A Simple Technique for Avoiding Femoral Component Malpositioning in Total Hip Resurfacing Arthroplasty

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Abstract

Proper femoral component orientation and positioning are crucial in avoiding early complications of total hip resurfacing arthroplasty. Fluoroscopic verification of guide-wire positioning helps avoid femoral component malpositioning but is technically difficult using standard protocols. In this article, we describe a simple technique that allows for fluoroscopic verification of guide-wire positioning. This technique is useful within the learning curve for total hip resurfacing arthroplasty.

Given the increasing demand for hip arthroplasties, the number of procedures performed is expected to increase 3-fold by 2030.[1] Also projected to increase significantly is the number of hip resurfacing procedures, which are most often performed in younger patients.[2] Short-term failure of hip resurfacing arthroplasty is a devastating complication that usually results from femoral neck fracture. Although patient factors, such as poor bone quality, may increase the risk for femoral neck fracture after hip resurfacing arthroplasty, technical factors also play a significant role.

Varus component positioning and inadvertent notching of the femoral neck cortex are the 2 most commonly cited technical factors associated with postoperative femoral neck fracture.[3-6] Orientation and positioning of a guide-wire through the femoral head and neck constitute the key step in preparing for femoral component implantation. An improperly placed guide-wire will misdirect tools used later, leading to femoral neck notching or component malpositioning. Extramedullary guides are commonly used to aid in proper guide-wire placement, but good results depend on surgeons' clinical judgment in assessing anatomical landmarks. Fluoroscopic evaluation is the simplest means of verifying proper guide-wire positioning, but orthogonal views are difficult to achieve. In this article, we describe a technique for simple and effective evaluation of guide-wire positioning that avoids the technical complications associated with malpositioning.

Surgical Technique

With our technique, any standard hip approach may be used. Dr. Bolanos uses a posterior approach with the patient in a lateral decubitus position. The acetabulum is exposed and prepared, and then the acetabular component is implanted in the usual manner. Dr. Bolanos typically uses image intensifier radiographic guidance for acetabular placement to confirm appropriate seating, abduction, and sizing. After the femoral head and neck are adequately exposed, the guide-wire is placed using standard extramedullary jigs that reference anatomical landmarks, such as the tip of the greater trochanter and the lesser trochanter.

At this point, the fluoroscopic images used to assess guide-wire placement are difficult to obtain. Maneuvering the image intensifier while keeping the hip in a static position is tedious and difficult, and images may be obscured by other structures. Manipulating the hip, while keeping the image intensifier in a static position, is made difficult by the protruding guide-wire. With our technique, a cannulated drill is used over the guide-wire, and a 6.3-mm cannulated screw is then placed over it. The screw is countersunk so that the head of the screw is flush with the surface of the femoral head. This prevents screw head prominence while allowing for easy retrieval. A 40-mm-long screw is used to allow for adequate fluoroscopic visualization within the femoral neck, and to avoid perforating the proximal femur lateral cortex. At this point, the guide wire is removed

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Figure 1. Positioning of image intensifier with our described procedure. Dr. Bolanos uses fluoroscopy to help position acetabular component (depicted here). Image intensifier is placed in same position for anteroposterior and lateral fluoroscopy of proximal femur for assessment of guide-wire positioning.

and the hip reduced into the acetabular component. The screw must be adequately countersunk to avoid inadvertent scratching of the inner surface of the acetabular component.

Next, the image intensifier is positioned (Figure 1) and an anteroposterior (AP) view of the hip is obtained. Hip rotation can be fine-tuned to obtain a true AP hip view. Varus/valgus orientation and superoinferior screw position are assessed with ease (Figure 2A). Next, the hip is dislocated and placed in a position of full extension and roughly 90° of internal rotation. The image intensifier, still in the same position, is used to obtain a lateral view of the femoral head and neck. Again, hip rotation can be fine-tuned to obtain a true lateral view. Anteversion/retroversion and AP screw position are assessed with ease (Figure 2B).

If screw position or orientation is deemed inadequate on either view, the screw is removed, the guide-wire is repositioned, and all the steps are repeated until positioning is appropriate. At this point, the guide-wire is replaced through the cannulated screw, and a cannulated screwdriver is used to remove the screw. Standard instrumentation is used to prepare the femoral head and neck, and the final component is implanted. The image intensifier can be used in the same manner to verify appropriate positioning of the final components (Figure 3).

Although our technique is useful within the learning curve for hip resurfacing arthroplasty, several caveats must be considered. First, when the cannulated screw is inappropriately positioned, repositioning of the guide-wire through the existing screw hole may be technically challenging. Second, placing a large cannulated screw creates a relatively large hole in the femoral neck, particularly for smaller patients. In most cases, the screw hole is filled with the stem of the femoral component. However, when several passes of the large screw are needed, the femoral neck may be weakened. Given this situation, caution should be taken when using our technique in patients with other risk factors for femoral neck fracture.

Discussion

There has been a recent resurgence in patient demand for, and surgeon interest in, total hip resurfacing arthroplasty. US surgeons are relatively inexperienced in this technique, which has a learning curve. Recent literature suggests that a hip specialist's first 25 procedures are associated with a higher complication rate. Furthermore, achieving consistency in component positioning and orientation may take a surgeon 75 to 100 procedures or more.[7]

Proper positioning and placement of the femoral component are more difficult in hip resurfacing arthroplasty than in standard total hip arthroplasty. Current standard surgical protocols do not allow for confirmation of femoral component placement until after femoral preparation has been completed. Rather, these protocols require that surgeons rely on their clinical judgment to confirm appropriate guide-wire placement.

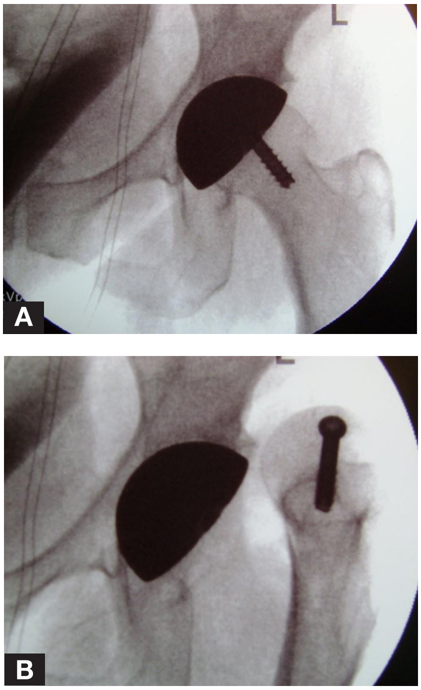

Figure 2. (A) Fluoroscopic image of proximal femur with hip reduced and image intensifier positioned as in Figure 1. Anteroposterior image of hip allows for assessment of varus/valgus alignment and superoinferior screw position. (B) Fluoroscopic image of proximal femur with hip extended and internally rotated and image intensifier positioned as in Figure 1. Lateral image of hip allows for assessment of version and anteroposterior screw translation.

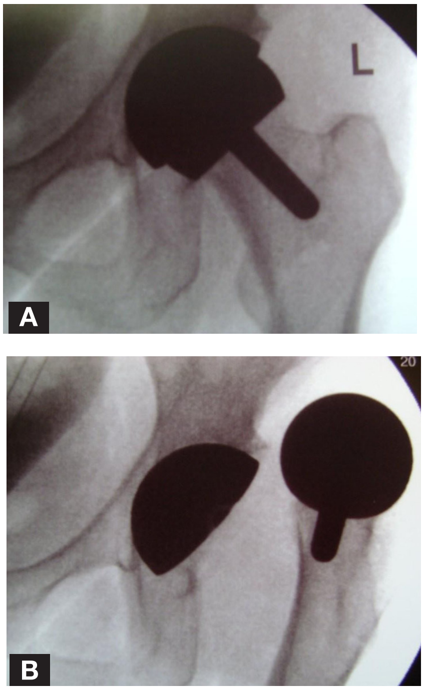

Figure 3. (A) With hip reduced, final position of femoral component is assessed in anteroposterior plane. (B) With hip extended and internally rotated, final position of femoral component is assessed in lateral plane.

Although experienced surgeons may not need additional guidance, surgeons within the learning curve may not have the experience needed to avoid complications resulting from malpositioning.

Recent studies have shown that imageless navigation improves accuracy in varus/valgus orientation of the femoral component, reduces outliers, reduces the risk of femoral neck notching, and shortens the learning curve associated with hip resurfacing arthroplasty.[8-10] Disadvantages include availability, cost, and the learning curve for use of navigation instrumentation. In addition, cam-type lesions of the femoral head and neck may reduce the accuracy and precision of imageless navigation.[11] This common deformity in hip resurfacing candidates obscures the true topical anatomy of the femoral neck, leading to inaccuracy in version and AP translation of the final component. Computed tomography–based navigation improves accuracy with respect to the cam-type deformity[12] but is expensive, not widely available, and adds time and inconvenience to the procedure.

Although these techniques help surgeons within the learning curve to avoid errors in guide-wire positioning, they do not allow for verification of appropriate positioning after placement. Fluoroscopy is ideal for assessing guide-wire positioning, but protrusion of the guide-wire out of the femoral head prevents the limb manipulation needed for orthogonal views. In this article, we describe a simple technique for using fluoroscopy to assess guide-wire positioning after placement with standard extramedullary guides.

Authors' Disclosure Statement

Dr. Bolanos reports being a consultant for Zimmer, Smith and Nephew, and Medtronic. Dr. Parvizi reports being a consultant for Stryker. The other authors report no actual or potential conflict of interest in relation to this article.

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