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Incidence and Risk Period of Periprosthetic Femoral Fracture After Cementless Bipolar Hemiarthroplasty in Elderly Patients

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ABSTRACT

Background: The purpose of this study was to investigate the periprosthetic femoral fracture (PFF) after cementless bipolar hemiarthroplasty incidence, noting fracture types and the results of treatment in elderly patients.
Methods: We retrospectively reviewed 1563 elderly patients (1177 women and 386 men) who underwent cementless bipolar hemiarthroplasty for femoral neck fracture (1061 patients) or intertrochanteric fracture (502 patients). The type of fracture was classified according to the Vancouver classification. The average age was 79.6 years (range, 65-103 years). Clinical and radiologic evaluations were performed and Kaplan-Meier survivorship was analyzed.
Results: Thirty-seven PFFs (2.4%) occurred during a mean follow-up of 44.4 months. Two-thirds of PFFs (67%) occurred within 1 year. Most PFFs (22/27), which occurred within 2 years, were Vancouver type B fractures. After that, type A fractures were predominant (7/9). Based on Kaplan-Meier survivorship with PFF as the end point, the incidence rate was 1.7% (95% confidence interval [CI] = 1.6%-1.8%) at 12 months, 2.2% (95% CI = 2.1%-2.3%) at 36 months, and 3.8 % (95% CI = 3.6%-4.0%) at 144 months postoperatively.
Conclusion: After cementless bipolar hemiarthroplasty in elderly patients, a caution should be paid to prevent PFF particularly during 1-year postoperatively.

Populations around the world are rapidly aging, and an increasing incidence of hip fractures is a global trend in the elderly population [1,2]. Bipolar hemiarthroplasty (HA) has become a common treatment for osteoporotic hip fractures in the elderly. The use of a cementless stem is an attractive option for surgeons, as the cementing procedure can have serious cardiopulmonary complications in elderly patients [3]. However, periprosthetic femoral fracture (PFF) appeared as a common complication after HA in senile patients [2,4-6]. To date, there is a lack of research about the incidence and characteristics of PFF after cementless bipolar HA in a large cohort of patients.

The primary aim of our study was to investigate the incidence and type of PFF after cementless bipolar HA in elderly patients who were treated for hip fractures. We also investigated the results after PFF treatments.

Materials and Methods

Subjects

From May 2003 to December 2013, 1677 patients (1754 hips) underwent bipolar HA for hip fractures at 2 institutions. During this period, we exclusively used cementless prostheses. Excluded were 89 patients (95 hips) who were younger than 65 years at the time of index arthroplasty. In the remaining 1588 patients (1659 hips), data of time to the PFF were collected. If the PFF was not observed, the data were regarded as censored. Twenty-five patients, who did not return to our clinic after the index operation, were excluded from the analysis. In bilateral cases, only the first-operated hips were

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analyzed to keep the principle of statistical independence [7]. Thus, 1563 patients were subject to final analysis. The average age of the cohort at the time of index operation was 79.6 ± 7.0 years (range, 65-103 years), and 1177 patients (75.3%) were women. The primary diagnosis was femoral neck fracture in 1061 patients and unstable intertrochanteric fracture in 502 (Table 1).

According to the stem classification of Feyen and Shimmin [8], proximal porous-coated standard metaphyseal fixation stems were used in 708 patients (45.3%), full porous-coated standard metaphyseal fixation stems in 501 patients (32%), full porous-coated standard meta and diaphyseal fixation stems in 217 patients (13.9%), full hydroxyapatite-coated standard metaphyseal fixation stems in 5 patients (0.3%), and full hydroxyapatite-coated standard meta and diaphyseal fixation stems in 132 patients (8.4%; Table 2).

The design and protocol of this retrospective study were approved by the institutional review board at the authors' hospitals.

Treatment and Evaluation of PFF

Treatments of PFFs were categorized as conservative, revision, or open reduction and internal fixation (ORIF). All PFF operations were performed by 2 senior surgeons. We classified the fractures on conventional anteroposterior and lateral radiographs according to the Vancouver classification [9], which integrates the site of the fracture, stability of the implant, and quality of host bone stock. Revision or ORIF was performed with locking compression plates and/or cerclage wires [10].

Clinical union was considered to be obtained when patients had no pain during walking and palpation and radiographs showed no evidence of screw loosening or fracture displacement [11]. Radiological union was considered to be obtained when 3 of the 4 cortices had a bridging callus in the anteroposterior and lateral views. Malunion was defined as an anteroposterior or mediolateral deviation of >5° from anatomic norms [12]. Postoperative complications were reviewed and subcategorized according to Parvizi et al [13].

Statistical Analysis

We performed Kaplan-Meier survival analysis for all patients with periprosthetic fractures as an end point [14]. We performed sensitivity analysis for 2 analyses: a best-case and a worst-case scenario (in which 25 patients who did not return after index operation and were considered to have had periprosthetic fracture through the 144 months follow-up). We also compared the death rates between PFF patients and non-PFF patients and between early (within 6 months) PFF patients and late (after 6 months) PFF patients using log-rank test.

Statistical analysis was performed using SPSS, version 20 (SPSS, Chicago, IL). The chi-square test or Fisher exact test was used for analysis of categorical data, and *t* test was used for continuous data for demographic and clinical variables between patients without and with PFF. For all other tests, a *P* value of <.05 was considered significant.

Table 1
Demographic Data of 1563 Patients Who Underwent Primary Cementless Bipolar Hemiarthroplasty for Proximal Hip Fractures.

Variable	All	Periprosthetic Femoral Fx		*P* Value
		Fx (n = 37)	Non-Fx (n = 1526)	
Age at index operation (y)	79.6 ± 7.0	77.3 ± 7.7	79.6 ± 7.1	.055
Gender				.959
Men	386 (24.7%)	9 (24.3%)	378 (24.7%)	
Women	1177 (75.3%)	28 (75.7%)	1148 (75.3%)	
BMI (kg/m^2)	23.4 ± 3.2	22.7 ± 3.9	23.6 ± 3.1	.284
Follow-up length (mo)	44.4 ± 30.0	47.9 ± 27.4	43.8 ± 29.8	.329
Primary diagnosis				.690
Femur neck fracture	1061 (67.9%)	24	1037	
Intertrochanteric fracture	502 (32.1%)	13	489	
Number of death (patients)				.159
12 mo	179 (12.6%)	2 (5.4%)	177 (11.6%)	
24 mo	290 (18.6%)	3 (8.1%)	287 (18.8%)	
36 mo	391 (25.0%)	6 (16.0%)	385 (25.2%)	

Data are expressed as mean ± standard deviation.
BMI, body mass index; Fx, fracture.

Table 2
The Type of Cementless Stem and Details of Implants.

Type of Cementless Stem	Number of Patient	Number of PFF
Proximal porous-coated standard MF stem	708	13 (1.8%)
BiCONTACT stem (Aesculap, Tuttlingen, Germany)	263	5 (1.9%)
Bencox ID stem (Corentec, Cheonan, Korea)	230	5 (2.2%)
M/L Taper stem (Zimmer, Warsaw, IN)	196	3 (1.5%)
Accolade stems (Stryker Orthopaedics, Mahwah, NJ)	11	0 (0%)
Taperloc standard stems (Biomet, Bridgend, South Wales, UK)	8	0 (0%)
Full porous-coated standard MF stem	501	15 (2.9%)
Bencox stem (Corentec)		
Full porous-coated long MDF stem	217	7 (3.2%)
Benfix long stem (Corentec)		
Full hydroxyapatite-coated standard MF stem	5	0 (0%)
Corail stem (DePuy International, Leeds, UK)		
Full hydroxyapatite-coated long MDF stem	132	2 (1.5%)
KAR stem (DePuy)		

PFF, periprosthetic femoral fracture; MF, metaphyseal fixation; MDF, meta and diaphyseal fixation.

Results

During follow-up periods, PFF occurred in 37 patients (2.4%), and the remaining 1526 patients including 619 deaths (40.5%) were censored for 12-144 months (mean, 44.4 months) after the index HAs. There were no significant differences in the death rates between PFF patients and non-PFF patients and between early PFF patients and late PFF patients.

The injury mechanisms of PFFs were from a low-energy fall (ie, a fall from standing height or less) or no definite trauma in all the patients. Primary diagnoses for previous HAs were femoral neck fractures in 24 and unstable intertrochanteric fractures in 13. Eight of the 37 patients (21.6%) who had PFFs deceased at a mean of 47.9 months after the PFF. Nineteen of the 37 patients (51%) had femurs of Dorr type B (Table 3). There were no significant differences in the PFF rates according to the surface coating and length of stems (Table 2).

The PFF types Vancouver type A in 9 (24%); Vancouver B1 in 13 (35%); Vancouver B2 in 10 (27%); Vancouver B3 in 1 (3%); and Vancouver C in 4 (11%). Fifteen PFFs (40%) occurred within 3 months after the index HA, and 25 (67%) occurred within 1 year (Fig. 1). Most PFFs (22/27), which occurred within 2 years, were Vancouver type B fractures, whereas 7 of the 9 PFFs, which occurred ≥3 years after the index HAs were Vancouver type A fractures (Fig. 2).

Mean time from the primary HA to PFF was 19.9 months (range, 10 days-110 months). Twenty-eight patients (76%) were treated surgically, and the remaining 9 were treated conservatively. Clinical and radiological union was obtained in PFFs (97%) at an average of 5.1 months (range, 3-9 months). One patient, who was operated with ORIF, had deep infection 12 weeks postoperatively. The infection was treated with a 2-staged reconstruction.