Intraoperative Arthrographic Assessment of Ambiguous Neck of Femur Fractures in Patients With Chronic Kidney Disease

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Summary: The loss of bone mineral density caused by Chronic Kidney Disease can make the delineation of a patient's bony anatomy impossible during intra-operative fluoroscopy. This has the potential to increase the failure rate of implants used in the surgical treatment of neck of femur fractures due to sub-optimal placements. Intra-operative arthrograms add to the techniques available to a surgeon to achieve optimal implant placement without compromising the patient's renal function nor increasing the radiation dose exposure to the surgical team.

Key Words: neck of femur fracture—chronic kidney disease—mineral bone disorder—arthrogram.

(*Tech Orthop* 2018;33: 255–257)

BACKGROUND

Chronic kidney disease-mineral bone disorder (CKD-MBD) syndrome is a recognized long-term complication of chronic renal insufficiency. CKD-MBD can result in renal osteodystrophy, which can cause the loss of cortical bone and an increase in demineralized collagen fibers, resulting in the loss of bone mineral density (BMD) and structural integrity,[1] which is reflected by a reduced radio-opacity on fluoroscopy; reduced clarity of displayed images.

Fluoroscopy plays a vital role in the safe and appropriate placement of the fixation device(s) used to the treat neck of femur fractures; which should be sited within a defined region of the femoral head to achieve optimal fixation. Inadequate placement of these devices has been shown to be associated with a higher failure rate of the surgical fixation.[2]

In severe cases of decreased BMD the reduced radio-opacity may make it impossible to clearly see the bony anatomy on intraoperative fluoroscopy, thereby making the safe and accurate position of any prosthesis challenging. We propose that intraoperative arthrograms can be a useful adjunct to delineate the bony anatomy and allow for accurate metalwork placement in such situations.

SURGICAL TIP

This technique was demonstrated in a 58-year-old women with stage 5 CKD, who presented with computed tomography proven undisplaced bilateral intracapsular neck of femur fractures, which was occult on intraoperative fluoroscopy; therefore preventing the safe placement of metalwork.

Under fluoroscopic guidance a fine-bore needle attached to a syringe filled with 10 mL Omnipaque 300 contrast (GE Healthcare, Amersham, UK) was guided along the femoral neck into the hip capsule. Contrast was then infiltrated into the hip capsule in a gradual manner until the femoral neck and head were visible and clearly defined on fluoroscopy.

The intraoperative arthrogram delineated the bony anatomy of the femoral head (Fig. 1) allowing for the safe fixation of the fracture with a dynamic hip screw, satisfactory positioning was confirmed on intraoperative fluoroscopy (Fig. 2). Further confirmation of satisfactory positioning of the device was obtained 4 weeks postoperatively with plain film radiographs of the pelvis and hips (Fig. 3). There was no significant change in the patient's renal function preoperatively and postoperatively; urea 15 preoperative and 16 postoperative, estimated glomerular filtration rate 7 preoperative and 6 postoperative.

DISCUSSION

A reduction in BMD, as seen in CKD-MBD results in a significantly increased risk of sustaining fractures of the hip.[3] The resultant osseous reabsorption in renal osteodystrophy makes plain x-ray and intraoperative fluoroscopy very difficult to interpret, therefore hindering safe surgical treatment. One can use 3-dimensional imaging to aid diagnosis and monitor outcomes from surgery, but intraoperatively these modalities are rarely available. There are other ways to improve a fluoroscopic image including; increasing the radiation dose, reducing the distance from the object to the receiver, coning, altering the contrast settings, and digital imaging but even these methods may not be sufficient. In the our described method, no alteration in the fluoroscopic setup is required and minimal equipment is required in addition to a standard set.

The majority of contrast agents are excreted by the kidneys, the use of such agents is advised with caution in patients with CKD as their use may precipitate contrast induced nephropathy, renal impairment, or acute renal failure. The manufacturer of Omnipaque advises the agent is safe to use in renal impairment patients at standard doses and volumes provided that protectionary measures are adopted; adequate prehydration of the patient, maximal dose reduction, and avoidance of concurrent use of other agents that may impair renal function.[4] In the case presented, we observed no deterioration in the renal function of our patient.

Previous studies have shown obese patients (body mass index $\geq 30\ kg/m^2$) undergoing fluoroscopic intraarticular hip injections are exposed to greater radiation doses compared with individuals with a normal body mass index. Greater radiation doses are required to maintain image resolution due to the

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The authors declare that they have nothing to disclose.

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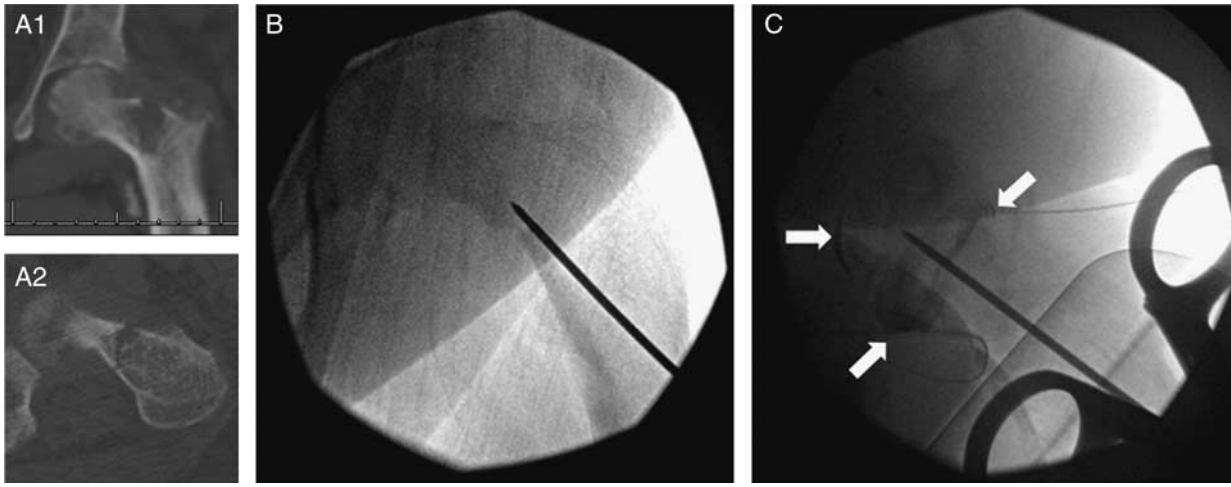

FIGURE 1. Coronal (A1) and axial (A2) computed tomographic images confirming the presence of a left neck of femur fracture. B, Appearance on initial intraoperative fluoroscopy. C, Delineation of the femoral head landmarks after arthrogram (white arrows).

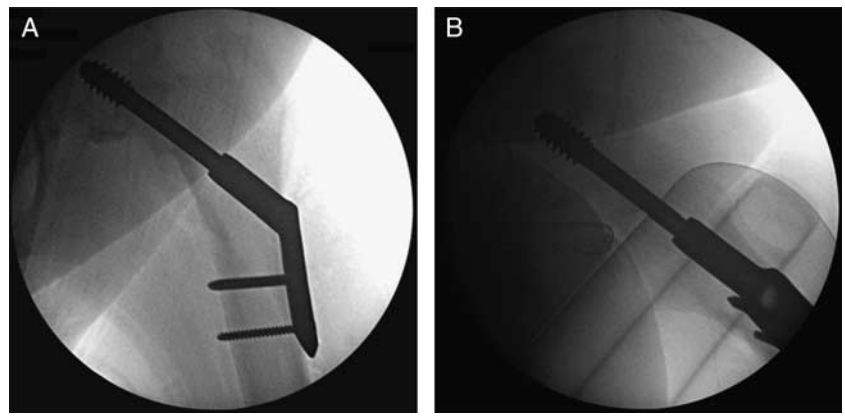

FIGURE 2. Intraoperative fluoroscopy anteroposterior (A) and lateral (B) images showing positioning of the screw in a 2-hold dynamic hip screw within the left femoral head.

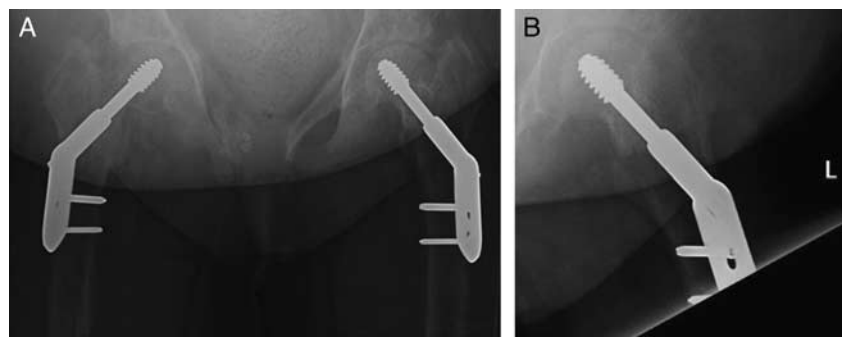

FIGURE 3. Anteroposterior pelvis (A) and lateral left hip (B) plain radiographs taken 4 weeks postoperatively showing satisfactory positioning of both dynamic hip screw devices.

attenuation of the x-rays by adipose tissue.[5] Although the increase in radiation for an individual patient may not be significant, the cumulative total for theater staff over a career may represent a significant increase in radiation exposure and risk. In such incidences we feel our described technique may present an alternative to increasing the radiation dose.

We have shown intraoperative contrast arthrograms are a useful addition to a surgeon's armamentarium in the treatment

of patients with CKD-MBD, but may also be of value in patients with a gross body habitus presenting with a similar pattern of injury.

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