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Comparative Interrupted Time Series Analysis of Medical Expenses in Patients with Intertrochanteric Fracture Who Underwent Internal Fixation and Hemiarthroplasty

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Purpose: The objective of this study was to assess postoperative direct medical expenses and medical utilization of elderly patients who underwent either hemiarthroplasty (HA) or internal fixation (IF) for treatment of a femoral intertrochanteric fracture and to analyze differences according to surgical methods and age groups.

Materials and Methods: Data from the 2011 to 2018 Korean National Health Insurance Review & Assessment Service database were used. Risk-set matching was performed for selection of controls representing patients with the same sex, age, and year of surgery. A comparative interrupted time series analysis was performed for evaluation of differences in medical expenses and utilization between the two groups.

Results: A total of 10,405 patients who underwent IF surgery and 10,405 control patients who underwent HA surgery were included. Medical expenses were 18% lower in the IF group compared to the HA group during the first year after the fracture (difference-in-difference [DID] estimate ratio 0.82, 95% confidence interval [CI] 0.77-0.87, $P<0.001$), and 9% lower in the second year (DID estimate ratio 0.91, 95% CI 0.85-0.99, $P=0.018$). Length of hospital stay was significantly shorter in the IF group compared to the HA group during the first two years after time zero in the age ≥80 group.

Conclusion: A noticeable increase in medical expenses was observed for patients who underwent HA for treatment of intertrochanteric fractures compared to those who underwent IF over a two-year period after surgery. Therefore, consideration of such findings is critical when designing healthcare policy support for management of intertrochanteric fractures.

Keywords: Hip fractures, Intertrochanteric fractures, Hemiarthroplasty, Fracture fixation, Health expenditures

INTRODUCTION

Among the major types of osteoporotic fracture, hip fractures have been associated with severe functional loss and decreased quality of life, as well as high mortality rates for elderly patients[1]. In the United States, more than 300,000 cases of hip fracture are reported annually, and a worldwide increase in the incidence of hip fractures is expected[2]. Hip fracture patients incur significant healthcare expenses not only for loss of physical function but also for the treatment and management of comorbidities. Consequently, hip fractures have already become a socioeconomic burden in developed countries[3].

Various methods have been employed in the effort

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to reduce healthcare costs incurred by hip fracture patients. Screening for osteoporosis, evaluating the severity of osteoporosis, and prescribing osteoporosis medications are important methods for preventing future fractures[4]. Rehabilitation therapy can also be applied for prevention of fractures, and multidisciplinary treatment can prevent complications after fractures[5]. In addition, examination of the type of fracture and the patient's medical condition by an orthopedic specialist as an effort to utilize the most clinically cost-effective surgical intervention can be considered[6]. This could also be considered a critical matter.

Internal fixation (IF) is the primary choice for treatment of stable intertrochanteric fractures. However, obtaining favorable outcomes may not always be possible when treating unstable intertrochanteric fractures with IF[7,8]. Several studies have suggested that performing hemiarthroplasty (HA) for treatment of unstable intertrochanteric fractures can reduce operative failure and reoperation rates[9,10]. HA is generally associated with higher healthcare costs compared to IF. Considering this aspect, the lack of research comparing healthcare costs in treatment of intertrochanteric fracture using these two surgical methods is understandable. However, to the best of our knowledge, there is a lack of studies analyzing the effect of using HA compared to IF in treatment of patients with intertrochanteric fracture on long-term healthcare costs or the differences in healthcare utilization. Such analysis would be essential in the effort to understand the impact of utilizing these surgical methods on the healthcare system, which may be helpful in establishment of healthcare policies and guidelines for treatment of intertrochanteric fracture.

Thus, the objective of our study was to examine the postoperative direct medical expense and medical utilization for elderly patients who underwent HA or IF for treatment of a femoral intertrochanteric fracture and to analyze the differences according to surgical methods and age groups.

MATERIALS AND METHODS

The design and protocol for this retrospective cohort study were approved by Daejeon Eulji Medical Center's Institutional Review Board (IRB No. 2019-03-008).

1. Data and Patient Sample

Data from the 2011 to 2018 Korean National Health Insurance Review & Assessment Service (HIRA) database were utilized in this comparative large-sample cohort study. The HIRA collects data from claims submitted by healthcare providers for reimbursement under Korea's universal healthcare insurance system, with a fee-for-service model that covers the entire South Korean population[11]. The dataset includes all inpatient and outpatient medical claims data, including treatment procedure codes and diagnostic codes. Therefore, medical claims data for all hip arthroplasty procedures performed during the study period were identified.

2. Intertrochanteric Femoral Fracture Cohort

In consideration of previous studies, the inclusion criteria for the study sample were as follows[12-15]:

- First time admission to an acute care hospital (index admission) from 2011 to 2018 with codes for intertrochanteric femoral fractures (International Statistical Classification of Diseases and Related Health Problems, 10th Revision [ICD-10] S721); and
- Patients underwent surgeries including HA or IF
- Patients age ≥60 years old

The time zero (incidence date) for intertrochanteric fracture was defined as the date of admission to the hospital. The patients finally included in the study were classified according to the IF group and the HA group.

3. Cumulative Direct Medical Expenses

Quarterly, individual-level medical expenses were calculated for three years before and after time zero. The patients' quarterly direct medical expenses were recorded. Total medical expenses were defined as the sum of the amount paid by the National Health Insurance Corporation and the patient's co-payments for insured medical services, excluding payments for out-of-coverage services. According to the National Health Insurance Act, Korean patients pay a co-payment for insured medical services and out-of-pocket fees for uninsured services. Among them, only co-payments for insured medical services are archived in the HIRA database.

The total medical expenses included all expenses for outpatient and inpatient services, oriental medicine charges, dental services, prescriptions, and drugs, along with benefits covered by the National Health Insur-

ance Services[16]. Expenses for long-term care hospitals were included; however, costs of long-term care service were not. All medical expenses were converted to Korean won using the 2023 conversion index[11]. The won was then converted to US dollars with an exchange rate of 1,300 won per dollar (March 31, 2023).

4. Medical Utilization

The outcome variables for medical utilization were classified according to (1) hospital length of stay (LOS) of all admission cases, and (2) the total number of outpatient visits that included clinic and hospital visits. The unit of analysis was the patients' quarterly variables.

5. Risk-set Matching with Propensity Scores in Patients with Intertrochanteric Fracture

Although the HIRA database was constructed retrospectively, this study was conducted as a prospective study[17]. In addition, risk-set matching of patients with similar co-morbidity, medical utilization, and direct medical expenses before surgery was performed in order to maximize the comparability of the effect of surgery on direct medical expenses and medical utilization. Based on propensity score, risk-set matching was first performed for assignment of controls that reflect patients with the same sex, age, and year of surgery distribution in the HA group at time zero who underwent IF[17,18]. If patients who underwent HA passed during the follow-up period, patients whose time of death was within one month were matched to increase the comparability of medical utilization and expenses between the two groups. This process of risk-set matching was repeated until the patient who underwent HA had been completely matched[17,19-21]. Ultimately, propensity score was matched 1:1 successively for each risk-set using the nearest neighbor-matching algorithm and a maximum caliper width of 0.01 for probabilities. Probabilities were estimated as propensity scores from the logistic regression model and the matching variables were age, sex, Charlson comorbidity index (CCI) for three years immediately before surgery, medical utilization (including hospitalization and outpatient visits) and direct medical expenses for one year immediately before surgery, and year of surgery[18,22]. Patients who were matched from the risk-sets were then excluded to prevent overlapping samples. The process was repeated within consecutive risk-sets until patients who underwent HA were no longer reflected in the risk-set.

6. Statistical Analysis

In this comparative interrupted time series analysis, time series were constructed using the time unit of one-quarter before and after three years from time zero[23]. The time series were divided into seven segments before time zero and every half year after time zero. Changes in baseline trends and intercepts were considered before time zero, however, only intercept changes were considered in segments after the time zero[16]. In other words, the difference between before and after surgery in the HA and IF group was compared. All independent variables, including seasonality and CCI, were adjusted for performance of segmented regression analysis.

A generalized linear model with a gamma distribution and logarithmic link function was used for the segmented regression analysis. A generalized estimating equation using a robust standard error was used to avoid overestimation of the standard errors of the parameter estimates. All calculated P-values were two-sided, and $P<0.05$ were considered significant. All analyses were performed using SAS Enterprise Guide software (ver. 7.1; SAS Institute). Baseline characteristics, including age, sex, calendar year of surgery, CCI, medical history, medication history, and seasonality were examined as covariates. Weighting and scoring of comorbid conditions was performed for calculation of the CCI using Quan's method, with additional points given to comorbidities that can affect the health outcomes of patients[24]. Prescriptions for antihypertensive, antidiabetic, and lipid-lowering agents of more than 90 days were considered for patients who had taken the corresponding medications. Medical history included admission within one year before surgery and number of outpatient visits. Stratified analysis was also performed to examine the effect of surgery type on medical utilization and costs according to age group (<80 years, ≥80 years).

RESULTS

1. Baseline Characteristics of the Matched Cohort

A total of 19,454 patients who underwent HA surgery and 91,729 patients who underwent IF from 2011 to 2018 were included in the HIRA database (Fig. 1). Among them, 2,569 patients who underwent HA surgery in 2011 were excluded due to the challenge of determining the patients' conditions at the time of surgery due

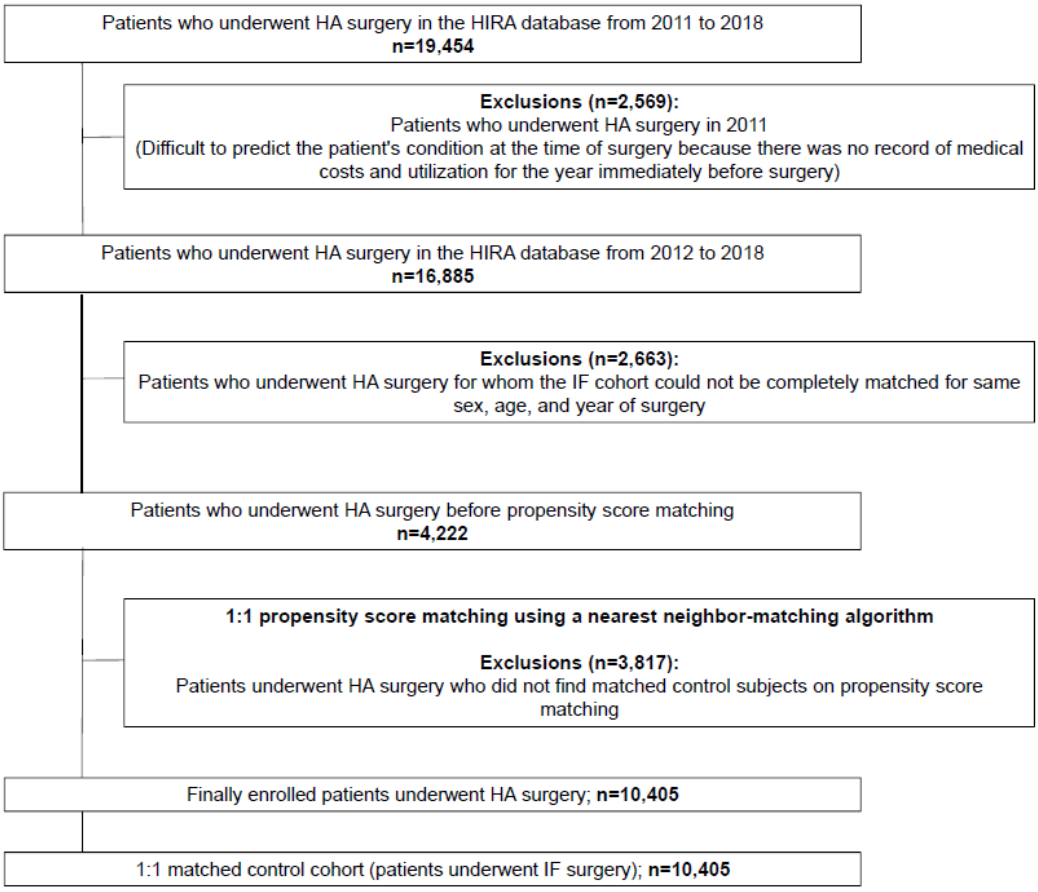

Fig. 1. Flow chart for patient selection and study analysis. HA: hemiarthroplasty, HIRA: Health Insurance Review & Assessment Service, IF: internal fixation.

to the lack of medical expense and utilization records for the year immediately prior to the surgery. Risk-set matching was performed, and during the process, 2,663 patients who underwent HA surgery were excluded due to discrepancies in age, gender, and the year of hip fracture compared to the IF group. In addition, 3,817 patients who underwent HA surgery were excluded due to substantial differences in propensity scores compared to patients in the IF group. Finally, 10,405 patients who underwent IF surgery and 10,405 control patients who underwent HA surgery were included (Table 1). The overall mean age was 81.4 years, and 83.5% of patients in both groups were female.

2. Differences in Direct Medical Expenses

The direct medical expenses per quarter in each group are shown in Fig. 2. Prior to time zero, the direct medical expenses per quarter were similar between the two groups. However, in the first quarter following time zero, medical expenses were higher for the HA group compared to the IF group. Afterward, similar medical expenses were again incurred by patients in both groups. In the first year after time zero, the IF group expended 2,295 USD less in direct medical expenses compared to the HA group, and in the second year, their expenditure was 210 USD less (Table 2).

Differences in differential changes in direct medical expenses in the IF and HA groups before and after time zero are shown in Table 3. Medical expenses were 18% lower in the IF group compared to the HA group during the first year after fracture (difference-in-difference [DID] estimate ratio 0.82, 95% confidence interval [CI] 0.77-0.87, $P<0.001$), and even in the second year, their medical expenses were 9% lower (DID estimate ratio 0.91, 95% CI 0.85-0.99, $P=0.018$). However, no statistically significant decrease was observed in the third year after fracture.

Table 1. Baseline Characteristics of Study Participants

Variable	Hemi arthroplasty	Internal fixation	Standardized difference*
Total	10,405 (50.0)	10,405 (50.0)	
Sex			0
Male	1,719 (16.5)	1,719 (16.5)	
Female	8,686 (83.5)	8,686 (83.5)	
Age (yr)	81.4±6.8	81.4±6.8	0
Age group			0.004
<80 yr	3,731 (35.9)	3,751 (36.0)	
≥80 yr	6,674 (64.1)	6,654 (64.0)	
Charlson comorbidity index			0.022
0	2,766 (26.6)	2,839 (27.3)	
1	2,907 (27.9)	2,848 (27.4)	
2	1,912 (18.4)	1,864 (17.9)	
≥3	2,820 (27.1)	2,859 (27.5)	
Medical history			
No. of outpatient visits within 1 years before surgery			0.028
≥0, <10	896 (8.6)	866 (8.3)	
≥10, <30	1,605 (15.4)	1,692 (16.3)	
≥30, <60	2,534 (24.4)	2,469 (23.7)	
≥60, <90	1,759 (16.9)	1,801 (17.3)	
≥90	3,611 (34.7)	3,577 (34.4)	
No. of admission within 1 years before surgery			0.005
0-1	5,754 (55.3)	5,725 (55.0)	
≥2	4,651 (44.7)	4,680 (45.0)	
Antihypertensive agents			0.014
Yes	7,401 (71.1)	7,466 (71.8)	
Antidiabetic agents			0.036
Yes	2,814 (27.0)	2,645 (25.4)	
Lipid-lowering agents			0.036
Yes	3,566 (34.3)	3,389 (32.6)	
Month at the time of surgery			0.187
January to March	2,453 (23.6)	3,144 (30.2)	
April to June	2,355 (22.6)	2,496 (24.0)	
July to September	2,540 (24.4)	2,396 (23.0)	
October to December	3,057 (29.4)	2,369 (22.8)	
Year of surgery			0.000
2012	1,750 (16.8)	1,750 (16.8)	
2013	1,700 (16.3)	1,700 (16.3)	
2014	1,719 (16.5)	1,719 (16.5)	
2015	1,796 (17.3)	1,796 (17.3)	
2016	1,868 (18.0)	1,868 (18.0)	
2017	1,572 (15.1)	1,572 (15.1)	
Anesthsia			0.039
General	2,819 (27.1)	2,638 (25.4)	
Spinal	7,586 (72.9)	7,767 (74.6)	

Values are presented as number (%) or mean±standard deviation.
*Standardized difference of less than 0.1 (10%) is generally considered negligible.

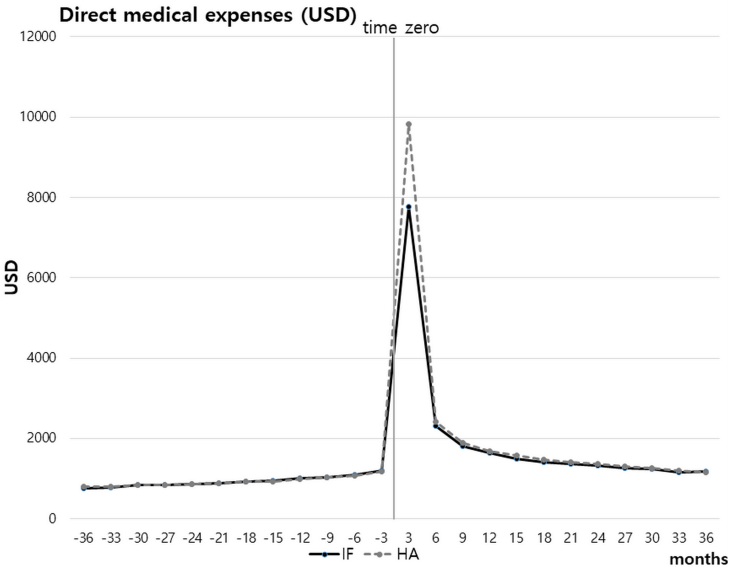

Fig. 2. Graph showing the direct medical expenses per quarter for intertrochanteric fractures in the hemiarthroplasty (HA) group and the internal fixation (IF) group. USD: US dollar.

Table 2. Direct Medical Expenses in the Patients Who Underwent IF and HA before and after Time Zero (Unit: USD)

Period	IF (case group)	HA (control group)	Mean difference (95% CI)*	*P*-value
Direct medical expenses before time zero				
3 years	3,168±4,749	3,212±4,814	−44 (−31 to 119)	0.248
2 years	3,536±5,280	3,523±5,293	13 (−87 to 62)	0.739
1 year	4,330±6,250	4,279±6,142	51 (−135 to 33)	0.234
Direct medical expenses after time zero				
1 year	13,523±9,480	15,818±10,108	−2,295 (−2,428 to −2,162)	<0.001
2 years	5,494±8,234	5,705±8,397	−210 (−326 to −94)	<0.001
3 years	4,706±7,703	4,797±7,764	−91 (−209 to 28)	0.133

Values are presented as mean±standard deviation.
IF: internal fixation, HA: hemiarthoplasty, USD: US dollar, CI: confidence interval.
*Mean difference: the difference in direct medical expenses between the patients who underwent IF and the patients who underwent HA.

Table 3. Differences in Differential Changes in Direct Medical Expenses between the IF and Matched HA Cohorts before and after Time Zero

IF (case group) vs. HA (control group)	Estimate ratio	95% CI	*P*-value
Indication of predicted graph*			
Ratio of baseline direct medical expense difference	0.94	0.88-1.02	0.119
Ratio of direct medical expense increase per quarter	1.00	0.99-1.00	0.037
Ratio of difference in the slope of direct medical expense increase†	1.01	1.00-1.01	0.086
Difference in difference estimate‡			
1 year	0.82	0.77-0.87	<0.001
2 years	0.91	0.85-0.99	0.018
3 years	0.92	0.83-1.01	0.075

IF: internal fixation, HA: hemiarthroplasty, CI: confidence interval.
*Indicators of the predicted graph for direct medical expenses, considering the increase in direct medical expenses of both groups before hip fracture.
†Slope difference: difference in the slope of the increase in direct medical expenses in the patients with IF and HA.
‡Difference in difference estimate: the ratios of direct medical expenses at each time point, considering the difference in direct medical expenses before and after time zero in the IF group and the difference in direct medical expenses before and after time zero in the HA group.

3. Differences in Medical Utilization

Differences in differential changes in medical utilizations in the IF and HA groups before and after time zero are shown in Table 4. No statistically significant difference in hospital LOS and outpatient visits for three years after time zero was observed between the two groups.

Table 4. Differences in Differential Changes in Medical Utilizations between the IF and Matched HA Cohorts before and after Time Zero

IF (case group) vs. HA (control group)	Estimate ratio	95% CI	*P*-value
Hospital LOS			
Indication of predicted graph*			
Ratio of baseline LOS difference	1.05	0.93-1.17	0.452
Ratio of LOS increase per month	1.00	0.99-1.00	0.171
Ratio of difference in the slope of the LOS increase†	1.00	1.00-1.00	0.793
Difference in difference estimate‡			
1 year	0.95	0.81-1.01	0.104
2 years	0.94	0.65-1.00	0.053
3 years	0.95	0.60-1.02	0.170
No. of outpatient visits			
Indication of predicted graph*			
Ratio of baseline OV difference	1.00	0.97-1.12	0.948
Ratio of OV increase per month	1.00	1.00-1.01	0.001
Ratio of difference in the slope of the OV increase†	1.00	1.00-1.00	0.511
Difference in difference estimate‡			
1 year	1.00	0.97-1.03	0.829
2 years	1.01	0.98-1.07	0.664
3 years	1.03	1.00-1.07	0.061

IF: internal fixation, HA: hemiarthroplasty, CI: confidence interval, LOS: length of stay, OV: number of outpatient visits.
*Indicators of the predicted graph for LOS, and OV, considering the increase in LOS, and OV of both groups before hip fracture.
†Slope difference: difference in the slope of the increase in LOS, and OV in the patients with IF and HA.
‡Difference in difference estimate: the ratios of LOS, and OV at each time point, considering the difference in LOS, and OV before and after time zero in the IF group and the difference in LOS, and OV before and after time zero in the HA group.

4. Differences by Age

Differences in differential changes in direct medical expenses and hospital LOS in the IF and HA groups according to age groups are shown in Table 5. In the age <80 group, a significant decrease in direct medical expenses was observed in the IF group compared to the HA group during the first year after time zero (DID estimate ratio 0.86, 95% CI 0.82-0.91, $P<0.001$). Also, in the age ≥80 group, a significant reduction in direct medical expenses was observed in the IF group compared to the HA group for the first two years after time zero. In addition, LOS was significantly shorter in the IF group compared to the HA group during the first two years after time zero in the age ≥80 group. However, in the age <80 group, no differences in LOS were observed between the two groups ($P>0.05$).

DISCUSSION

In summary, the results of this study are as follows: Direct medical expenses were lower in the IF group compared with the HA group during the first and second years after surgery, with most of the differences in cost incurred within the first three months after surgery. Over a period of three years after surgery, no significant differences in terms of hospital LOS and number of outpatient visits were observed between the two groups. However, in the age ≥80 group, a reduction in hospital LOS for up to two years after surgery was observed in the IF group compared to the HA group.

Selection of a surgical treatment method for patients with hip fractures should focus not only on restoring the patient's function but also on minimizing the potential for surgical and medical complications as much as possible[25]. In this regard, use of both a sliding hip screw and an intramedullary nail has been recommended as an option for treatment of intertrochanteric fractures[26]. However, the risk of fixation failure is increased when performing IF for treatment of unstable intertrochanteric fractures, particularly those with severe comminution in the posteromedial femoral cortex, due to an insufficient area of support for resistance to axial loading and preventing collapse[27]. In a meta-analysis of randomized controlled trials comparing IF and HA in treatment of unstable intertrochanteric fractures, Hongku et al.[9] reported that the lowest risk

Table 5. Differences in Differential Changes in Medical Expenses and Hospital LOS between the IF and HA Cohorts before and after Time Zero according to Age Group

IF (case group) vs. HA (control group)	<80 years			≥80 years		
	Estimate ratio	95% CI	*P*-value	Estimate ratio	95% CI	*P*-value
Direct medical expenses of the episode						
Indication of predicted graph*						
Ratio of baseline direct medical expense difference†	0.98	0.90-1.06	0.556	0.99	0.93-1.07	0.845
Ratio of direct medical expense increase per quarter	1.00	0.99-1.00	0.005	0.99	0.99-1.00	<0.001
Ratio of difference in the slope of direct medical expense increase‡	1.00	1.00-1.00	0.982	1.00	1.00-1.01	0.394
Difference in difference estimate§						
1 year	0.86	0.82-0.91	<0.001	0.82	0.78-1.35	<0.001
2 years	1.00	0.93-1.07	0.996	0.93	0.87-1.00	0.016
3 years	0.98	0.91-1.07	0.685	0.96	0.89-1.04	0.296
Hospital LOS						
Indication of predicted graph*						
Ratio of baseline LOS difference†	0.85	0.71-1.01	0.063	1.16	1.00-1.35	0.052
Ratio of LOS increase per quarter	1.00	0.99-1.01	0.630	1.00	0.99-1.00	0.582
Ratio of difference in the slope of LOS increase‡	1.01	1.00-1.01	0.122	1.00	0.99-1.00	0.244
Difference in difference estimate§						
1 year	1.03	0.93-1.14	0.550	0.91	0.83-0.98	0.019
2 years	0.98	0.88-1.09	0.749	0.91	0.83-0.99	0.036
3 years	0.97	0.87-1.09	0.633	0.94	0.86-1.03	0.190

LOS, length of stay, IF: internal fixation, HA: hemiarthroplasty, CI: confidence interval.
*Indication of predicted graph: Indicators of the predicted graph for direct medical expense, an LOS, considering the increase in direct medical expense, and LOS of both groups before matching.
†Baseline expense difference: difference in direct medical expense, and LOS in the patients who underwent IF (case group) and HA (control group).
‡Expense slope difference: difference in slope of direct medical expense, and LOS increase in the patients who underwent IF (case group) and HA (control group).
§Difference in difference estimate ratio: The ratios of medical expenses at each time considering the difference between the difference in medical expense before and after time zero in the IF (case) group and the difference in medical expense before and after time zero in the HA (control) group.

of operative failure and reoperation rates, as well as the most favorable short-term functional results, were obtained with use of HA. Tu et al.[28] also reported that HA, compared to IF, can enable early weight bearing and reduce the occurrence of implant-related complications in patients with unstable intertrochanteric fractures. However, according to the results of our study, higher medical costs were incurred with use of HA compared to IF. Therefore, the choice of HA for treatment of patients with intertrochanteric fracture should be limited to cases with a high risk of IF failure, particularly in the unstable type. However, it should be noted that this difference in medical expenses is limited to the short-term period after surgery. In addition, despite significantly higher expenses for revision arthroplasty, we believe that a long-term increase in medical expenses in the HA group was not observed due to the low revision rate for HA. Differentiating based on the method of surgical treatment used is important when providing medical policy support for patients with intertrochanteric fractures. In particular, policy support for medical expenditure is required for up to two years after surgery for patients who have undergone HA for treatment of intertrochanteric fractures, and the emphasis is greater within the first three months after surgery.

Early ambulation for patients with hip fractures is known to prevent complications such as pneumonia and pressure sores, and reduce functional loss[1]. The decline in physical function observed in these patients can lead to increased dependence on others as well as a decreased quality of life, thus early ambulation is critical[29]. Therefore, we believe that preserving function after surgical treatment for intertrochanteric fractures can have an impact on patients' health status and alter their patterns of healthcare utilization. In our study, no significant difference in medical utilization was observed between the HA group and the IF group.

However, in patients aged 80 and older, a higher LOS was observed in the HA group compared with the IF group up to two years after surgery. We believe there are several reasons for this finding. First, in the long term, the function of a normal joint may be superior to that of an artificial joint. Studies reporting clinical outcomes for patients with intertrochanteric fracture who underwent IF or HA have presented conflicting arguments, resulting in ongoing debates[28,30,31]. However, in our opinion, regardless of the surgical method used, appropriate anatomical reduction and rigid fixation or anatomical restoration do not appear to result in significant clinical or functional differences. However, in a network meta-analysis of randomized controlled trials comparing the IF group and the HA group in elderly patients with intertrochanteric fracture, Hongku et al.[9] reported that, within six months after surgery, the highest Harris hip score was observed in the HA group; however, in the long term, the best HHS was observed in the IF group using a proximal femoral nail. They asserted that despite the advantage of early weight-bearing for patients undergoing HA, a normal joint will ultimately exhibit functional superiority to an artificial joint. We believe that this may have a greater impact on functional decline, particularly in elderly patients with a high prevalence of sarcopenia. Second, the issue of recovery from muscle loss may have greater significance in elderly patients[32]. During execution of the surgical approach, damage to soft tissues caused by HA may be greater than that caused by IF. In elderly patients, damaged muscle may be replaced with fibrous tissue or healing may be inadequate, which can impact functional recovery and have long-term effects on function[33]. And, the lack of difference in LOS observed between the two groups at postoperative three years in the age ≥80 group can be attributed to the high mortality rate in patients with hip fractures, resulting in only the survival of individuals who were healthy with good functional status. However, conduct of additional research will be required for establishment of causal relationships regarding these findings.

Our study has several limitations. First, because this study is based solely on the South Korea database, direct comparison of the healthcare expenses reported in our study with the expense increases or decreases reported in studies from other countries is difficult. However, this study compared the relative expenses incurred by patients in the hip fracture group and the matched control group. The characteristics and recovery of hip fracture patients are similar regardless of race or country; therefore, we believe that the duration of escalating healthcare expense can be generalized. Second, in the study design, due to the nature of the claimed data, we were unable to account for differences in the type of intertrochanteric fracture between the two groups. The likelihood of a stable fracture was higher in the IF group, while the proportion of unstable fractures was likely higher in the HA group. However, unlike IF, it appears that the clinical outcomes for HA do not vary based on the type of intertrochanteric fracture[9,34]. Therefore, we believe that a comparison of the two groups is possible. In addition, the healthcare expenses incurred before the fracture, not just the underlying diseases affecting preoperative patients, were considered in order to adjust for the severity of underlying diseases. After matching, expenses incurred before the fracture and demographic factors in the analysis of differences in healthcare expenses and utilization between the two groups were readjusted as an effort to minimize differences in health status. Third, the disease codes recorded in the cohort may not always accurately reflect an individual's actual health condition, which is an inherent constraint of administrative claims databases. However, the selection of patients with intertrochanteric fracture in this study was based on previous research findings and a high level of reproducibility has been demonstrated. This is due to the widespread adoption of the fee-for-service system among healthcare providers, and the fact that all treatment related procedures, including surgeries, are documented and claimed by hospitals.

CONCLUSION

In conclusion, an increase in healthcare expenses was demonstrated for patients who underwent HA for treatment of intertrochanteric fractures compared to those who underwent IF over a two-year period following surgery. Many of these increased expenses were incurred within three months after surgery, and an increase in LOS was observed among patients aged 80 or older. Our research results should be considered when designing healthcare policy support for patients with intertrochanteric fracture.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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