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Preoperative Radiographic Evaluation of Patients With Pelvic Discontinuity



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ABSTRACT

Background: Pelvic discontinuity (PD) is a rare but devastating mechanism of failure in total hip arthroplasty. Radiographic findings have been described for the identification of PD. However, no study has specifically examined radiographic parameters and the utility of specific views in the preoperative identification of PD.

Methods: We performed a retrospective review of 133 patients who underwent acetabular revision for PD. Preoperative radiographic studies were reviewed including anteroposterior pelvis (AP; n = 133), true lateral hip (n = 132), Judet (n = 47), false profile (n = 4), and computed tomography scans (n = 14). Radiographs were read by the senior authors to identify the following parameters suggestive of PD: visible fracture line, medial migration of the inferior hemipelvis, and obturator ring asymmetry.

Results: Using only the AP view, the fracture line was visible in 116 (87%), medial migration of the inferior hemipelvis in 126 (95%), and obturator ring asymmetry in 114 (86%). A fracture line was visualized in 65 of 132 hips (49%) evaluated with laterals, 36 of 47 hips (77%) evaluated with Judet views, 3 of 4 (75%) evaluated with a false profile view, and 10 of 14 (71%) evaluated with computed tomography.

Conclusion: Preoperative evaluation with a combination of an AP pelvis radiograph, plus a true lateral radiograph of the hip, plus Judet films in combination with the criteria for discontinuity defined in this article, allowed for identification of PD in a 100% of patients.

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Pelvic discontinuity (PD) is a unique and uncommon pattern of bone loss in total hip arthroplasty characterized by dissociation of the superior and inferior hemipelvis through the acetabulum. This condition commonly is the result of fracture and/or bone loss secondary to osteolysis or previous hip surgery. The American Academy of Orthopedic Surgery (AAOS) categorizes PD as a type IV deficiency, which has been further subcategorized as Type IVa, a PD with a cavitary or mild segmental bone loss, Type IVb, a PD with a large segmental or combined defect, and Type IVc, a PD in a previously irradiated pelvis [1,2].

Identifying PD before revision surgery is important because its presence requires advanced reconstructive techniques [3–5]. Preoperative radiographic findings on anteroposterior (AP) pelvis

radiographs associated with PD have been described as: visible fracture line, obturator ring asymmetry, and medial migration of the inferior hemipelvis [1]. However, no study has specifically examined the sensitivity of various radiographic views and findings to identify PD.

The purpose of this study was to review a large cohort of patients with intraoperatively proven PD and retrospectively identify preoperative radiographic parameters associated with PD. We used the AP pelvis radiographic parameters that were previously described and additionally evaluated the value of supplemental radiographic views including a true lateral radiograph of the hip, Judet views, false profile view, and computed tomography (CT) scans. In addition, we defined radiographic criteria for the identification of PD.

Using the information obtained from this study, we provide recommendations for accurately identifying PD preoperatively.

Materials and Methods

Study approval was obtained by our institution's review board. The total joint registry at our institution was used to identify all

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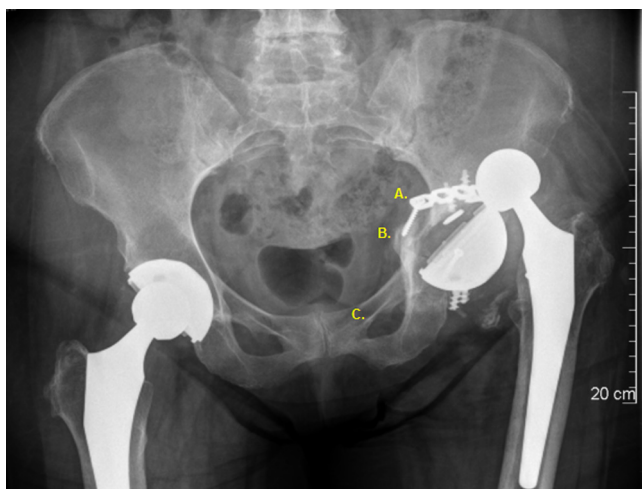


Fig. 1. AP radiograph of the pelvis showing: A., visible fracture line; B., medial migration of the inferior pelvis; and C., obturator ring asymmetry. AP, anteroposterior.

total hip arthroplasty revision cases in patients aged older than 18 years that were performed for PD from 1997 to 2011. A specific code identified the medical record numbers for all patients who had intraoperatively identified PD. Each patient's medical record was retrieved, and the operative report was reviewed to confirm PD was present at the time of revision surgery, and not created during the revision surgery. Patients with acetabular fractures that were not a PD were excluded as were patients who had a PD secondary to an acetabular tumor resection.

The senior authors (RJS, DGL, DB) reviewed all preoperative hip radiographic studies that patients had before undergoing the revision surgery. All patients had a minimum of an AP pelvis radiograph of the involved hip and all but one had a true lateral radiograph of the involved hip. The AP pelvis radiograph was a standard AP pelvis in the supine position and the lateral view was a cross-table lateral. Additional relevant imaging, including Judet views, false profile views, and pelvis CT scans were also reviewed when available. The number and type of preoperative radiographic studies varied and was determined by the treating surgeon.

On initial review of AP pelvis radiographs, the senior authors confirmed the presence or absence of 3 key radiographic characteristics: presence of a definitive fracture line (through the acetabulum), medialization of the inferior hemipelvis, and a change in rotational alignment between the superior and inferior hemipelvis evidenced by asymmetry of the obturator foramina. All AP radiographs were confirmed to be true AP radiographs by identifying that the coccyx to be approximately 2–4 cm proximal and in-line with the pubic symphysis. Additional radiographic views also were reviewed. On the Judet views, false profile views, and true lateral hip views, the key finding identified was the presence or absence of a visible fracture line. Evaluation of each radiographic parameter was recorded, and the independent and combined sensitivities of each parameter were calculated. The senior authors classified acetabular bone loss by both the AAOS and Paprosky classifications.

Table 1
Incidence of Radiographic Findings^a on AP Pelvis Radiograph.

Percent with 1 of 3 radiographic parameters	100
Percent with at least 2 radiographic parameters	96
Percent with all 3 radiographic parameters	70

AP, anteroposterior.

^a Parameters: visible fracture line, medial translation of inferior hemipelvis, and obturator ring asymmetry.

Table 2
Incidence of Radiographic Findings on Plain Films.

Radiographic parameters	N	%
Medial inferior hemipelvis translation on AP pelvis radiograph	126/133	95
Obturator ring asymmetry on AP pelvis radiograph	114/133	86
Visible fracture line on AP pelvis radiograph	116/133	87
Visible fracture line of posterior column on lateral radiograph	65/132	49
Visible fracture line of anterior column on Judet views	40/47	85
Visible fracture line of posterior column on Judet views	41/47	87

AP, anteroposterior.

The identification of PD was defined as (1) a visible fracture line through the pelvis on 2 orthogonal views (ie either on the AP pelvis radiograph in combination with a true lateral radiograph or on both Judet views) or (2) a visible fracture line on the AP pelvis film, true lateral radiograph, or Judet film in combination with 1 of 2 secondary findings suggestive of PD (either medial translation of the inferior hemipelvis or obturator ring asymmetry).

Results

We identified 133 hips with intraoperatively confirmed PD. All hips had at least an AP pelvis radiograph that was obtained preoperatively. Additional views included a true lateral hip radiograph in 132 hips, Judet views in 47 hips, false profile views in 4 hips, and 14 had a preoperative CT scan.

The patient cohort included 21 male patients and 112 females. The modified AAOS [2] classification consisted of 4 patients with type IVA, 126 patients with type IVB, and 3 patients with type IVC discontinuity. Using the Paprosky classification, there was one patient with type 2B, 27 patients with type 2C, 25 patients with type 3A, and 80 patients with type 3B bone loss.

On the AP pelvis radiograph, a fracture line was visible in 116 (87%), obturator ring asymmetry was present in 114 (86%), and medial migration of the inferior hemipelvis was present in 126 (95%). All patients had at least one finding present on the AP radiograph. Ninety-three of 133 (70%) had coincidence of all 3 radiographic parameters on the AP pelvis radiograph (Fig. 1; Table 1).

Two patients with bilateral PD had “pseudonormalization” of the rotation of the inferior aspect of the left and right hemipelvis and therefore had little obturator ring asymmetry.

A visible fracture line on the AP pelvis film and on the lateral radiograph was present in 52 of 132 (39%). A visible fracture line on the AP pelvis film in addition to at least one secondary sign (medial

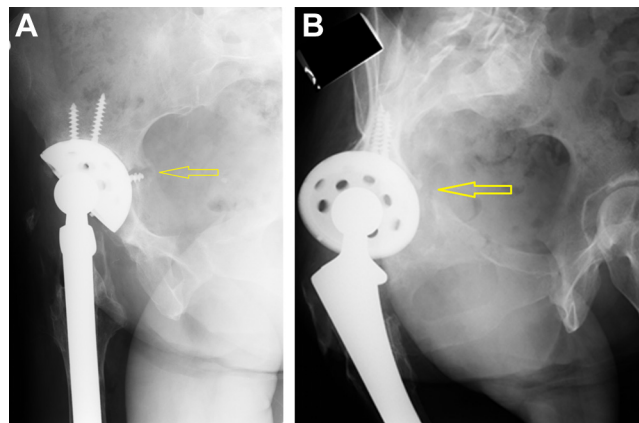


Fig. 2. (A, B) Judet views demonstrating a pelvic discontinuity of the anterior and posterior columns of the right hip. The yellow arrow in panel A corresponds to the discontinuity through the posterior column and the arrow on panel B corresponds to the discontinuity through the anterior column.

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