Incidence of postoperative complications and non-periprosthetic fractures after total hip arthroplasty: A more than 10-year follow-up retrospective cohort study

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ABSTRACT. Objective: Postoperative complications and non-periprosthetic fractures (NPPFs), which was defined as a fracture existing non-periprosthetic implant, after total hip arthroplasty (THA) have a negative effect on the patients’ ability to perform activities of daily living. Thus, investigating these incidences of patients after THA will be valuable as it lead to a more strategic physical therapy interventions and advanced research to prevent these problems. The purpose of this study was to investigate the incidence of postoperative complications related to implants and NPPFs in patients after THA, a more than 10-year follow-up. Methods: This is a retrospective cohort study. A total 892 patients with hip osteoarthritis who underwent primary THA were analyzed (age at surgery was 45-79 years; 805 women; the average follow-up period was 12.4-year). The postoperative complications related to implants and NPPFs were calculated using data from their medical records. Results: The postoperative complications occurred in 37 patients, and NPPFs occurred in 72 patients, who were significantly older, and hip and knee OA diagnosis, compared to patients without NPPFs (p <.05). The most common cause of NPPFs was minor trauma. In patients aged ≥ 65 years, significantly more NPPFs occurred during the first year after surgery (p <.05). Conclusion: More than 10-year after THA, the incidence of NPPFs was higher than that of postoperative complications related to implants. Older patients who had hip and knee OA were a significantly higher risk of developing NPPFs due to falls within the first year after surgery.

Key words: total hip arthroplasty, postoperative complications, non-periprosthetic fractures, fall

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tutes (PFFs) increase over time, leading to a decrease in implant survival, ADLs, and QOL. In addition, non-periprosthetic fractures (NPPFs), which was defined as a fracture in a bone with an existing non-periprosthetic implant, in patients after joint replacement was a major problem for health care systems that is known to be increased risk of morbidity, post-operative complications required further surgery, and mortality. Previous literature demonstrated the incidence and risk factors of implant-related postoperative complications after THA; however, little is known about the incidence of NPPFs in patients long-term after THA.

The number of older patients undergoing THA with osteoporosis and risk of falls are increased due to an aging population, and the incidence of NPPFs may lead to an increase after THA. Thus, it is important to clarify the incidence and predisposing factors for implant-related postoperative complications and NPPFs in order to establish more effective physical therapy interventions. Therefore, the purpose of this study was to examine the incidence of implant-related postoperative complications and NPPFs in patients at a more than 10-year follow-up after THA.

Materials and Methods

Study design

This is a retrospective cohort study.

Patients

We retrospectively reviewed the medical records of 1,586 consecutive patients who underwent primary THA due to hip OA at the authors’ hospital between October 2004, and August 2009.

The inclusion criteria were as follows: (1) aged 45-79 years at the time of surgery; and (2) without osteotomy at the time of surgery; (3) had no fracture at the time of surgery; (4) did not have a history of hip surgery; (5) cementless acetabular component; (6) used included metal on polyethylene bearing. The exclusion criteria were as follows: (1) did not visit for regular postoperative medical examination; (2) deceased during the observation period; and (3) severe medical, neurological, or cognitive disease. For patients operated on bilaterally, we counted from the first operated hip.

This study was approved by the Mirai Iryo Research Center (approval number TGE 01339-151).

Surgical procedure and post-operative protocol

All surgeries were performed by the anterolateral approach. In the post-operative protocol, full weight-bearing was allowed on the day of surgery, walk with walker on the day after surgery, and walk with a cane on the second day after surgery. Patients were allowed to discharge the hospital when they could walk with a cane and climb and descend stairs. The length of hospital stay was 7-12 days. Patients were assessed postoperatively at 2-, 6-month, and 1-year, and every 1-2 years thereafter.

At the time of regular medical examinations, patients were given functional evaluations and exercise instruction by a physical therapist for about 20-40 minutes. These exercises were performed mainly open kinetic chain exercises (hip extension, external rotations, and abduction) aimed at improving the range of hip motion, increasing around these hip muscle strength. At the end of each intervention, the physical therapists instructed them to continue appropriate exercise at home.

Evaluations

In this study, we analyzed whether there was a difference in characteristics (age, sex, body mass index (BMI), and hip and knee OA diagnosis or arthroplasty) between patients who had the incidence of postoperative complications or NPPFs and those who did not have these incidences during 10-year after surgery.

The medical records, radiographic evaluation, and self-reported questionnaires were reviewed for age, sex, BMI, hip and knee OA or arthroplasty, postoperative complications, and all fractures. Radiographs of the hip in the anteroposterior and lateral view were assessed at each follow-up. Postoperative complications were evaluated by experienced 7 orthopedic surgeons for dislocation, thromboembolic disease (symptomatic venous thromboembolism (VTE)), PFFs, deep periprosthetic joint infection, osteolysis, implant loosening, and revision. When multiple incidences occurred in the same patient, only the first incidence event was included in this study.

NPPFs were assessed from patients’ self-report in the questionnaire, based on previous research. For verification of fractures, fracture site were confirmed by review of radiology reports or medical records. The first patient-reported fracture event was used in this study. When two or more fractures occurred at the same time, it was defined as a multiple fracture. Fracture site was described by its anatomical location. Participants were asked about fractures of the clavicle, vertebra, pelvis, contralateral proximal femur, patella, tibia, proximal humerus, proximal radius/ulna, and distal radius. Any spinal fracture (cervical, thoracic, or lumbar) was documented as a "vertebra" fracture since in some cases it was difficult to distinguish the locations of these fractures based on the responses in the questionnaire. Next, the patients were asked to describe when they had a fracture (< 1 year or ≥ 1 year after surgery). With regard to the cause of fracture, minor trauma was defined as a fall to the floor at the same level on which the patients had been standing or sitting, whereas major trauma included traffic accidents and any other high-energy trauma. Spontaneous fractures were those occurring without any obvious trauma.
Complications and non-periprosthetic fractures after THA

Statistical analysis

Data were organized using descriptive statistics. The mean value and standard deviation of each item in the patient demographics data were calculated. One-way analysis of variance and a chi-square test were used to compare patient backgrounds among the three groups. Bonferroni’s post-hoc test was used for each significant difference between the three groups (P-values < .017 were considered statistically significant).

As a sub-analysis, we examined the effect of age based on age 65-year” on variation in site, fracture type, cause, and the postoperative duration of NPPFs using a chi-square test. Statistical analyses were conducted using IBM SPSS statistics version 24 for Windows (SPSS Inc., an IBM Company, Chicago, IL, USA). P-values < .05 were considered statistically significant.

Results

Among the 1,586 possible eligible patients, 1,352 patients were included; of these, 460 patients were excluded due to lost to follow-up, deceased, or other serious neurological, medical, psychosis disease. Finally, a total of 892 patients were followed up at a more than 10-year (10.2-14.8 years) (Fig. 1).

The demographic data are shown in Table 1. The postoperative complications occurred in 37 patients, and NPPFs occurred in 72 patients. The age of patients with postoperative complications were significantly higher compared to patients without postoperative complications. Similarly, patients with NPPFs were also significantly older, and hip and knee OA diagnosis, compared to patients without NPPFs (p < .05).

Factors of implant-related postoperative complications were shown in Table 2. The most common implant-related postoperative complication was dislocation. In total, dislocation was observed in 13 patients, 6 and 7 patients developing <1 year and ≥1 year, respectively. Head size of dislocated patient was < 32 mm in 12 patients, and ≥ 32 mm in 1 patient, respectively. Four patients had recurrent dislocation, and 1 patient required revision surgery. Aseptic loosening of the femoral stems without fracture was observed in 5 patients (2 cemented and 3 non-cemented) and 2 patients in the acetabular cups. PFFs were observed in 5 patients. Two patients were treated with open reduction and internal fixation (ORIF) and two patients received conservative treatment. One patient required revision surgery. Four patients were caused by minor trauma. Deep periprosthetic joint infection was observed in 4 patients. Osteolysis was observed in 4 patients, all of whom had conventional polyethylene. VTE was observed in 1 patient. Three patients had other complications. Among all subjects, 20 patients required revision surgery.

Variation in site, fracture type, cause, and the postop-
were significantly higher in patients aged <65 years (p < .001). In contrast, patellar and clavicle fractures were significantly higher in patients aged >65 years (p < .05). There was no significant difference in the incidence of multiple fractures between the two groups (p = .525). The most common cause of NPPFs was minor trauma in both age groups, which was no significant difference between the two groups (p = .120). Finally, in patients aged ≥65 years, significantly more NPPFs occurred during the first year after surgery (p < .05).

### Discussion

Our results found that, more than 10-year follow-up after THA, the incidence of NPPFs was twice as higher than that of implant-related postoperative complications. Furthermore, our study also showed that THA patients who were older and had hip and knee OA had a significantly increased risk of developing NPPFs. In addition, the risk of vertebra fractures were significantly higher in patients aged ≥65 years. The most common cause of NPPFs was minor trauma in both age groups. Furthermore, in patients aged ≥65 years, significantly more NPPFs occurred during the
first year after surgery. There have been few reports on the incidence of NPPFs after THA. The reason for this might be that previous studies have not focused on NPPFs because these are minor injuries and could not be classified due to the presence of a more complex fracture pattern. This is the first large population-based study to investigate the incidence of not only postoperative complications but also NPPFs more than 10-year follow-up after THA.

Our results showed that the incidence of NPPFs was twice as higher than that of implant-related postoperative complications more than 10-year follow-up after THA. One reason for this may be that, in recent years, implant-related postoperative complications such as dislocation and loosening due to wear have been decreased with the development of XLPE. However, even 10-year after THA, muscle strength and functional performance were still deficient, and these deficits lead to an increased risk of falls. Furthermore, older age was a factor in prolonging recovery of muscle strength and physical function after THA. Johnson et al. reported that older patients, who were significantly associated with frailty, were at a significantly higher risk of developing adverse events within the first year after surgery. Therefore, surgeons and physical therapists should consider assessing the risk of falls and fall-induced fractures after THA, especially in patients aged ≥65 years, as well as improving muscle strength and functional performance. Recently, Fatoye et al. have shown that 2-12 weeks of physiotherapy interventions might lead to improvements in hip muscle strength and functional performance in patients after THA. In addition, several studies

<table>
<thead>
<tr>
<th>Variable</th>
<th>&lt; 65 years (n=29)</th>
<th>≥ 65 years (n=43)</th>
<th>p-value</th>
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<td>Vertebra</td>
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<td>8</td>
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<td>Contralateral proximal femur</td>
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<td>Distal radius</td>
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<td>Proximal radius/ulna</td>
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<tr>
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<tr>
<td>≥ 1 year</td>
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*Results presented as number of cases.
*p<.05, **p<.001
reported that 4-10 weeks of home-based exercises showed similar functional improvements to outpatient physiotherapy interventions. Thus, physiotherapy interventions and home-based exercises might be an important factor in improving muscle strength and motor function in post-THA patients. However, only a few studies investigated whether long-term (>12 weeks) physiotherapy interventions and home exercises would restore muscle strength and functional performance to the same level as healthy individuals of the same age and prevent age-related functional decline. Future research is needed to determine whether long-term exercise restores motor function to a similar level as healthy individuals of the same age and prevents age-related functional decline.

The present study showed that, in patients aged ≥65 years, the most common site of NPPFs was vertebra, followed by contralateral proximal femur. More research is needed to explain why there is an increased risk of vertebra and contralateral proximal femur fractures in elderly patients undergoing THA. Some studies showed that, in patients after total joint replacement, decrease of postoperative mobility and daily activity levels might have led to lower bone mineral density (BMD) around hip and spine, which might increase future osteoporosis-related fracture risk. Additionally, Toogood et al. demonstrated that older patients had even lower daily activity levels after THA. Thus, these studies suggest that BMD around the hip and spine may decrease in older patients due to decreased mobility and activities of daily living after surgery, which may increase the risk of vertebral and proximal femoral fractures.

From our results, older THA patients with hip and knee OA were at higher risk of developing NPPFs. Several studies have shown that the relationship between lower extremity OA and falls, and fractures. Ikutomo et al. demonstrated that knee extensor muscle weakness and limping were strongly risk factors for falls in patients with end-stage hip OA. Thus, THA patients with lower extremity OA might have the insufficient recovery muscle strength, walking ability, thus an increased risk of falls and fall-induced fractures. Therefore, older THA patients with lower extremity OA may particularly need to be assessed for fall risk and to establish strategies that focus on improving knee extension strength and limping.

In our findings, the most common cause for fractures was minor trauma, even in PFF. Recently, it has been suggested that the incidences of PFFs might increase with age in elderly people with osteoporosis. Previous studies have identified minor trauma as the most common risk factor, accounting for approximately 75% of PFFs, with results similar to the present study. PFFs after THA were associated with poorer clinical outcomes, a higher incidence of postoperative complications, and loosening of the stem. In our results, two patients required ORIF and one patient required revision surgery. This suggests that prevention of minor trauma, such as falls, is also important for the prevention of PFFs, which is a serious complication after THA.

This study had several limitations. First, 411 patients (30.4%) were lost to follow up, which might have resulted in a selection bias. Second, previous studies reported that factors such as BMD, muscle mass, and physical activity also affected the fractures in the elderly, but this study could not evaluate these factors. Third, in this present study, our results might be underestimated because self-reports were included in the fracture result report. Self-reported relevance was 78% for hip fractures and 81% for wrist or forearm fractures, but vertebra fractures might be underestimated at 51% because many people had no symptoms or few symptoms. Fourth, there was a possibility that some of the subjects deceased due to fractures owing to a lack of detailed investigation of the cause of death. Finally, the impact of preoperative contralateral hip and knee OA on the NPPFs was unknown because this study did not include detailed information about other joint due to the retrospective nature of the study. However, few reports have investigated large-scale data on postoperative complications and NPPFs at a more than 10-year after THA. The findings of our study were important when considering strategies and advanced research on these issues.

**Conclusion**

Our study demonstrated that, more than 10-year follow up after THA, the incidence of NPPFs was twice as higher than that of postoperative complications related to implants. In addition, the occurrence of NPPFs in patients after THA was significantly associated with older age and hip and knee OA. Older patients who had hip and knee OA were a significantly higher risk of developing NPPFs due to falls within the first year after surgery.

**Conflict of Interest:** The authors declare no conflict of interest.

**References**