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Radiation Exposure during Fluoroscopic Guided Direct Anterior Approach for Total Hip Arthroplasty

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ABSTRACT

Fluoroscopic guidance is commonly utilized during direct anterior total hip arthroplasty (DA THA). The purpose of this study was to measure patient and surgeon exposure utilizing this technique. Fifty-one consecutive patients who underwent primary DA THA by a single surgeon were prospectively studied. Fluoroscopic guidance was utilized according to an established protocol. Dose-area product (DAP) (Gy-cm^2) and fluoroscopy time were recorded for each case. Surgeon exposure was recorded by a dosimeter. The median DAP was 0.716 Gy-cm^2 (range 0.251–1.81). Mean fluoroscopy time was 0.59 minutes. Dosimeter results were 10 mrem for all procedures combined. DAP and fluoroscopy times were comparable to published values for other fluoroscopically guided hip procedures. This information may aid in setting reference dose levels for this procedure.

The direct anterior approach for total hip arthroplasty (DA-THA) has become an increasingly popular technique [1–3]. Fluoroscopic guidance is commonly utilized during this approach to assess bone preparation, component positioning, and reproduction of leg length and offset. Because the patient is positioned supine, fluoroscopic guidance is easily employed, and can allow for improved accuracy in reconstruction through a relatively small incision [4]. Care must be taken in the orientation and interpretation of fluoroscopic imaging as alterations in pelvic tilt and rotation can result in images that may be misinterpreted if not carefully examined [5]. Nonetheless, when properly employed fluoroscopy has been found to be useful and has been advocated by several authors [1,4,5].

Radiation exposure during medical procedures can have health implications for patients and health care providers alike. In recent years, the use of fluoroscopy in orthopedic procedures has increased significantly. During the course of fluoroscopically guided surgery, the surgeon must generally remain relatively close to the x-ray beam and thus cannot use distance as a means of diminishing radiation dose. The amount of radiation to which a surgeon is exposed is of concern and acceptable levels are a subject of ongoing debate. Stochastic radiation effects such as carcinogenesis cannot be ruled out at low levels of exposure and as such many facilities have embraced the ALARA (As-Low-As-Reasonably-Achievable) Philosophy in establishing safe practices [6]. Nonetheless, Hendee et al point out that many of the published risk estimates for radiation induced carcinogenesis are flawed and when emphasized, may induce unnecessary anxiety and even reluctance among some patients to undergo important imaging procedures [7,8]. The physician must utilize professional judgment to determine the utility and necessity of imaging in performance of patient care.

Thus the technical advantage afforded by fluoroscopic guidance must be weighed against the risks associated with increased radiation exposure. Furthermore, ongoing efforts to reduce radiation exposure during fluoroscopy are an important means of protecting both patients and health care providers. The establishment of reference radiation doses for fluoroscopic assisted DA-THA allows for meaningful comparison to other commonly performed orthopedic procedures and also provides a baseline value that can be utilized to assess the efficacy of radiation reduction protocols. Currently, there is no published data on radiation doses associated with fluoroscopically guided DA-THA. The purpose of this study was to measure patient and surgeon exposure utilizing this technique.

Patients and Methods

A consecutive series of 51 primary DA-THA performed by a single surgeon were prospectively enrolled in our study over a four month period. All patients consented to inclusion and approval for our research protocol was obtained from our institutional review board. Patient demographics including age, gender, height, weight, body mass index, and surgical side were recorded.

Twenty-six of the patients were male and twenty six of the surgeries were left hips. The mean BMI was 29.2 (range 21.9–43.26). Mean age

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was 67 years (range 39–83). Mean and median case duration was 84 minutes (range 56–135).

Surgery

All patients underwent primary DA-THA according to our senior surgeon's established protocol, which has been previously described [9]. Fluoroscopic guidance was utilized sparingly and at specific points during the case (Fig. 1). Fluoroscopy was utilized to: confirm the height of the neck cut, assess depth and position of reaming, check acetabular cup position during insertion and after placement of ancillary screws, assess fit of femoral broach, check trial implants for reproduction of leg length and offset, and visualize final component position. The same prosthesis was used for all cases. All components were non-cemented. Acetabular components were inserted with 1 or 2 ancillary screws at the discretion of the operating surgeon. Procedures were performed using a Philips BV Endura mobile C-arm (Philips Medical Systems, Eindhoven, The Netherlands). The surgeon and all OR personal wore protective equipment in the form of lead aprons and thyroid shields.

Measurement of Radiation Exposure

The accuracy of the mobile C-arm's displayed dose area product (DAP) value was calibrated with an external ionization chamber to within ±5%.

Surgeon exposure was measure by means of an external dosimeter which was worn for all cases and cumulative radiation dose was assessed at the end of the study period. The dosimeter was worn over the lead in the chest area. As a means of control, another arthroplasty surgeon, who performs posterior approach THA without fluoroscopy wore a dosimeter for all cases during the same interval.

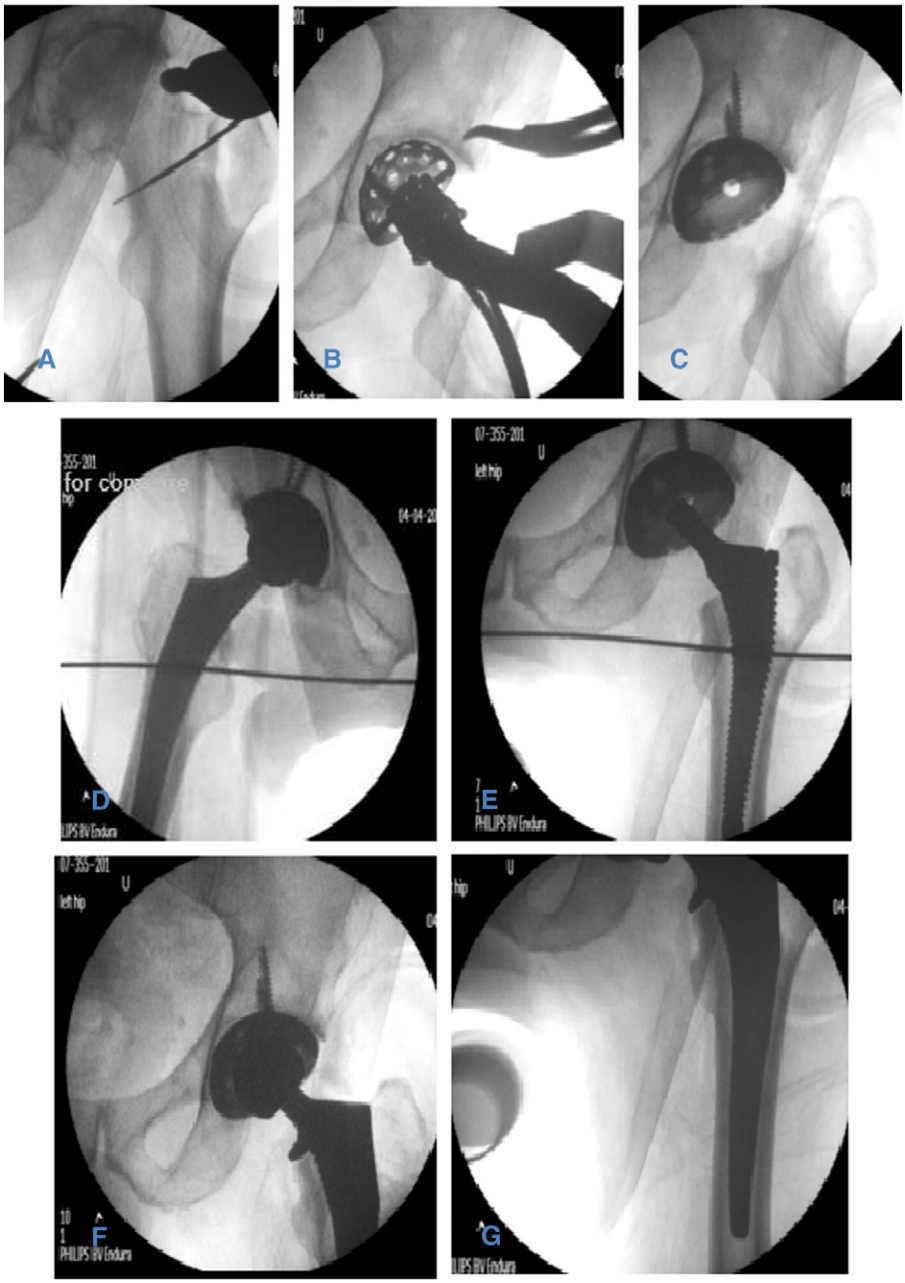

Fig. 1. Fluoroscopic image guidance was utilized for several steps throughout the procedure to improve accuracy of bony preparation and component positioning. (A) Measuring of templated neck cut. (B) Acetabular reaming. (C) Confirmation of screw position (D&E). Assessment of leg length (F&G). Assessment of final component position.