

Scintigraphic and X-Ray Arthrographic Diagnosis of Femoral Prosthesis Loosening: Concise Communication

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In order to determine loosening of femoral components of conventional total hip arthroplasties, a comparison of radionuclide (RA) and radiographic arthrograms (XA) was performed. The hips of 29 patients were studied with radiographic contrast and intraarticular Tc-99m sulfur colloid. The XAs were positive for loosening in 10/29 studies, whereas the RAs were positive in 19/29 studies. In five of ten in which both studies were positive, the RA showed femoral prosthesis loosening more clearly than the XA. By surgical follow-up, there were four false-negative XAs. Our data suggest that the RA is valuable in determining femoral component loosening.

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With a standard radiographic arthrogram (XA), it is difficult to detect femoral component (FC) loosening of a total hip prosthesis because the metal prosthesis and surrounding radiopaque cement obscure the radiographic contrast agent. A radionuclide arthrogram (RA) is useful because the Tc-99m photons are not obscured by the prosthesis or cement, nor is the radionuclide distribution confused with the cement.

MATERIALS AND METHODS

Ten to fifteen milliliters of diatrizoate meglumine 60%, injected intraarticularly, is followed by 0.8-1 mCi of nonabsorbable technetium-99m sulfur colloid (Tc SC) in 1 ml, through the same needle. After completion of the radiographic arthrogram, the patient is scintigraphed. Usually gamma imaging is begun 1 to 1½ hr after injection of the TcSC. Images are then obtained in anterior, lateral, and frog-leg positions (300K counts each) with a low-energy all-purpose parallel-hole collimator and large-field-of-view gamma camera. A Tc-99m point

source is used to mark the medial, lateral, and anterior

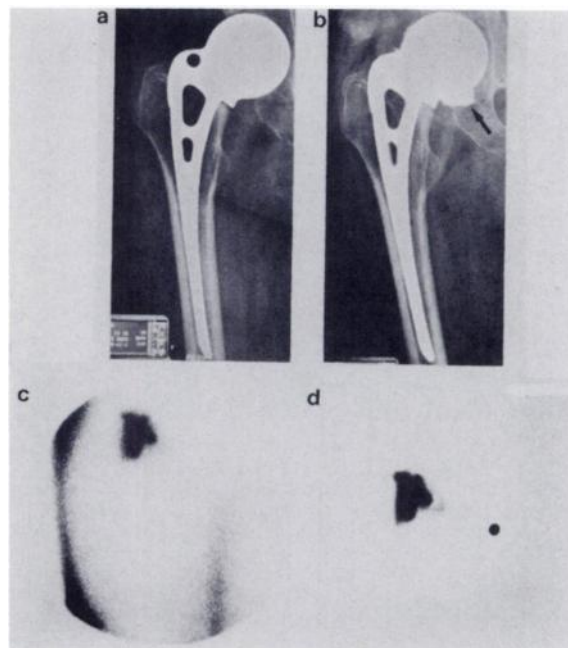


FIG. 1. Negative XA and RA (a) Plain film. (b) Radiographic arthrogram; arrow points to contrast limited to region of joint space. (c) Co-57 transmission image. (d) Tc-99m arthrogram also shows activity in region of joint space. Black dot in d is Tc-99m marker on symphysis pubis.

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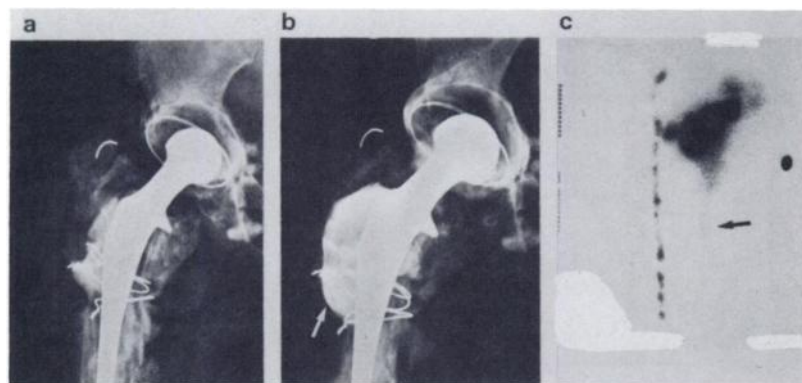


FIG. 2. Positive XA and RA. (a) Plain XA shows large amount of cement around prosthesis. (b) Large pocket of contrast is seen lateral to femoral component (arrow), with minimal collection of contrast medially. (c) RA clearly shows activity around entire femoral component (arrow), compatible with loosening. Vertical line at lateral aspect of thigh represents a Tc-99m marker drawn along patient's thigh.

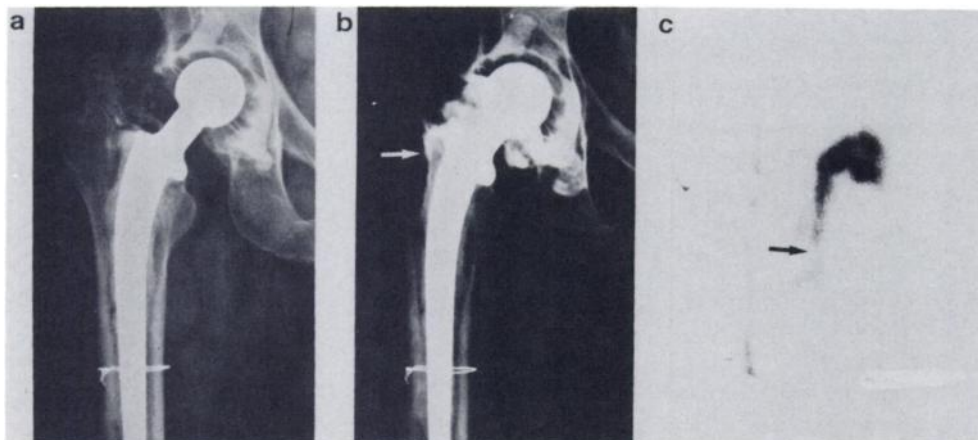


FIG. 3. Positive XA and RA. (a) Plain film. (b) XA shows contrast only around the proximal aspect of FC (arrow). (c) RA: arrow points to activity extending all down shaft of FC. (Tc-99m marker along lateral aspect of thigh).

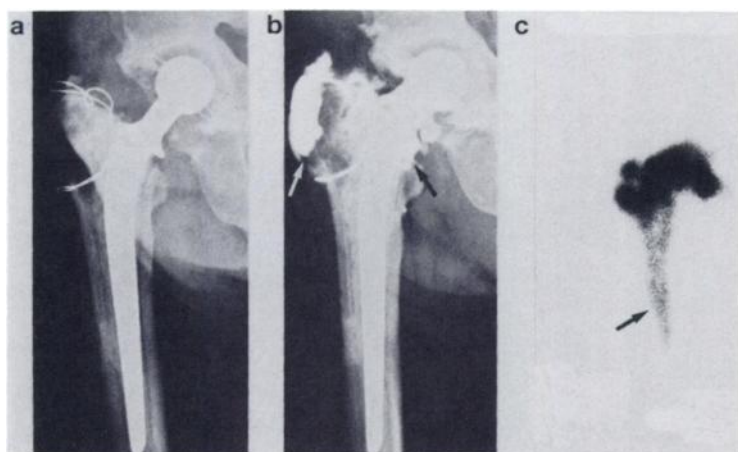


FIG. 4. Negative XA and Positive RA. (a) Plain film. (b) XA shows contrast collecting in pocket over greater trochanter (white arrow) and around femoral neck (black arrow). (c) RA: arrow shows activity completely around femoral prosthesis, consistent with loosening.

aspects of the thigh. Cobalt-57 transmission images are also obtained to locate the intraarticular activity.

RESULTS

Twenty-eight patients were studied for a total of 29 matched XA and RA (both hips in one patient). In ten patients, the RA and XA were both negative (4/10 with surgical proof). Such a patient is a 50-yr-old white female with osteoporosis (Fig. 1), who had a subcapital

fracture of the right hip in July 1981, with placement of an Austin-Moore prosthesis. She did well for 2 mo, then developed right hip pain and was unable to walk without crutches. The XA and superimposed Co-57 transmission image show contrast and activity limited to the region of the lower half of the femoral head. There is no extension of activity down the femoral prosthesis. Both studies were interpreted as negative for FC loosening. At surgery there was no evidence of loosening of either component.

	XA	RA
Positive	10	19
Negative	19	10

	RA	XA
True positive	9	5
True negative	4	4
False negative	0	4
False positive	0	0

Sensitivity: XA = 55%, RA = 100%.
Specificity: both 100%.

In ten patients, the RA and XA both showed loosening of the FC (5/10 with surgical proof). In five of ten cases however, the RA showed FC loosening to a greater extent, and more obviously, than the XA. Such a patient is a 33-yr-old black female with sickle cell disease (Fig. 2). Bilateral total hip arthroplasties (THA) were performed in 1973. She had several revisions on the right side for pain and infection. The XA is particularly difficult to interpret due to the large amount of cement. Loosening of the femoral prosthesis was questioned on the basis of the XA. Tomograms showed an ununited fracture of the medial femoral shaft. The RA shows definite activity around the entire aspect of the femoral prosthesis, consistent with loosening.

The patient in Fig. 3 is a 50-yr-old male who had a right THA because of degenerative changes secondary to a slipped capital femoral epiphysis. Both studies were interpreted as positive for loosening, although the RA is more striking. The FC was loose at surgery.

In nine cases, the XA was negative and the RA positive for FC loosening. In four of the nine the loosening has been surgically verified. The patient in Fig. 4 is a 60-yr-old white farmer who had a right THA for hip pain. At surgery, the femoral component was found to be loose.

In no patient was the XA positive and the RA negative. Tables 1 and 2 summarize our results to date.

DISCUSSION

Radiographic and radionuclide arthrography are complementary. Radiographic arthrograms are useful

for acetabular loosening, RA for femoral. The RA may demonstrate a greater extent of loosening than the XA because diatrizoate meglumine 60% is approximately six times more viscous than the saline solution radiopharmaceuticals. Viscosity undoubtedly impairs the flow of the radiographic contrast around a loose prosthesis. Moreover, there is neither confusion of the Tc-99m SC with cement nor obscuration of the Tc-99m SC by the metal prosthesis, as is the case in XA and contrast materials.

Our results closely approximate those of Abdel-Dayem (1) demonstrating the valuable complementary nature of RA to XA in identification of femoral-component loosening.

Research is under way to improve portrayal of intraarticular activity by superimposing a bone scintigram, obtained with i.v. Tc-99m methylenediphosphonate, upon an image obtained with intraarticularly injected In-111 DTPA. Since their energies are different (140 keV compared with 173 and 247 keV), the two images may be made without moving the patient.

REFERENCE

1. ABDEL-DAYEM HM, BARODAWALA YK, PAPADEMETRIOU T: Scintigraphic Arthrography, Comparison with Contrast Arthrography and Future Applications. *Clin Nucl Med* 7: 516-522, 1982