The Journal of Arthroplasty xxx (2017) 1–5

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Intraoperative Femur Fracture Risk During Primary Direct Anterior Approach Cementless Total Hip Arthroplasty With and Without a Fracture Table

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ARTICLE INFO

Article history:
Received 9 December 2016
Received in revised form
5 April 2017
Accepted 10 April 2017
Available online xxx

Keywords:
anterior approach
arthroplasty
periprosthetic fracture
intraoperative fracture
femur fracture
fracture table

ABSTRACT

Background: There is no study to date comparing intraoperative femur fractures (IFFs) in the direct anterior approach (DAA) with and without a fracture table. We hypothesize that there is no significant difference in the IFF with and without a fracture table when performed by experienced DAA hip surgeons.

Methods: This study is a 1-year retrospective review of patients who underwent DAA total hip arthroplasty by 2 surgeons: one surgeon uses a flat table and manually elevates the femur with a large bone hook, while the other surgeon uses a fracture table and a mechanical femoral elevator. Exclusion criteria included cemented femoral implants, femoral neck fractures, and lack of 6-month follow-up.

Results: We identified 487 patients for analysis (220 male and 267 female, average age 66.55 years). There were 12 total IFFs (2.46%): 8 female and 4 male patients. The average age of IFF patients was 70.67 years and in nonfracture patients was 66.00 years. There was no difference in gender ($P = .2981$) or age ($P = .2099$) between IFF and nonfracture patients. In the fracture table group, there were 6 IFFs (2.22%) in 271 patients; in the nonfracture table group, there were 6 IFFs (2.76%) in 216 patients. There was no statistical difference in IFF between the 2 groups ($P = .6973$). We observed just 2 patients (0.4%) in this series where the IFFs changed management requiring a revision femoral stem.

Conclusion: There was no statistical difference in IFF with or without the use of fracture table. Both DAA surgical technique variations are felt to be equivalent regarding the risk for IFF during DAA cementless total hip arthroplasty.

The direct anterior approach (DAA) is a minimally invasive surgical approach that utilizes intermuscular and internervous tissue planes for total hip arthroplasty (THA), with a potentially steep initial learning curve. Several studies have reported an increased rate of intraoperative femur fractures (IFFs) during the initial adoption of this approach. Masonis et al [1] reviewed complications of the first 300 DAA cases and reported 3 intraoperative calcar fractures in the first 62 cases (4.8%) and none in the remaining 238 cases (0%) in the study. Similarly, Jewett and Collis [2] reviewed complications of the first 800 DAA cases and found that the majority of intraoperative fractures were in the first 200 cases (20 intraoperative fractures of 200 cases, 10%) and all the fractures occurred in the first 400 cases. The learning curve is related to the inherent difficulty in exposing the femur during the DAA, and perhaps to differences in femoral orientation for broaching as compared to traditional approaches.

Due to differences in surgeon experience and technique, the published studies in the literature vary greatly among the reported IFF rate. Studies reporting IFFs in the DAA using a fracture table range from 0.8% to 6.5% [1–6]. Studies reporting IFFs in DAA using a standard operating room (OR) table range from 1% to 7% [7–10]. Although IFFs during the learning curve are well established, there

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2017.04.020.

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http://dx.doi.org/10.1016/j.arth.2017.04.020
0883-5403/

Table 1
Primary Femoral Implant Used in Direct Anterior Approach With and Without a Fracture Table.

Stem	DAA Without Fracture Table	DAA IFF Without Fracture Table	DAA With Fracture Table	DAA IFF With Fracture Table	% IFF by Stem
Tri-Lock	184	4	88	0	1.47
Corail	21	1	177	6	3.03
Summit	11	1	2	0	7.69

The surgeon who performed the DAA THA using a fracture table used a higher percentage of Corail stems (65.3%) vs the surgeon who performed DAA without a fracture table (9.7%), which may explain why the surgeon using the fracture table had all 6 IFFs using the Corail stem.

Table 2
Characteristics of Intraoperative Femur Fracture in Direct Anterior Approach With a Fracture Table.

Age	Sex	Dorr Class	Type of Arthritis	Stem	Stem Size	Location of Fracture	Treatment
36	F	A	Dysplasia	Corail	8	Calcar	Cerclage
68	F	B	OA	Corail	14	Unrecognized calcar fracture	Revision femoral stem
78	F	A	OA	Corail	12	Calcar	Cerclage
82	F	B	OA	Corail	13	Medial perforation	Revision femoral stem
85	F	B	OA	Corail	12	Calcar	Cerclage
90	F	B	OA	Corail	10	Calcar	Cerclage

F, female; OA, osteoarthritis.

Table 3
Characteristics of Intraoperative Femur Fracture in Direct Anterior Approach Without a Fracture Table.

Age	Sex	Dorr Class	Diagnosis	Stem	Stem Size	Location of Fracture	Treatment
49	F	C	AVN	Summit	6	Lateral cortex	Primary Stem
59	M	B	AVN	Tri-Lock	4	Calcar	Cerclage
59	M	B	AVN	Tri-Lock	5	Calcar	Cerclage
73	M	B	OA	Tri-Lock	8	Calcar	Cerclage
83	F	A	OA	Corail	11	Posterolateral cortex	Cerclage
86	M	A	OA	Tri-Lock	10	Lateral cortex	Primary stem

AVN, avascular necrosis of the femoral head; F, female; OA, osteoarthritis.

are currently no studies directly comparing IFF rate in the DAA with and without a fracture table by experienced DAA hip surgeons. The purpose of this study is to (1) compare the IFF rate with and without a fracture table by experienced DAA hip surgeons and (2) identify potential risk factors for IFFs.

Materials and Methods

After Institutional Review Board approval, a retrospective cohort design was implemented; electronic chart and radiographic review of consecutive patients who underwent primary DAA THA over a 1-year period by 2 experienced DAA arthroplasty surgeons (>1500 DAA THA cases). The 2 surgeons use different DAA techniques: one surgeon uses a radiolucent operating room table without fluoroscopy and manually elevates the femur with a large bone hook, while the other surgeon uses a fracture table (Hana; Mizuho OSI, Union City, CA) with fluoroscopy and a mechanical femoral elevator. Both surgeons used DePuy THA implants (Tri-Lock, Summit, Corail) during the study period.

Patients were identified by current procedural terminology code 27130 for THA utilizing the hospital billing database. Patients were included if the patient underwent cementless DAA THA performed with preoperative, immediate postoperative, and 6-month postoperative radiographs all available for review. Exclusion criteria included cemented femoral implants, femoral neck fractures, and lack of 6-month postoperative follow-up. Preoperative radiographs were reviewed by 2 independent orthopedic surgeons for type of arthritis (primary, inflammatory, dysplasia, avascular necrosis) and Dorr femur classification [11]. Electronic medical records and operative notes were reviewed and data collected including age, gender, type, size of femoral implant, and intraoperative fracture. Statistical analysis was performed with *t*-test and chi-square test for categorical variables.

Results

After inclusion and exclusion criteria were applied, there were 487 patients identified for the study. There were 5 patients excluded for cemented femoral implants and 15 patients excluded for THA after femoral neck fracture. There were 220 men and 267 women with an average age of 66.6 years. The femoral implants used with a fracture table and nonfracture table groups are listed in Table 1. Overall, there were a total of 12 IFFs in the cohort, 6 fractures occurred in the fracture table group and 6 in the nonfracture table group. The rate of IFF was 2.22% in 271 patients with the use of the fracture table and 2.76% in 216 patients when using the nonfracture table. The rate of fracture was not significantly different between the 2 groups ($P = .6973$). Importantly, there were only 2 patients out of 487 patients (0.4%) where the fracture changed clinical management to require a return to the OR for placement of a revision femoral stem rather than using a primary stem with or without cerclage wire application. Both these cases were seen in the fracture table group. There were no femoral revisions at 6-month postoperative follow-up.

The patient characteristics and implants used for patients sustaining IFF are provided in Tables 2 and 3. The majority of the 12 fractures were calcar fractures recognized intraoperatively and these were all treated with single cerclage cable placed above the lesser trochanter (Fig. 1). The remaining patients who sustained fracture were as follows: 2 lateral cortex fractures due to broaching treated intraoperatively with a stable primary cementless femoral stem (Fig. 2), 1 postoperative femoral implant subsidence 1 week after surgery due to unrecognized calcar fracture treated with a revision cementless stem (Fig. 3), and 1 medial femoral cortex perforation identified on postoperative X-ray and revised the following day to a primary cementless stem (Fig. 4).

Patients who sustained fractures were slightly older (average age 70.67 years) than those who did not sustain a fracture (average age 66.00 years). Eight of the patients sustaining fracture were men and the remaining 4 were female. There was no difference in gender ($P = .2981$) or age ($P = .2099$) between intraoperative fracture and nonfracture patients. Of those sustaining an IFF, 4 had Dorr A femurs, 7 Dorr B, and 1 Dorr C. There was no discernible trend in intraoperative fracture when evaluating Dorr classification or arthritis diagnosis. The patient characteristics of those not sustaining fracture are provided in Table 4.

Discussion

It has been well established in the literature that DAA THA poses a risk for IFF; however, the reported rates vary from 0.8% to 7% and focus mainly on cases in the surgeon's initial learning curve. Suggested risk factors for IFF include both surgeon experience, as well as various patient characteristics such as age, gender,