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Periprosthetic Occult Femoral Fracture: An Unknown Side Effect of Press-Fit Fixation in Primary Cementless Total Hip Arthroplasty

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Purpose: The objectives of this study were to examine the prevalence and risk factors for development of periprosthetic occult femoral fractures during primary cementless total hip arthroplasty (THA) and to assess the clinical consequences of these fractures.

Materials and Methods: A total of 199 hips were examined. Periprosthetic occult femoral fractures were defined as fractures not detected intraoperatively and on postoperative radiographs, but only observed on postoperative computed tomography (CT). Clinical, surgical, and radiographic analysis of variables was performed for identification of risk factors for periprosthetic occult femoral fractures. A comparison of stem subsidence, stem alignment, and thigh pain between the occult fracture group and the non-fracture group was also performed.

Results: Periprosthetic occult femoral fractures were detected during the operation in 21 (10.6%) of 199 hips. Of eight hips with periprosthetic occult femoral fractures that were detected around the lesser trochanter, concurrent periprosthetic occult femoral fractures located at different levels were detected in six hips (75.0%). Only the female sex showed significant association with an increased risk of periprosthetic occult femoral fractures (odds ratio for males, 0.38; 95% confidence interval, 0.15-1.01; P=0.04). A significant difference in the incidence of thigh pain was observed between the occult fracture group and the non-fracture group (P<0.05).

Conclusion: Occurrence of periprosthetic occult femoral fractures is relatively common during primary THA using tapered wedge stems. We recommend CT referral for female patients who report unexplained early postoperative thigh pain or developed periprosthetic intraoperative femoral fractures around the lesser trochanter during primary THA using tapered wedge stems.

Key Words: Total hip arthroplasty, Intraoperative periprosthetic femoral fracture, Occult fracture, Cementless femoral stem, Press-fit

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INTRODUCTION

Cementless femoral stems enable immediate attainment of mechanical stability for achievement of long-term biological stability using press-fit fixation. However, use of cementless femoral stems may result in generation of excessive hoop strains, which can cause periprosthetic fractures[1]. Several major national registry studies[1-3] have described "the non-cemented paradox", where the use of cementless femoral stems is continually increasing worldwide despite registry data indicating that a better outcome can be achieved with use of cemented femoral stems in elderly patients, mainly due to a lower risk of periprosthetic fracture.

The reported incidence of periprosthetic femoral fracture during primary total hip arthroplasty (THA) using cementless femoral stem ranges from 3.2% to 5.4%[4]. Several recent reports[5-8] have focused on occurrence of periprosthetic occult fractures during cementless THA. These fractures are often diagnosed as postoperative periprosthetic fractures after the patient has begun weight-bearing exercise[9,10].

Using three-dimensional computed tomography (CT) data, the purposes of this study were: (1) to determine the incidence of occult intraoperative periprosthetic femoral fracture during primary THA using cementless tapered wedge stems, (2) to determine risk factors contributing to occurrence of these fractures, and (3) to examine their effects on implant survival.

MATERIALS AND METHODS

A total of 191 patients (222 hips) who underwent primary THA and postoperative CT at our hospital between March 2012 and May 2019 with a minimum follow-up period of 12 months were identified retrospectively. Postoperative CTs had been performed as part of another study[11] involving measurement of anteversion of the femoral stem relative to the lesser trochanter. Exclusion criteria for this study included (1) use of a cemented stem (11 patients/14 hips); and (2) a history of proximal femoral fracture or proximal femoral osteotomy (seven patients/nine hips). A total of 173 patients/199 hips (including 133 males and 40 females) were enrolled in the current study. The study was approved by the Institutional Ethics Committee of VHS Medical Center (Study No. 2018-11-003) and the informed consent was waived by the Institutional Ethics Committee. The mean age of patients was 67.4±9.1 years (range, 37-90 years). The mean body mass index (BMI) was 24.7±3.4 kg/m^2 (range, 13.5-34.3 kg/m^2). Preoperative diagnoses of hips included avascular osteonecrosis of the femoral head (ONFH) (n=129), dysplastic hip (n=25), osteoarthritis (n=17), posttraumatic osteoarthritis (n=9), femur neck fracture (n=7), fixation failure after femoral neck fracture (n=5), inflammatory arthritis (n=3), posttraumatic avascular necrosis (AVN) (n=1), and Legg-Calvé-Perthes sequelae (n=3).

Two different types of cementless femoral stems were implanted: (1) non-collared Corail® stems (DePuy Synthes) in 119 hips and (2) Tri-lock® stems (DePuy Synthes) in 80 hips. All femoral stems had a proximal tapered wedge shape designed to provide rotational stability with a capacity for self-lock during press-fit insertion. The proximal geometry of the Corail® stem had a double-tapered wedge shape and that of the Tri-lock® stem had a single-tapered wedge shape.

All operations were performed by one surgeon using a posterolateral approach. Using the technique recommended for insertion of these stems, the femoral canal was prepared by broaching alone without distal reaming. Broaching was performed sequentially until achievement of longitudinal stability and rotational stability. A C-arm was used for estimation of stem alignment in order to obtain a neutral position. A neutral position was defined as a position within 3° of valgus or varus stem alignment. Adjustment procedures were performed in cases where an estimated stem alignment with a neutral position could not be attained. The size of the true stem corresponded to the size of the last femoral broach. Evaluation of the final status and for detection of intraoperative periprosthetic fractures was performed using a C-arm. No detectable motion was observed between implant and bone during surgery in any of the cases. The mean length of the stem used was 133.5±10.3 mm (range, 108-148 mm) for Corail® stems and 104.4±9.8 mm (range, 95-117 mm) for Tri-lock® stems.

A previously described protocol was used for acquisition of radiographs[12]. Patients underwent immediate follow up, at three days, two weeks, four weeks, three months, six months, and one year after surgery, and yearly thereafter. Dual-energy CT scans were performed within three days after the operation using a dual-source CT system (Somatom Definition Flash; Siemens Healthcare). Metal artifact reduction software (iMAR; Siemens Healthcare) with dedicated parameters was used in order to reduce the number of artifacts caused by implants.

Radiographic follow-up examinations were performed using 3-day postoperative and final follow-up anteroposterior (AP) pelvis and CTL hip radiographs. Assessment of stem subsidence[13] and stem alignment[14] was performed in order to determine differences between patients with and without periprosthetic femoral fractures. Evaluation of stem subsidence was performed using two AP pelvis radiographs: one was obtained immediately after surgery and the other was obtained at the final follow-up visit. The middle of the lesser trochanter was used as the reference point. The reference point for the stem was the rim of the component. Adjustment for magnification of radiographs was standardized based on the fixed diameter of the acetabular cups. Calculations were performed based on the two AP pelvis radiographs for measurement of the distance between the femoral reference point and the rim of the stem and the difference between the two signified stem subsidence. Evaluation of proximal femoral geometry including Dorr ratio[15], Dorr type[15], and cortical thickness index (CTI) was performed using preoperative AP pelvis radiographs[16]. Review of immediate postoperative radiographs and CT scans was performed for identification of periprosthetic femoral fractures. Confirmation of a fracture line on postoperative radiographs or axial CT images indicated a diagnosis of fracture. True fracture lines were distinguished from nutrient artery canals of the femur on radiographs[17] and CT images[18]. Review of three-dimensional reconstructed CT images was performed for differentiation of fractures from metal artifacts. CT scout images were useful for identification of fractures located at different levels. Screening of radiographs and performance of CT scans of 199 hips was performed by one of the authors, while review of the detected femoral fractures was performed by other authors. Periprosthetic occult femoral fracture was distinguished from periprosthetic intraoperative femoral fracture. Periprosthetic occult femoral fracture was defined as a fracture not detected intraoperatively and on postoperative radiographs, but only observed on postoperative CT[8]. Classification of periprosthetic intraoperative femoral fractures was based on the system reported by Capello and colleagues[19]. Type T_G was defined as a fracture detected in the greater trochanteric region. Type T_L was defined as a fracture detected in the lesser trochanteric region. Type A1 was defined as a fracture of the medial cortex that included the residual neck, calcar, and lesser trochanter. Medial displacement was obtained using a well-fixed stem. Type B1 was defined as a fracture detected around or just below the stem, with a well-fixed stem. Treatment of patients with periprosthetic femoral fractures detected during the operation included cerclage wiring for type T_L, type A1, and type B1 fractures or cannulated screws with wiring for type T_G fractures. Patients with periprosthetic occult femoral fractures were allowed three weeks non–weight-bearing. Patients were allowed progressive weight-bearing exercise beginning at three weeks after the operation with more frequent monitoring using serial radiographs at one-week intervals for three weeks.

A diagnosis of thigh pain was based on the definition reported by Barrack et al.[20]. Localized pain in the anterior and/or lateral thigh below the inguinal area was regarded as thigh pain. Measurement of the intensity of thigh pain, if present, was performed using a visual analog scale (VAS).

Evaluation of clinical variables (age, sex, BMI, and preoperative diagnosis), surgical variables (stem type and stem length), and radiographic variables (Dorr ratio, Dorr type, and CTI) was performed for determination of risk factors for periprosthetic occult femoral fractures. Analysis of thigh pain, stem subsidence, and stem alignment was performed for evaluation of differences between patients with and without periprosthetic occult femoral fractures. Assessment of normality was performed using the Shapiro–Wilk test. Analysis of continuous variables was performed using the two-sample *t*-test or the Mann–Whitney U test. Analysis of categorical variables was performed using Fisher's exact test or the chi-squared test. Stepwise logistic regression was performed to determine associations between variables and the occurrence of occult intraoperative periprosthetic femoral fractures. All statistical analyses were performed using the IBM SPSS software program (ver. 18.0; IBM) and the R version 3.5.1 software program (R Development Core Team, R Foundation for Statistical Computing). A *P*-value less than 0.05 was considered statiscally significant.

RESULTS

1. Distribution of Periprosthetic Femoral Fractures

Periprosthetic occult femoral fractures were detected in 21 (10.6%) of 199 hips. In these fractures, fracture lines started from the region below the lesser trochanter in 11/21 cases (52.4%). Fractures were located at the anterior cortex in 16/21 cases (76.2%) (Fig. 1). Visible fracture patterns are shown in Table 1. Among 10 (5.0%) periprosthetic intraoperative femoral fractures, fractures in nine hips were detected intraoperatively and on postoperative radiographs in one hip. Fracture types included T_G in one hip, T_L in six hips, A1 in two hips, and B1 in one hip. Of eight

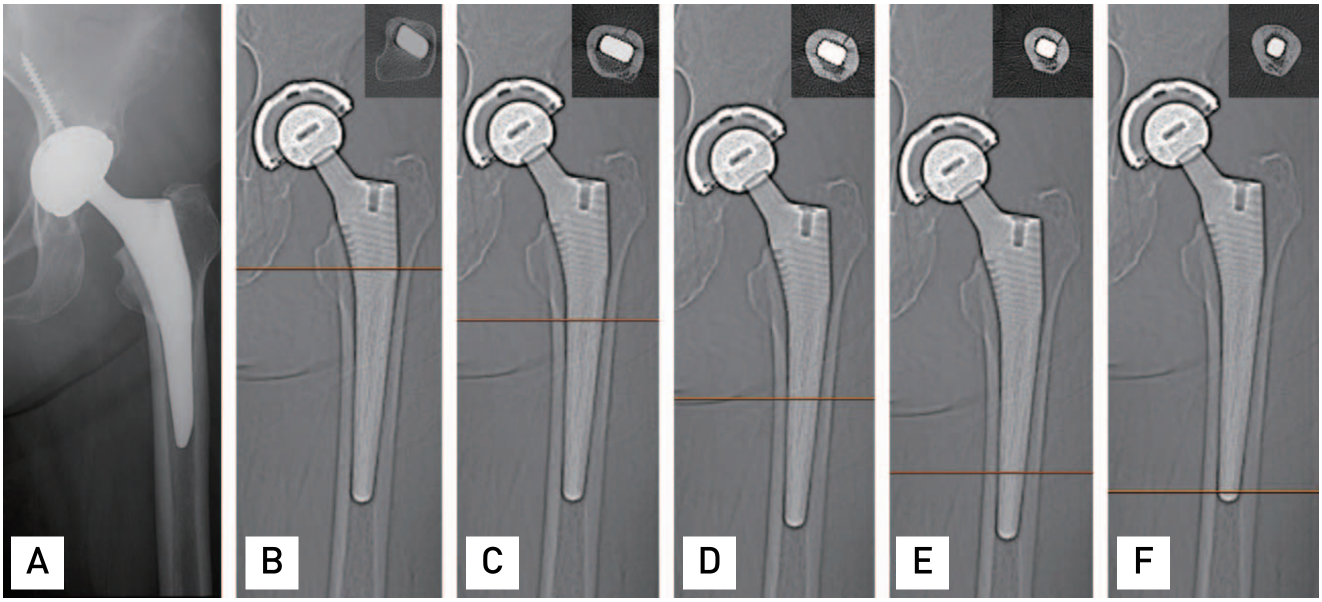

Fig. 1. A 69-year-old female who underwent primary total hip arthroplasty using a Corail® stem. (A) Immediate postoperative radiograph. (B-F) Immediate postoperative computed tomography (CT) images. A fracture line starting from the region below the lesser trochanter located at the anterior cortex and extending to the distal one-third of the femoral stem was observed on axial CT images.

Table 1. Visible Patterns of Periprosthetic Occult Femoral Fractures on Computed Tomography Images

No.	Sex	Age (yr)	Fracture location	Proximal extension	Distal extension			
					Proximal 1/3	Middle 1/3	Distal 1/3	Below stem tip
1	F	63	Anterolateral	Below LT			O	
2	F	65	Anteromedial	Around LT		O		
3	F	66	Anterolateral	Below LT			O	
4	F	72	Posteromedial	Below LT			O	
5	M	65	Anteromedial	Around LT		O		
6	M	71	Posteromedial	Around LT	O			
7	M	67	Anteromedial	Around LT			O	
8	M	67	Anteromedial	Around LT		O		
9	M	71	Anterolateral	Below LT		O		
10	F	74	Posteromedial	Proximal 1/3				O
11	F	78	Posteromedial	Below LT			O	
12	F	63	Anteromedial	Middle 1/3			O	
13	F	72	Anteromedial	Below LT				O
14	F	69	Anteromedial	Around LT			O	
15	M	47	Anteromedial	Below LT			O	
16	M	71	Anteromedial	Below LT			O	
17	M	71	Anteromedial	Below LT			O	
18	M	70	Anteromedial	Around LT	O			
19	M	72	Anteromedial	Around LT	O			
20	M	38	Anteromedial	Around LT	O			
21	M	69	GT					

F: female, M: male, GT: greater trochanter, LT: lesser trochanter.

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hips with periprosthetic intraoperative femoral fractures that were detected around the lesser trochanter, concurrent periprosthetic occult femoral fractures located at different levels were detected in six hips (75.0%) (Fig. 2, 3). Types of periprosthetic occult femoral fractures detected in these six hips included A1 in one hip and T_L in five hips. A significant difference in the incidence of occult fracture was observed between the wiring group (75.0%, 6/8 hips) and the non-wiring group (7.9%, 15/191 hips) (P<0.05).

2. Risk Factor for Periprosthetic Occult Femoral Fractures

No significant difference in the incidence rate of periprosthetic occult femoral fractures was observed between Corail® and Tri-lock® stems (Table 2). After stepwise logistic regression analysis, only female sex showed a significant association with an increased risk of periprosthetic occult femoral fractures (odds ratio for males, 0.38; 95% confidence interval, 0.15-1.01; P=0.04) (Table 3).

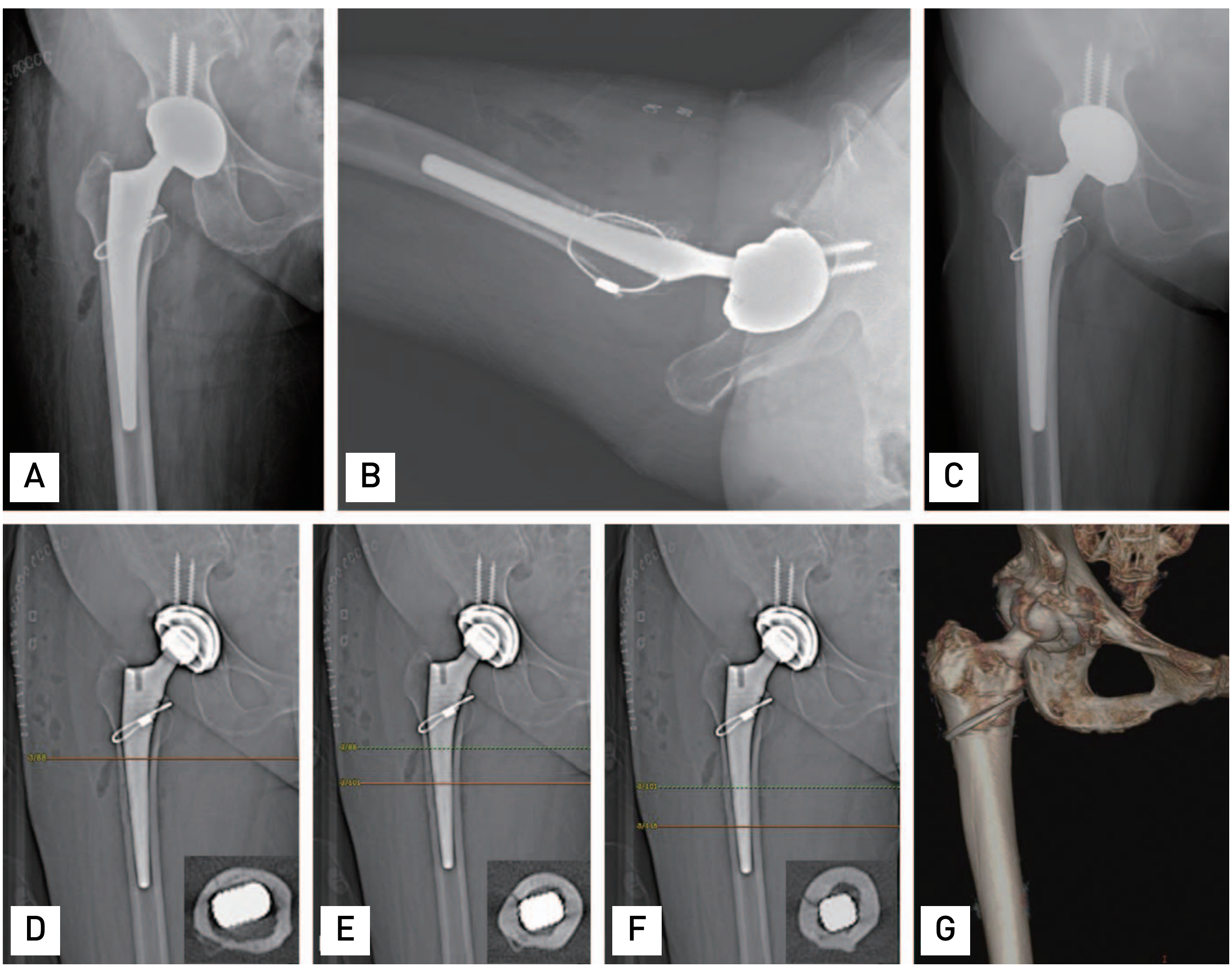

Fig. 2. A 66-year-old female who underwent primary total hip arthroplasty using a Corail® stem. (A, B) Immediate postoperative radiograph. A type TL periprosthetic femoral fracture was detected during the operation and fixed by cerclage wiring. (C) One-year postoperative radiograph showed no abnormal findings in the right hip. (D-F) Immediate postoperative computed tomography (CT) images. (G) A periprosthetic occult femoral fracture that extended to the distal one-third of the femoral stem was observed concurrently on axial and three-dimensional CT reconstruction images at different levels.

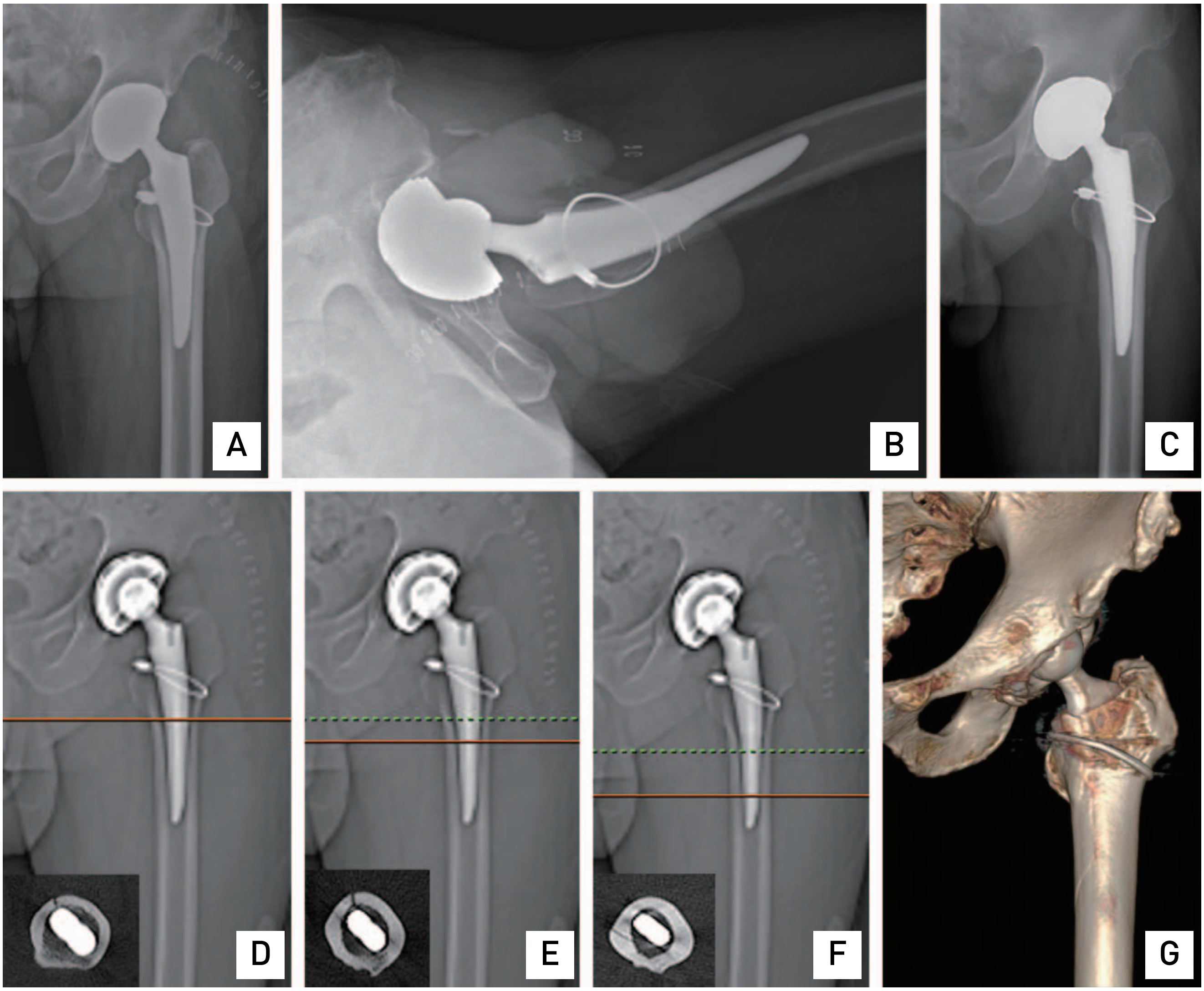

Fig. 3. A 71-year-old male who underwent total hip arthroplasty using a Tri-lock® stem. (A, B) Immediate postoperative radiograph. A type TL periprosthetic femoral fracture was detected during the operation and fixed by cerclage wiring. (C) Three-year postoperative radiograph showed no abnormal findings in the left hip. (D-F) Immediate computed tomography (CT) images. (G) A periprosthetic occult femoral fracture that extended to the tip of the femoral stem was observed concurrently on axial and three-dimensional CT reconstruction images at different levels.

3. Distribution of Stem Subsidence, Stem Alignment, and Thigh Pain

The mean follow-up period was 37.8 months (range, 12-78 months). The mean stem subsidence was 1.8±0.9 mm (range, 0-3.7 mm). All stems were implanted in a neutral position within 3° of valgus or varus stem alignment. No significant difference in stem subsidence or stem alignment was observed between the occult fracture group and the non-fracture group. Except for four hips with only periprosthetic intraoperative femoral fractures, thigh pain was reported during the follow-up period in 27 (13.8%) of 195 hips (occult fracture group, 14/21 hips, 66.7%; non-fracture group, 13/174 hips, 7.5%). The maximum VAS score for thigh pain ranged from 1 to 9, with a mean score of 4.3. A significant difference in the incidence of thigh pain was observed between the occult fracture group and the non-fracture group (P<0.05). The median time of pain onset was postoperative seven days in the occult fracture group and postoperative three months in the non-fracture group. Resolution of thigh pain occurred during the follow-up perod in 25 (92.6%) of 27 hips. However, thigh pain persisted until the latest follow-up in the remaining three hips (occult fracture group, 1/21, 4.8%; non-fracture

Table 2. Characteristics of Variables for Corail® and Tri-lock® Stems

Variable	Corail® (n=119)	Tri-lock® (n=80)	*P*-value
Age (yr)	66.6±7.4	68.6±11.2	0.16
BMI (kg/m²)	24.5±3.4	25.1±3.4	0.22
Dorr ratio	0.52±0.08	0.51±0.09	0.37
Stem length (mm)	133.5 (108-148)	104.4 (95-117)	0.04*
Sex			0.09
Male	98 (82.4)	57 (71.3)	
Female	21 (17.6)	23 (28.8)	
Diagnosis			0.82
ONFH	79 (66.4)	50 (62.5)	
Dysplastic hip	13 (10.9)	12 (15.0)	
Osteoarthritis	8 (6.7)	9 (11.3)	
PTOA	6 (5.0)	3 (3.8)	
Neck fracture	5 (4.2)	2 (2.5)	
Fixation failure	4 (3.4)	1 (1.3)	
Inflammatory arthritis	1 (0.8)	2 (2.5)	
Posttraumatic AVN	1 (0.8)	0 (0.0)	
LCP sequelae	2 (1.7)	1 (1.3)	
Dorr type			0.73
A	52 (43.7)	39 (48.8)	
B	60 (50.4)	36 (45.0)	
C	7 (5.9)	5 (6.3)	
Occult fracture			>0.99
Occurred	13 (10.9)	8 (10.0)	
Non-occurred	106 (89.1)	72 (90.0)	
Non-occult fracture			0.73
Occurred	5 (4.2)	5 (6.3)	
Non-occurred	114 (95.8)	75 (93.8)	

Values are presented as mean±standard deviation, mean (range), or number (%).
BMI: body mass index, ONFH: osteonecrosis of the femoral head, PTOA: posttraumatic osteoarthritis, AVN: avascular necrosis, LCP: Legg-Calvé-Perthes.
* $P<0.05$.

group, 3/174, 1.7%). No significant difference in the incidence rate of persistent thigh pain was observed between the occult fracture group and the non-fracture group. Healing of all 21 periprosthetic occult femoral fractures was confirmed using serial follow-up radiographs without any requirement for additional surgical interventions (Fig. 2, 3).

DISCUSSION

Several studies have examined the incidence of periprosthetic femoral fractures that occur during primary THA[4,21]. However, data regarding occurrence of periprosthetic occult femoral fractures during primary THA are inadequate. In the current study, the incidence of periprosthetic occult femoral fracture in patients undergoing primary THA was 10.6% (21/199 hips), much higher compared with previous reports[4]. Our findings also indicated that only the female sex showed significant association with an increased risk of periprosthetic occult femoral fracture fractures (odds ratio for males, 0.38; 95% confidence interval, 0.15-1.01; P=0.04) (Table 3). Healing of all 21 hips with periprosthetic occult femoral fractures was confirmed at the final follow-up without additional surgical interventions.

With the decline in use of cemented techniques, use of press-fit fixation has become a common practice even in osteoporotic elderly patients[1-3]. However, one problem is the increase in occurrence of periprosthetic intraoperative femoral fractures associated with use of cementless implants. Based on the incidences of periprosthetic occult femoral fracture reported in a previous study[8] (11.5%) and in the current study (10.6%), it is suggested that the occurrence of periprosthetic femoral fractures during press-fit fixation should no longer be regarded as a rare event. In addition, considering the low risk of periprosthetic femoral fracture with use of cemented femoral stems, use of cementing techniques should not be eliminated.

Table 3. Simple and Multiple Logistic Regression Analysis of Risk Factors for Periprosthetic Occult Femoral Fractures

Variable	Coefficient	SE	Wald statistic	Odds ratio	95% CI	*P*-value
Simple logistic regression						
Age	-0.01	0.02	-0.31	0.99	0.94-1.04	0.75
Male	-1.15	0.48	-2.39	0.32	0.12-0.81	0.02*
Female						
BMI	0.15	0.07	2.13	1.12	1.01-1.33	0.03*
ONFH				1		
Dysplastic hip	1.09	0.55	1.96	2.97	1.00-8.82	0.07
Osteoarthritis	-0.58	1.07	-0.55	0.56	0.07-4.55	0.59
PTOA	0.11	1.10	0.10	1.12	0.13-9.63	0.92
Neck fracture	-16.38	2465.33	-0.01	NA	NA	0.99
Fixation failure	-16.38	2917.01	-0.01	NA	NA	0.99
Inflammatory arthritis	-16.38	3765.85	-0.01	NA	NA	0.99
LCP sequelae	-16.38	3765.85	-0.01	NA	NA	0.99
Dorr ratio	-5.09	2.90	-1.75	0.01	NA	0.08
Dorr type A				1		
Dorr type B	-0.30	0.48	-0.62	0.74	0.29-1.89	0.53
Dorr type C	-0.43	1.09	-0.39	0.65	0.08-5.56	0.70
CTI	-1.00	3.55	-0.28	0.37	0.00-383.61	0.78
Corail® stem				1		
Tri-lock® stem	-0.08	0.47	-0.18	0.92	0.36-2.33	0.86
Stem length	-0.02	0.12	-0.17	0.98	0.77-1.24	0.86
Multiple logistic regression						
Male	-0.96	0.50	-1.93	0.38	0.15-1.01	0.04*
BMI	0.12	0.07	1.67	1.13	0.98-1.30	0.10

SE: standard error, CI: confidence interval, BMI: body mass index, ONFH: osteonecrosis of the femoral head, PTOA: post-traumatic osteoarthritis, NA: not available, LCP: Legg-Calvé-Perthes, CTI: cortical thickness index.
* $P<0.05$.

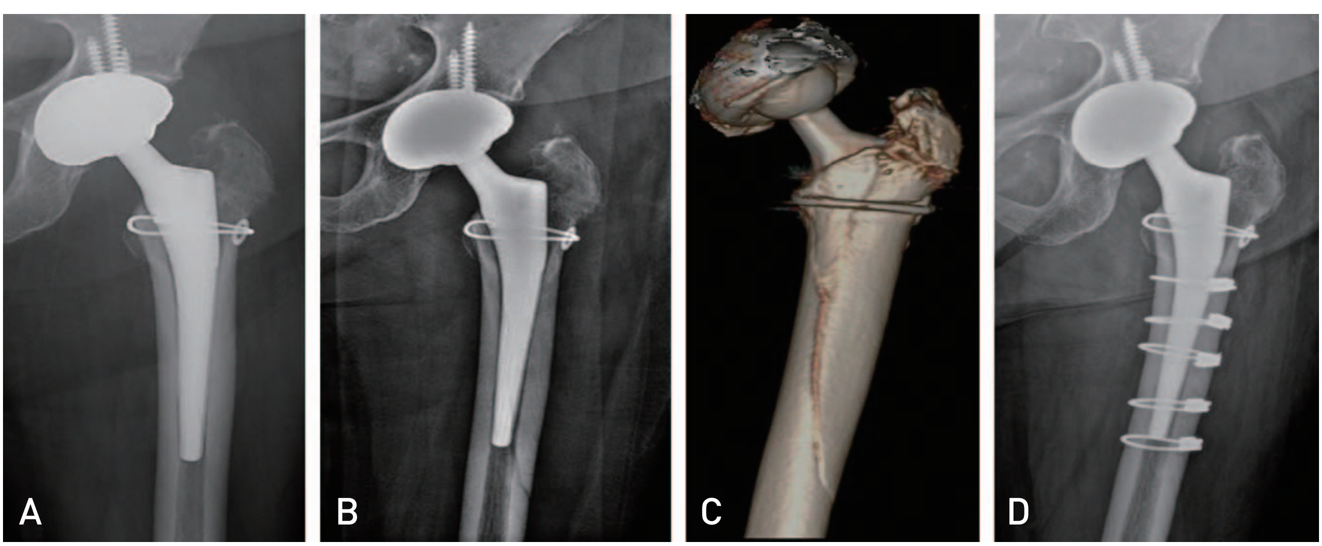

Fig. 4. A 75-year-old female who underwent total hip arthroplasty using a Corail® stem. (A) Immediate postoperative radiograph. (B) Two-week postoperative radiograph. (C) Three-dimensional computed tomography reconstruction image. (D) One-year post-revisional radiograph after multiple cerclage wiring.

Detection of a sudden change in resistance during insertion of the stem or unexplained instability during the operation can be an indication of a displaced periprosthetic intraoperative femoral fracture. In addtion, they can be easily

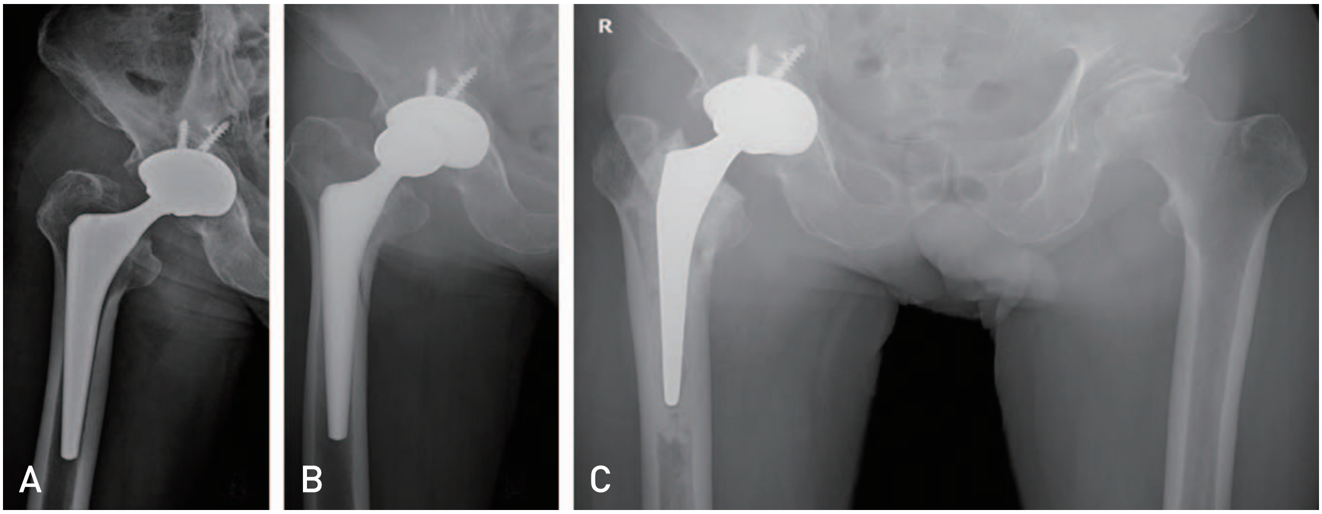

Fig. 5. A 72-year-old male who underwent total hip arthroplasty using a tapered wedge cementless femoral stem in another hospital. (A) Immediate postoperative radiograph. (B) Three-month postoperative radiograph. Compared with the immediate postoperative radiograph, the fracture line was observed below the lesser trochanter with stem subsidence and head subluxation. (C) One-year post-revisional radiograph after revision using a cemented femoral stem.

detected on postoperative radiographs. However, in some cases periprosthetic occult femoral fractures cannot be detected during the operation or clearly observed on postoperative radiographs because (1) the region below the lesser trochanter is covered with dense soft tissue, particularly on the anterior surface and is rarely exposed during the primary THA, (2) fracture lines involve only one cortex without displacement, and (3) these fractures might be completely hidden on postoperative radiographs by the implant or a cortical shadow[17]. According to our findings, fracture lines started from the region below the lesser trochanter in 11/21 cases (52.4%) or were located at the anterior cortex in 16/21 cases (76.2%) (Fig. 1). Our findings also showed that of eight hips with intraoperative periprosthetic femoral fractures detected around the lesser trochanter, concurrent periprosthetic occult femoral fractures located at different levels were detected in six hips (75.0%) (Fig. 2, 3). These findings underscore the difficulty in detecting periprosthetic occult femoral fractures originating from the region below the lesser trochanter during the operation.

Periprosthetic occult femoral fractures are usually stable in non–weight-bearing situations such as at the time of surgery and during the early postoperative period[22]. However, subsequent displacement or induction of early failure could occur[23]. Our study included two cases of undetected periprosthetic occult femoral fractures that were subsequently displaced after early weight-bearing ambulation (Fig. 4, 5).

Magnetic resonance imaging can provide highly accurate diagnoses of occult hip fractures[15,24]; however, CT using metal artifact reduction software is preferable as the first-line imaging modality for evaluation of postoperative THA patients in cases where a periprosthetic fracture is suspected[25,26]. In the current study, 21 periprosthetic occult femoral fractures in 199 hips that were not detected during the operation and on postoperative radiographs were observed on postoperative CT images. However, routine use of CT scans for detection of periprosthetic occult femoral fractures after THA is not practical[6] or necessary due to the lack of clinical relevance[7].

The authors attempted to determine any correlations between patient/bone characteristics and the potential for development of periprosthetic occult femoral fracture. Stem type and length had no influence on the occurrence of periprosthetic occult femoral fractures. The only significant finding was a greater tendency for development of these fractures in females (odds ratio for males, 0.38; 95% confidence interval, 0.15-1.01; P=0.04) (Table 3). Although bone density data could not be obtained for each patient, weak bone in elderly females is regarded as an important risk factor for fractures; therefore, osteoporosis in elderly females may be associated with an increased risk of occult intraoperative periprosthetic femoral fracture. In addition, morphology of proximal femoral bone, which was not evaluated in this study, may be considered, particularly in female patients with stovepipe or champagne-flute morphology of the proximal femur. Our findings also showed that of eight hips with periprosthetic intraoperative femoral fractures detected around the lesser trochanter, concurrent periprosthetic occult femoral fractures located at different levels were detected in six hips (75.0%). These findings are consistent with results reported in a previous study[8].

In this study, the incidence of thigh pain was 13.8%, comparable to the incidence reported in previous studies that utilized stems with a design similar to those used in our study[27,28]. No difference in persistent thigh pain was observed between the occult fracture group and the non-fracture group. In our study, healing was confirmed at the final follow-up without additional surgical intervention in all cases belonging to the occult fracture group. This finding may have contributed to the result showing that there was no difference in persistent thigh pain between the two groups. However, a significant difference in the occurrence of thigh pain was observed between the occult fracture group and the non-fracture group (P<0.05). A difference in the median time of pain onset was also observed between the occult fracture group (median time: postoperative seven days) and the non- fracture group (median time: postoperative three months). The authors believe that these differences could in part be ascribed to periprosthetic occult femoral fractures that occurred during the operation.

Our findings demonstrated that periprosthetic occult femoral fracture had no significant adverse effect on stem subsidence, stem alignment, or persistent thigh pain. In addition, healing of all 21 periprosthetic occult femoral fractures occurred with no requirement for additional surgical interventions (Fig. 2, 3). These findings support the assertion made in a previous study[8] that implant survival is not adversely affected by periprosthetic occult femoral fractures if rigid fixation of the implant is obtained, however, this type of fracture might pose a risk for early failure[23] without achievement of a tight press-fit fixation or use of a proper rehabilitation protocol.

We would like to mention several limitations. First, the population studied (AVN [63%] and male [77%] predominance) is not typical for patients undergoing primary THA[29] and the age distribution of the patients (range, 37-90 years) is too broad. Retrospective observation studies focusing on complicationss of surgical procedures, like this study, have such limitations. Occurrence of periprosthetic occult femoral fracture might be attributed in part to this pattern. Second, all operations were performed by one surgeon. The incidence of periprosthetic occult femoral fracture might differ depending on the surgeon, even for the same implant. Third, based on the small sample size, this study might be underpowered for determining risk factors associated with development of periprosthetic occult femoral fractures.

CONCLUSION

Occurrence of periprosthetic occult femoral fractures during primary THA using tapered wedge cementless femoral stems is relatively common. Routine use of CT for detection of periprosthetic occult femoral fractures after THA is not necessary. However, on the basis of our results, we recommend early CT referral for female patients with unexplained early postoperative thigh pain or those who developed periprosthetic intraoperative femoral fractures around the lesser trochanter during primary THA using tapered wedge stems.

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