year	Total	Medication	No Medication	P-value	Total	Medication	No Medication	P-value
2011	14,915	5,228 (35.1%)	9,687 (64.9%)	< 0.0001	15,206	2,754 (18.1%)	12,452 (81.9%)	< 0.0001
2012	13,822	4,945 (35.8%)	8,877 (64.2%)		14,617	2,660 (18.2%)	11,957 (81.8%)	
2013	12,335	4,372 (35.4%)	7,963 (64.6%)		14,061	2,419 (17.2%)	11,642 (82.8%)	
2014	11,043	3,744 (33.9%)	7,299 (66.1%)		12,081	1,996 (16.5%)	10,085 (83.5%)	
2015	10,247	3,513 (34.3%)	6,734 (65.7%)		10,466	1,744 (16.7%)	8,722 (83.8%)	
2016	9,682	3,075 (31.8%)	6,607 (68.2%)		10,778	1,669 (15.5%)	9,109 (84.5%)	
Total	72,044	24,877 (34.5%)	47,167 (65.5%)		77,209	13,242 (17.2%)	63,967 (82.8%)	

*Exclusive criteria: multiple fractures, Paget disease, cancer, or osteoporosis treatment before the fracture.

*Cochran–Armitage trend test

Tables 2 and 3 show the proportions of patients who received osteoporosis medications within 6 months post-fracture in both HFs and DRFs, according to their baseline characteristics. Females and older patients were more likely to receive medications than males and younger patients. The highest rate for both HFs and DRFs was in those aged 70 to 79 years (40.9% and 30.0%, respectively). More HF patients were prescribed

osteoporosis medications in tertiary hospitals (44.9%), while the DRF patients who were treated in hospitals (20.7%) received more medications than those seen at other medical facilities.

Table 2
Baseline characteristics of DRFs from 2011 to 2016

	Medication (n = 11,672)	No Medication (n = 65,537)	Total (n = 77,209)	P-value
Sex Male Female	740 (3.8%) 12,502 (21.6%)	18,496 (96.2%) 45,471 (78.4%)	19,236 57,973	< 0.0001
Age (y) 50–59 60–69 70–79 80–89 ≥ 90	2,742 (8.4%) 4,370 (18.8%) 4,175 (30.0%) 1,751 (28.5%) 204 (18.9%)	30,025 (91.6%) 18,920 (81.2%) 9,757 (70.0%) 4,387 (71.5%) 878 (81.1%)	32,767 23,290 13,932 6,138 1,082	< 0.0001
Type of health insurance Medical care insurance Medical benefit system	12,352 (16.8%) 890 (23.5%)	61,066 (83.2%) 2,901 (76.5%)	73,418 3,791	< 0.0001
Type of medical institute Tertiary hospital General hospital Hospital Clinic Public health care centre	662 (16.2%) 4,239 (19.9%) 5,232 (20.7%) 3,105 (11.7%) 4 (12.9%)	3,429 (83.8%) 17,056 (80.1%) 20,066 (79.3%) 23,389 (88.3%) 27 (87.1%)	4,091 21,295 25,298 26,494 31	< 0.0001
*Exclusive criteria: multiple fractures, Paget disease, cancer, or osteoporosis medication before the fracture.				

Table 3

Baseline characteristics of HFs from 2011 to 2016

	Medication (n = 24,877)	No Medication (n = 47,167)	Total (n = 72,044)	P-value
Sex Male Female	5,070 (18.5%) 19,807 (44.3%)	22,296 (81.5%) 24,871 (55.7%)	27,366 44,678	< 0.0001
Age (y) 50–59 60–69 70–79 80–89 ≥ 90	1,028 (13.6%) 2,687 (26.9%) 9,114 (40.9%) 9,973 (39.1%) 2,075 (31.0%)	6,547 (86.4%) 7,299 (73.1%) 13,165 (59.1%) 15,538 (60.9%) 4,618 (69.0%)	7,575 9,986 22,279 25,511 6,693	< 0.0001
Type of health insurance Medical care insurance Medical benefit system	22,062 (35.1%) 2,815 (30.9%)	40,859 (64.9%) 6,308 (69.1%)	62,921 9,123	< 0.0001
Type of medical institute Tertiary hospital General hospital Hospital Clinic Public health care centre	5,403 (44.9%) 12,442 (33.8%) 6,802 (30.7%) 230 (22.0%) 0 (0.0%)	6,628 (55.1%) 24,395 (66.2%) 15,330 (69.3%) 814 (78.0%) 0 (0.0%)	12,031 36,837 22,132 1,044 0	< 0.0001

*Exclusive criteria: multiple fractures, Paget disease, cancer, or osteoporosis medication before the fracture.

Table 4
The kinds and proportions of osteoporosis medications used in hip and distal radius fracture patients from 2011 to 2016

	Hip fractures				Distal radius fractures			
Year	Total	BP	SERM	BP + SERM	Total	BP	SERM	BP + SERM
2011	5,228	4,900 (93.7%)	100 (1.9%)	228 (4.4%)	2,754	2,532 (91.9%)	32 (1.2%)	190 (6.9%)
2012	4,945	4,521 (91.4%)	184 (3.7%)	240 (4.9%)	2,660	2,304 (86.6%)	115 (4.3%)	241 (9.1%)
2013	4,372	3,991 (91.3%)	164 (3.7%)	217 (5.0%)	2,419	2,086 (86.2%)	146 (6.1%)	187 (7.7%)
2014	3,744	3,369 (90.0%)	216 (5.8%)	159 (4.2%)	1,996	1,732 (86.8%)	138 (6.9%)	126 (6.3%)
2015	3,513	3,164 (90.0%)	248 (7.1%)	101 (2.9%)	1,744	1,416 (81.2%)	238 (13.6%)	90 (5.2%)
2016	3,075	2,813 (91.5%)	215 (7.0%)	47 (1.5%)	1,669	1,398 (83.8%)	248 (14.8%)	23 (1.4%)
Total	24,877	22,758 (91.5%)	1,127 (4.5%)	992 (4.0%)	13,242	11,468 (86.6%)	917 (6.9%)	857 (6.5%)

*BP, bisphosphonates; SERM, selective oestrogen receptor modulators

The osteoporosis medications studied included bisphosphonates (alendronate, risedronate, ibandronate, etidronate, and zoledronic acid) and SERMs. Bisphosphonates were used mostly and trends to the increased use of SERMs were observed in both groups.

Discussion

Osteoporosis and OFs (i.e., DRFs, HFs, spine, and humerus fractures) are becoming more important health problems in the elderly [13]. OFs reduce quality of life and cause medical expenses in the elderly [14, 15].

DRFs occur mostly in individuals in their 50 s and 60 s and are predictive of a risk for secondary OF. Nevertheless, they tend to be less important than hip and spine fractures because of their lower morbidity and mortality [8, 16, 17]. DRFs are the second most common OFs in Korea [18, 19]. As background for the FLS, 50% of the patients who had HFs reported having other fractures, which could be called signal fractures, before their HFs [20, 21]. This means that osteoporosis management after DRFs could be an important intervention to prevent subsequent OFs.

In 2010, 9.9% of HFs, 19.3% of spine fractures, and 5.5% of proximal humerus fractures were managed with osteoporosis medications [22]. Jung et al. analysed the prescription rate of osteoporosis medications after a first OF in Korea from 2008 to 2012 and found that only 19% of men and 42% of women began anti-

osteoporosis treatment within 6 months after a first fracture [23]. The percentage of medication use for osteoporosis within 6 months post-DRF was 3.5% in men and 21.9% in women. Among HF patients, 20.1% of men and 45.9% of women received osteoporosis medications. In total, osteoporosis was managed in 18.9% of DRFs and 37.9% of HFs after fractures.

Our study revealed that from 2011 to 2016, 17.2% of DRF cases received osteoporosis medication within 6 months post-fracture, whereas 34.5% of HF cases did. Compared to a previous study, we observed a slightly lower prescription rate for osteoporosis medication, but not a big difference. The trend in the prescription rate showed a slight, but significant, decreasing tendency.

As in previous studies [23, 24], females were more likely than males to receive osteoporosis medication after DRFs and HFs. The rate of treatment was highest for those in their 70 s for both DRFs and HFs, as was a diagnosis of osteoporosis [10]. Similarly, young males were least likely to receive osteoporosis treatment in our study. Some studies have reported that men who are referred for osteoporosis tend to be with more severe osteoporosis [25], and the mortality rate related with HFs is higher in men than in women [26]. Therefore, physicians need to take care of young males with OFs, particularly DRFs.

The HF patients received more osteoporosis medications in tertiary hospitals, while the DRF patients who were treated in hospital received more medications than those seen at other medical facilities. This might result from the disease entity. Patients with an HF tend to be older and have more comorbidities and complications.

Bisphosphonates were mostly used; however, a gradual increase in the use of SERMs was observed, particularly in DRF patients. Although both DRFs and HRs are OFs, the T-score of bone mineral density sometimes exceeded − 2.5. This might be more common in DRFs because DRF patients are younger than HF patients. The increased use of SERMs might result from OFs in individuals with T-scores > − 2.5. Because complications of long-term bisphosphonate use are emerging, such as atypical femur fractures [27–29] and osteonecrosis of the jaws [30, 31], many clinicians think that the early use of bisphosphonate might not be ideal.

This study had several limitations. First, the incidence rates of DRFs and HFs calculated based on a medical claims database might be underestimated, in common with previous reports using medical claims databases. Second, we do not know whether the patients actually took the prescribed pills because our study was based on a claims database. Third, the healthcare system can affect the kinds of pills prescribed. Until 2016, parathyroid hormone and denosumab were permitted under very limited conditions. Since then, neither has been allowed for several conditions, so these two medications might have been used more before 2016.

Conclusions

The use of osteoporosis medications after DRFs and HFs is still inadequate for preventing subsequent OFs. Of course, we do not believe that osteoporosis medication alone is the most important treatment for osteoporosis. We emphasize that patients who receive osteoporosis medications should be aware of osteoporosis and additional treatments, such as exercise and dietary and lifestyle modifications. DRFs could

be a hallmark of subsequent hip and spine fractures. Physicians who treat DRFs in patients over 50 years of age should treat osteoporosis accordingly.

Abbreviations

DRF:distal radius fracture; FLS:fracture liaison service; HF:hip fracture; HIRA:Health Insurance Review and Assessment Service; ICD-10:International Classification of Diseases 10th revision; OF:osteoporotic fracture; SERM:selective oestrogen receptor modifier

Declarations

Acknowledgements

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Author contributions

The project was coordinated by DGK. DGK and HDJ drafted the manuscript, and together with HWN acquired the data from HIRA and analysed and interpreted the data. DGK, GWS and HUL revised the final draft critically for important intellectual content. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets analysed in this study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was conducted following approval by the Institutional Review Board of Soonchunhyang University Gumi Hospital (IRB number: SCHUH 2019–03).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

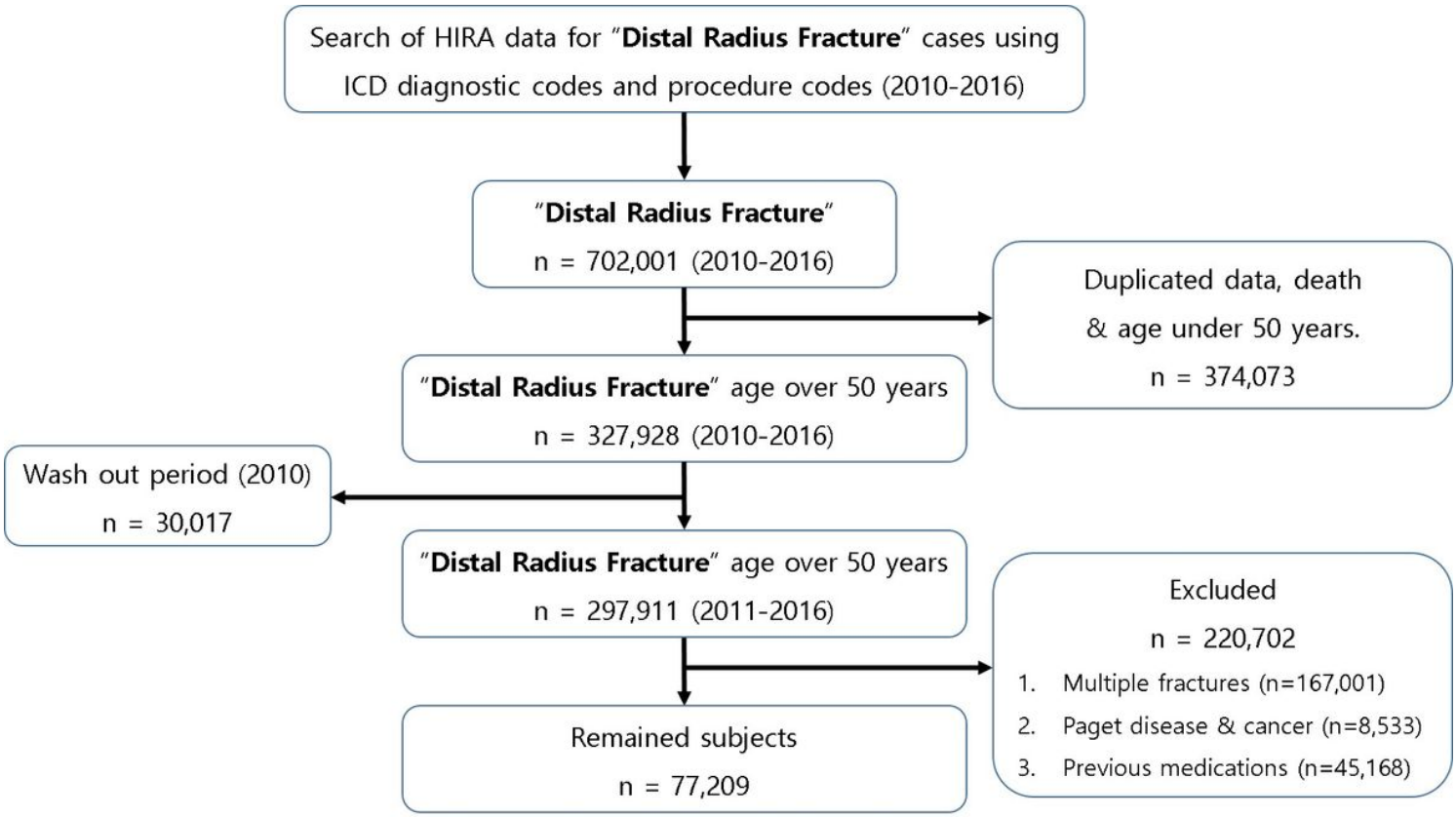


Figure 1

After applying the 1-year washout period, 160,487 HFs remained, of which 72,044 that met all of the inclusion criteria were included in the final analyses

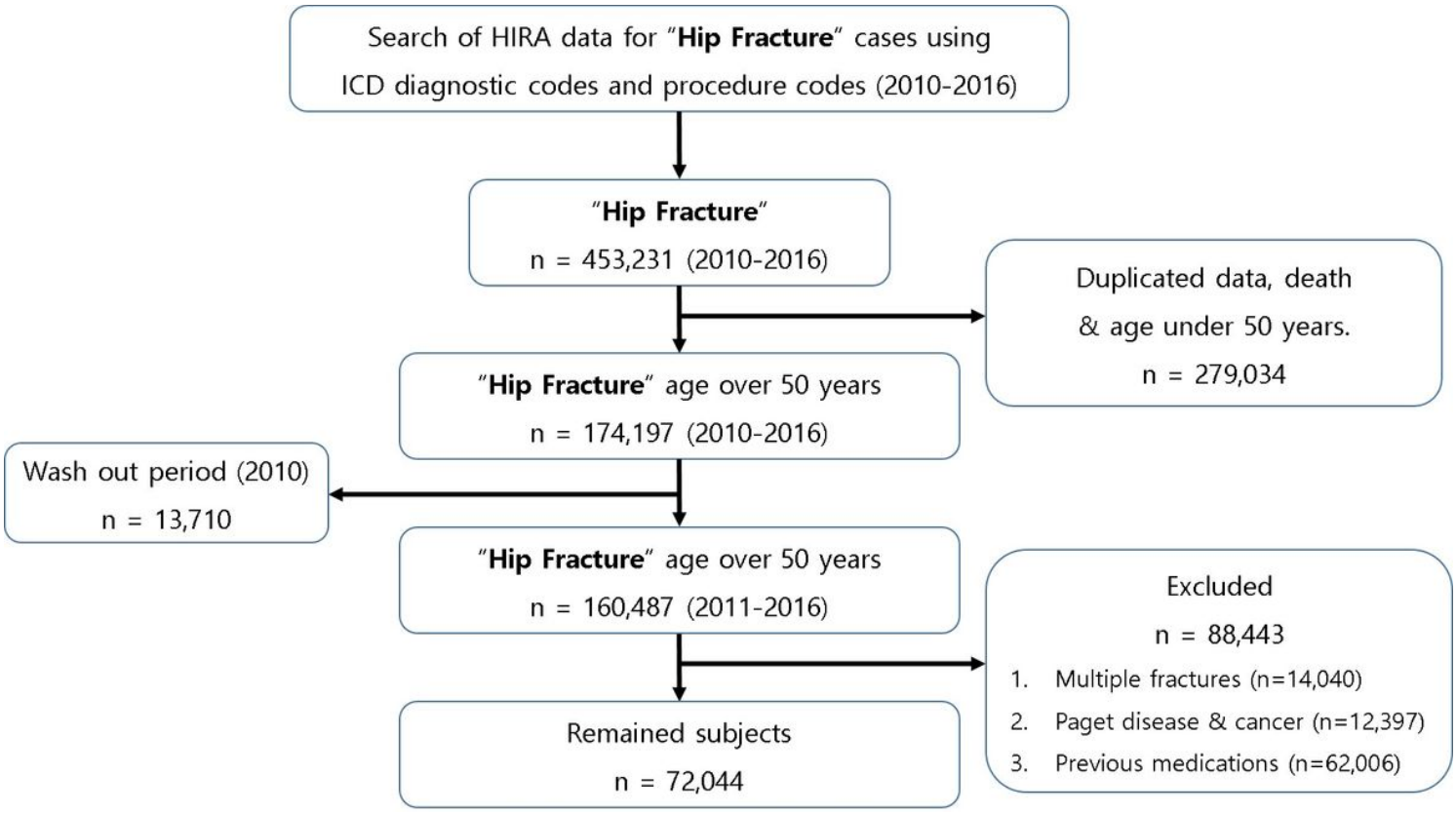
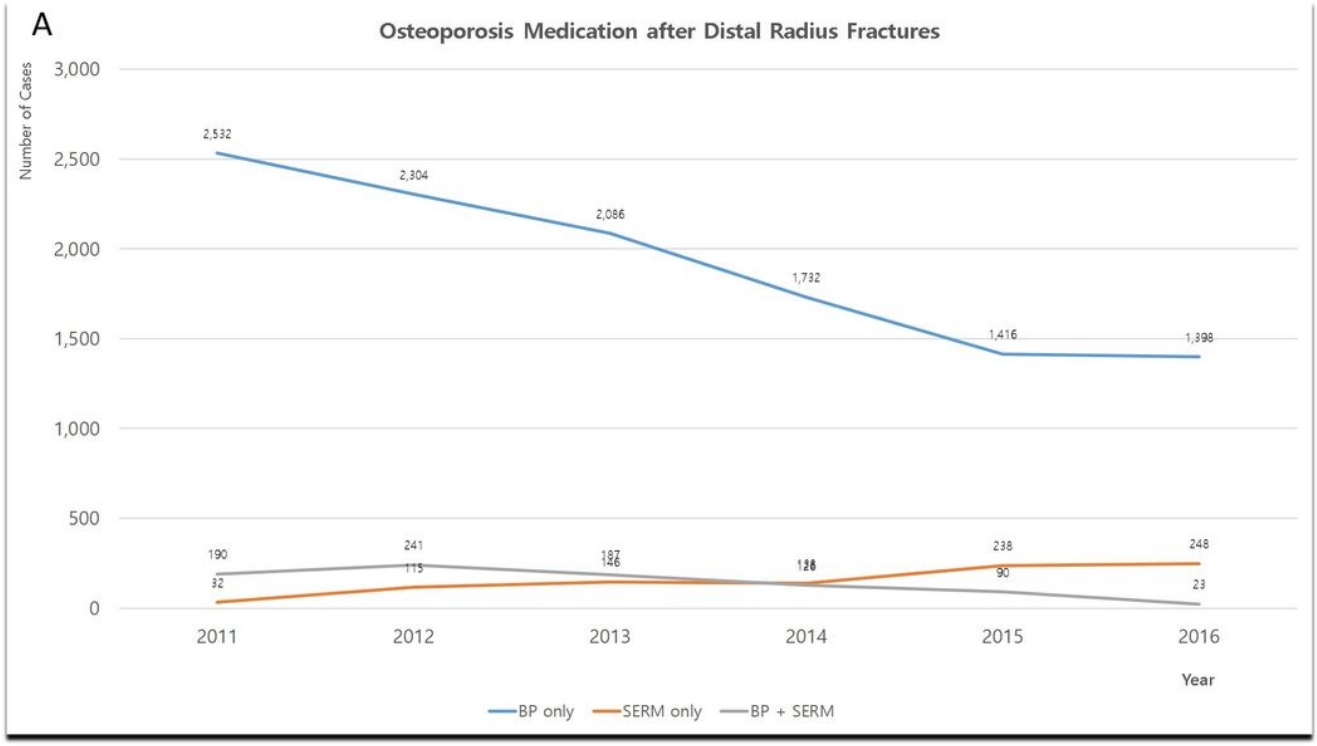


Figure 2

Similarly, we obtained 702,001 DRFs from 2010 to 2016 and 374,073 were excluded for the aforementioned reasons. Applying the washout period, 297,911 DRFs remained, of which 77,209 that met all of the inclusion criteria were included



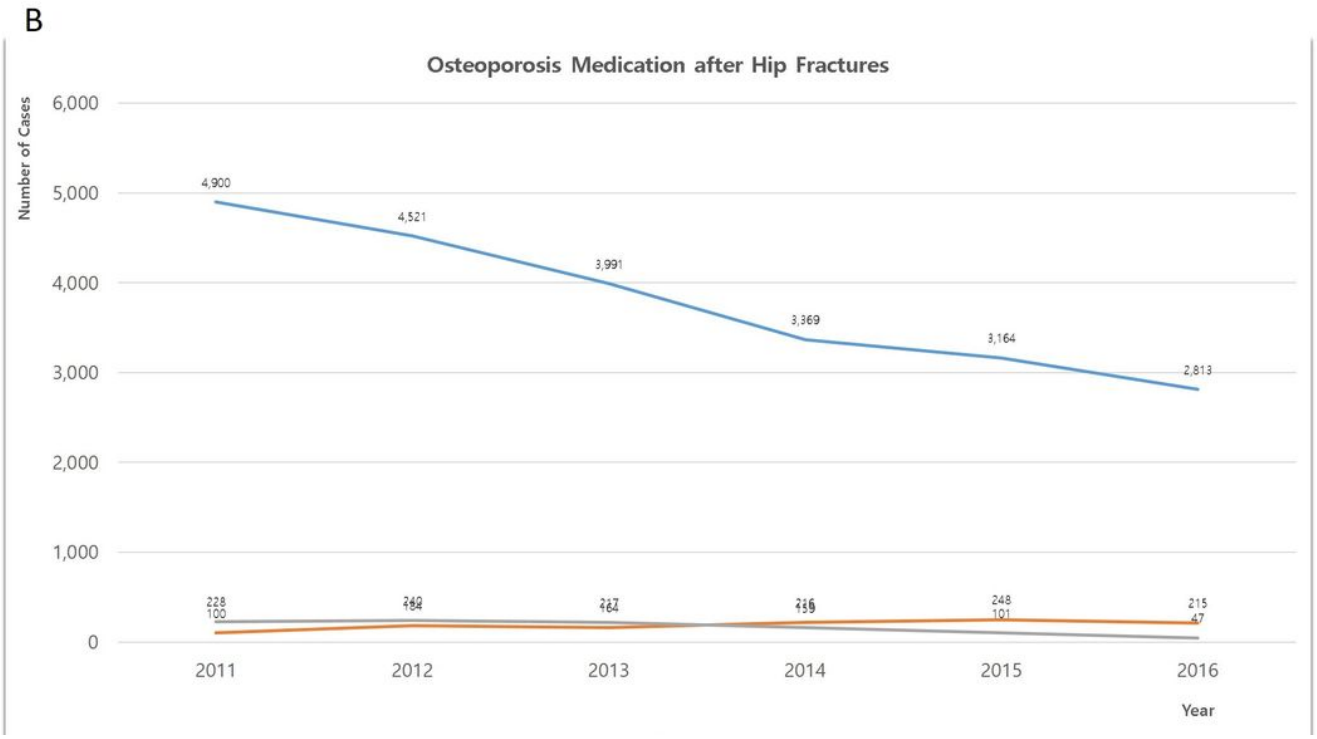


Figure 3

Osteoporosis medication after DRFs and HFs.