Assessment of Acetabular Version by Plain Radiograph

David C. Markel, MD, John L. Andary, MBA, MD, Paul Pagano, MD, and Sam Nasser, MD

Abstract

Radiographs are routinely used to assess the condition and position of the acetabular component. The condition of the cement mantle, or the ingrowth potential, is usually easily recognized. Component–bone position can be assessed by using the method of Ranawat or by measuring abduction angles. Assessment of the version of an acetabular component is often overlooked. This angle or position is important relative to instability, impingement, and motion abnormality.

The opening angle or version can be implied from a true acetabular or cross-table lateral radiograph, but good-quality views are often difficult to obtain on an outpatient basis. Using the simple technique presented here, clinicians can assess the acetabular component for version on the basis of plain anteroposterior pelvis and hip radiographs.

Dr. Markel is Chief, Department of Orthopaedic Surgery, Providence Hospital, Southfield, Michigan, and Associate Clinical Professor, Wayne State University, Detroit, Michigan.
Dr. Andary is with The Shoulder & Knee Center, Idaho Falls, Idaho.
Dr. Pagano is with The Orthopaedic Spine Center, Youngstown, Ohio.
Dr. Nasser is Professer of Orthopaedic Surgery, Wayne State University, Detroit, Michigan.

Requests for reprints: David C. Markel, MD, Department of Orthopaedic Surgery, Providence Hospital, 22250 Providence Dr, #401, Southfield, MI 48075 (tel, 248-569-0306; fax, 248-569-0364; e-mail, dmarkel@providence-hospital.org).

Am J Orthop. 2007;36(1)39-41. Copyright 2007, Quadrant HealthCom Inc.

Patients are often seen in an outpatient setting for routine follow-up or on referral for evaluation of a previous total hip arthroplasty. Standard office evaluation includes history taking, physical examination, and radiographic assessment of components. Orthopedic surgeons are well trained in assessing cement mantles and ingrowth potential and recognizing Gruen zones[1] and the zones described by Delee and Charnley.[2] Acetabular component–bone position can be assessed by using the method of Ranawat and colleagues[3] or by measuring abduction angles. Assessment of the version of an acetabular component is often overlooked. This cup angle or position is extremely important, particularly if one is assessing a patient for early loosening, instability, impingement, or motion abnormalities.[4-11] The anteroposterior (AP) opening angle or version of the acetabular component may be implied from a true acetabular radiograph or cross-table lateral radiograph. Unfortunately, good-quality views of this type are often difficult to obtain on an outpatient basis.

In this article, we present a simple technique for acetabular version assessment. This technique allows a clinician to assess the acetabular component version on the basis of plain radiographs and routine AP pelvis and hip projections. This technique is not unique. Reports in the radiology literature have either alluded to it or described its derivations for acetabular[12-19] and femoral[12,20,21] components. However, these reports have tended to be complicated by geometric descriptions and an impractical approach that often accompanies non–patient care disciplines.[14,16-19]

Description of Technique

The patient is placed supine on the x-ray table with the x-ray tube centered over the pubic symphysis, as per routine. An AP pelvis view is obtained in standard fashion. The patient or preferably the x-ray tube is then repositioned more laterally and centered over the hip joint. An AP view of the hip is obtained, as per routine. These 2 views are then directly compared to approximate the acetabular version.

> **"...version...is extremely important, particularly if one is assessing a patient for early loosening, instability, impingement, or motion abnormalities."**

Given the projection angles of the x-ray beam in the 2 different pelvic positions relative to the x-ray tube, the acetabular version can be assessed.[14,16-19] The key lies in simple geometry. When the acetabular component is anteverted, the opening angle of the cup appears larger in the AP hip view than in the AP pelvis view (Figures 1, 2). In other words, the component appears more anteverted. Conversely, when the opening angle appears smaller in the AP hip view, the cup is more retroverted (Figures 3, 4). When there is little or no difference in the opening angle of the component between one view and the other, the position is relatively neutral.

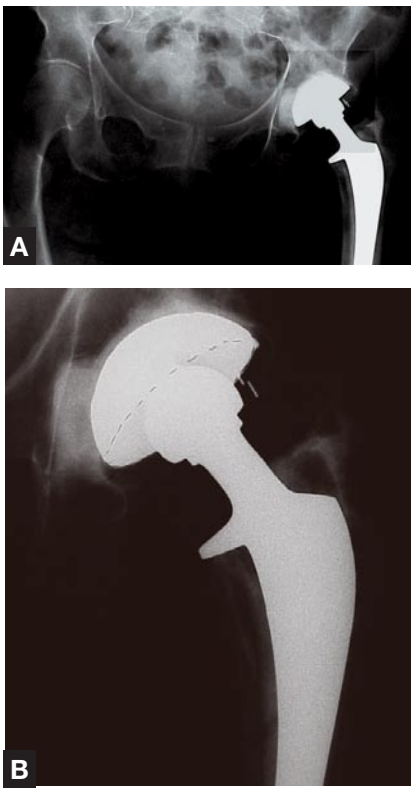
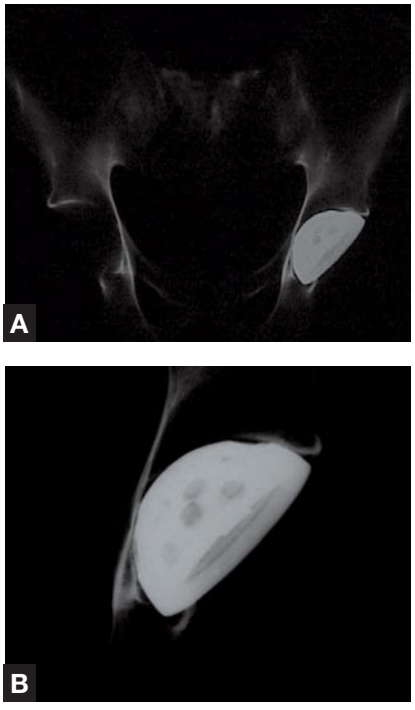


Figure 1. Anteroposterior pelvis **(A)** and hip **(B)** views of relatively anteverted acetabular component. Cup appears more anteverted in the hip view than in the pelvis view.



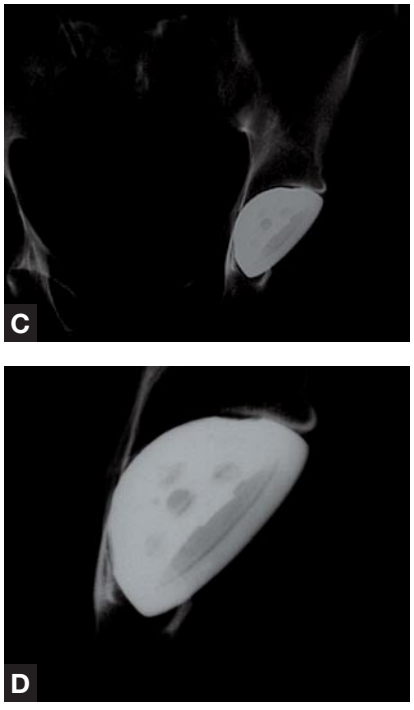


Figure 2. Anteroposterior views of anatomical specimen with cup in relatively anteverted position: **(A)** pelvis view; **(B)** close-up pelvis view; **(C)** hip view; **(D)** close-up hip view. Position of marking wires differs between pelvis and hip views.

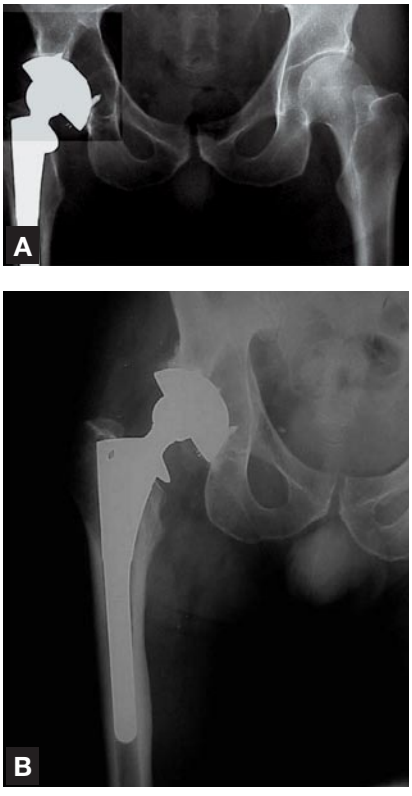


Figure 3. Anteroposterior pelvis **(A)** and hip **(B)** views of relatively retroverted acetabular component. Cup appears less anteverted in the hip view than in the pelvis view, and the spike on the backside of the cup is more prominent in the hip view.

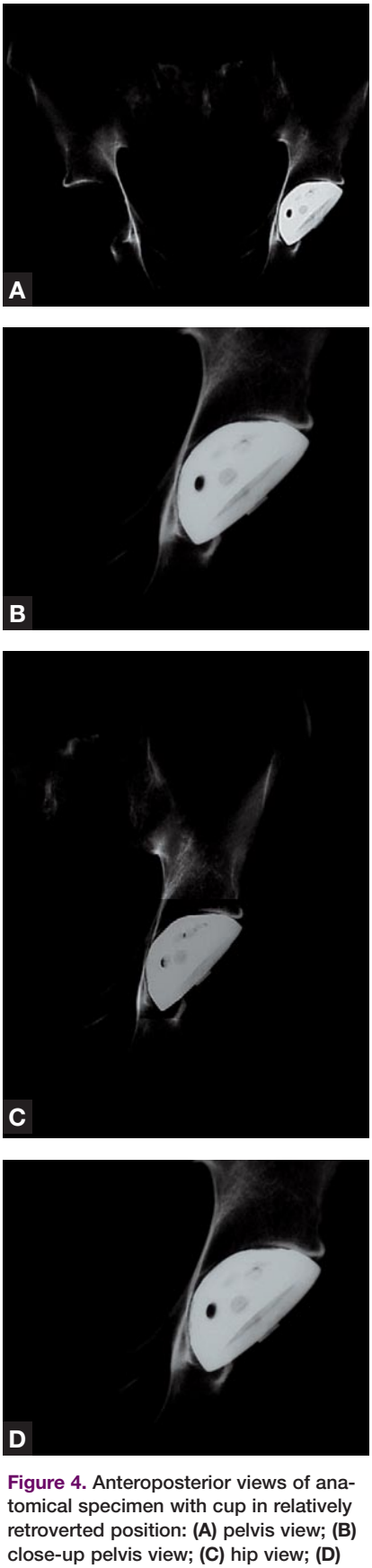


Figure 4. Anteroposterior views of anatomical specimen with cup in relatively retroverted position: **(A)** pelvis view; **(B)** close-up pelvis view; **(C)** hip view; **(D)** close-up hip view. Position of marking wires differs between pelvis and hip views.

Conclusions

This simple radiographic method can be used in virtually any outpatient setting and can often be effectively applied to "outside" films. It allows clinicians to effectively estimate the version of the acetabular component. This is particularly helpful in assessing patients for early loosening, instability, and impingement and in preoperative planning for revision surgery, particularly when it is possible that the indwelling acetabular component will be retained.[4-11] In addition, surgeons may use the method to evaluate acetabular positioning technique immediately postoperatively.

Authors' Disclosure Statement and Acknowledgments

The authors report no actual or potential conflicts of interest in relation to this article.

References

1. Gruen TA, McNeice GM, Amstutz HC. Modes of failure of cemented stem-type femoral components: a radiologic analysis of loosening. *Clin Orthop*. 1979;141:17-27.
2. Delee JG, Charnley J. Radiological demarcation of cemented sockets in total hip replacement. *Clin Orthop.* 1976;121:20-32.
3. Ranawat CS, Dorr LD, Inglis AE. Total hip arthroplasty in protrusio acetabulae of rheumatoid arthritis. *J Bone Joint Surg Am.* 1980;62:1059-1064.
4. Di Gioia AM, Jaramaz B, Blackwell M, et al. The Otto Aufranc Award. Image guided navigation system to measure intraoperatively acetabular implant alignment. *Clin Orthop.* 1998;355:8-22.
5. D'Lima DD, Urquhart AG, Buehler KO, Walker RH, Colwell CW. The effect of the orientation of the acetabular and femoral components on the range of motion of the hip at different head–neck ratios. *J Bone Joint Surg Am.* 2000;82:315-321.
6. Gondi G, Roberson JR, Ganey TM, Shahriari A, Hutton WC. Impingement after total hip arthroplasty related to prosthetic component selection and range of motion. *J South Orthop Assoc.* 1997;6:266-272.
7. Ilchmann T, Franzen H, Mjoberg B, Wingstrand H. Measurement accuracy in acetabular cup migration. A comparison of four radiologic methods versus roentgen stereophotogrammetric analysis. *J Arthroplasty.* 1992;7:121-127.
8. Kennedy JG, Rogers WB, Soffe KE, Sullivan RJ, Griffen DG, Sheehan LJ. Effect of acetabular component orientation on recurrent dislocation, pelvic osteolysis, polyethylene wear, and component migration. *J Arthroplasty.* 1998;13:530-534.
9. Paterno SA, Lachiewicz PF, Kelley S. The influence of patient-related factors and the position of the acetabular component on the rate of dislocation after total hip replacement. *J Bone Joint Surg Am.* 1997;79:1202-1210.
10. Thoren B, Sahlstedt B. Influence of pelvic position on radiographic measurements of the prosthetic acetabular component. An experimental study on a pelvic model. *Acta Radiol.* 1990;31:133-136.
11. Yoder SA, Brand RA, Pedersen DR, O'Gorman TW. Total hip acetabular component position affects component loosening rates. *Clin Orthop.* 1988;228:79-87.
12. Clarke IC, Gruen T, Matos M, Amstutz HC. Improved methods for quantitative radiographic evaluation with particular reference to total-hip arthroplasty. *Clin Orthop.* 1976;121:83-91.
13. Dick W, Morscher E. Contribution to the technique of acetabular implantation in total hip arthroplasty. *Arch Orthop* Unfallchir. 1975;83:215-220.
14. Fackler CD, Poss R. Dislocation in total hip arthroplasties. *Clin Orthop.* 1980;151:169-178.
15. Goergen TG, Resnick D. Evaluation of acetabular anteversion following total hip arthroplasty: necessity of proper centering. *Br J Radiol.* 1975;48:259-260.
16. Ghelman B. Radiologic localization of the acetabular component of a hip prosthesis. *Radiology.* 1979;130:540-542.
17. Herrlin K, Selvik G, Pettersson H. Space orientation of total hip prosthesis. A method for three dimensional determination. *Acta Radiol.* 1986;27:619-627.
18. McLaren RH. Prosthetic hip angulation. *Radiology.* 1973;107:705-706.
19. Pettersson H, Getz C-F, Lindberg HO, Carlsson AS. Radiographic evaluation of the position of the acetabular component of the total hip prosthesis. *Acta Radiol.* 1982;23:259-263.
20. Carlsson AS, Gentz CF. Postoperative dislocation in the Charnley and Brunswik total hip arthroplasty. *Clin Orthop.* 1977;125:177-182.
21. Ghelman B. Three methods for determining anteversion and retroversion of a total hip prosthesis. AJR *Am J Roentgenol*. 1979;133:1127-1134.