

# Painful Knee Arthroplasty

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A triple-tracer nuclear medicine study that incorporates  $^{99m}\text{Tc}$ -sulfur colloid,  $^{111}\text{In}$ -labeled leukocytes, and  $^{99m}\text{Tc}$ -methylene diphosphonate can be useful for the diagnosis of aseptic loosening in a patient after total-knee arthroplasty, as demonstrated in this case study. The triple-tracer technique takes less time and is more accurate than a bone scan alone.

**Key Words:** bone; instrumentation; joint/muscle;  $^{111}\text{In}$ -labeled autologous leukocytes;  $^{99m}\text{Tc}$ -MDP;  $^{99m}\text{Tc}$ -sulfur colloid

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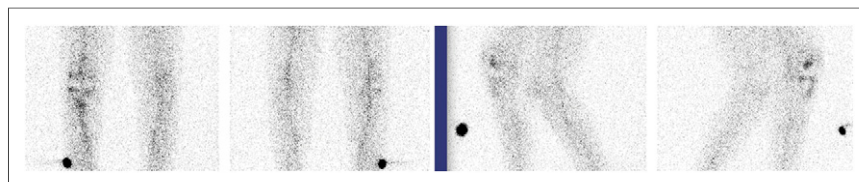
**T**his article discusses the importance of the use of a triple-tracer study in the postoperative knee to diagnose an aseptic knee. The components of the triple tracer will be discussed, as well as how the results of this study can aid the orthopedic surgeon in designing a treatment plan that will be successful for the patient.

knee pain, which did not improve with conservative management. She had undergone cemented total-right-knee arthroplasty 2 y previously for osteoarthritis. She was previously pain-free and had not undergone recent trauma. She was afebrile and had a mildly elevated white blood cell count of 10.7 billion/L. A triple-tracer study was requested to evaluate for septic prosthesis loosening.

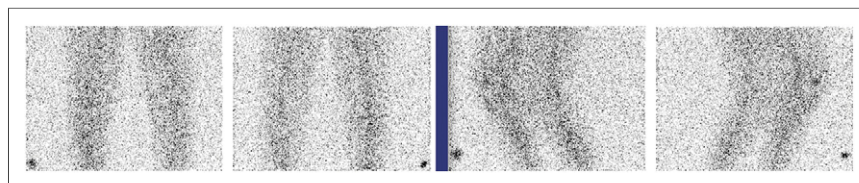
The patient was first injected with 373.7 MBq (10.1 mCi) of  $^{99m}\text{Tc}$ -sulfur colloid, and spot views of the knees were obtained. The patient was then injected with 20.72 MBq (0.56 mCi) of  $^{111}\text{In}$ -labeled leukocytes, and similar-projection 24-h delayed images of the knees were obtained. Lastly, the patient was injected with 862.1 MBq (23.3 mCi) of  $^{99m}\text{Tc}$ -methylene diphosphonate, and acquisition of dynamic flow and static blood-pool images followed immediately afterward. After 3–4 h of tracer localization, spot views of the knees were obtained.

Comparison of the  $^{99m}\text{Tc}$ -sulfur colloid and  $^{111}\text{In}$ -labeled leukocyte images (Fig. 1) did not demonstrate discordant uptake of the latter to suggest infection. On the 3-phase

**FIGURE 1.** Anterior/posterior (left) and medial/lateral (right) projection images of knees after injection with  $^{99m}\text{Tc}$ -sulfur colloid.



**FIGURE 2.** Anterior/posterior (left) and medial/lateral (right) projection images of knees after injection with  $^{111}\text{In}$ -labeled autologous leukocytes.



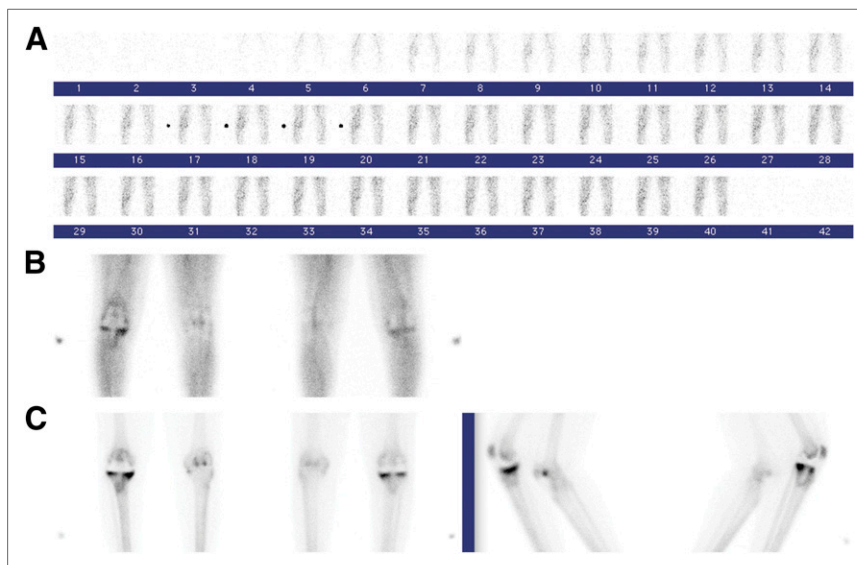
## CASE REPORT

A 59-y-old woman with a history of rheumatoid arthritis and osteoarthritis presented with 6 mo of progressive right

$^{99m}\text{Tc}$ -methylene diphosphonate bone scan, there was peri-prosthetic hyperemia near the tibial component on the early images (Fig. 2). On the delayed images, there was increased uptake at the interface between the tibial plateau native bone and the prosthesis, worse medially (Fig. 3).

The triple-tracer findings were consistent with aseptic failure of the prosthesis. Surgical exploration did not reveal any signs of infection; however, the tibial component had subsided into the medial tibial plateau and was easily

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**FIGURE 3.** (A) Anterior projection blood-flow images with right-sided marker. (B) Blood-pool  $^{99m}\text{Tc}$ -methylene diphosphonate images of knees in anterior/posterior projection. (C) Delayed static images of knees in anterior/posterior and medial/lateral projections.

dislodged during removal, concordant with the imaging findings. A new prosthesis was inserted, and after a short convalescent period, the patient was discharged home.

## DISCUSSION

More than 700,000 total-knee arthroplasties are performed in the United States annually, of which more than one quarter will eventually need revision. The most frequent cause, aseptic loosening, is an inflammatory reaction to the prosthetic components (1). Subsequently, the particulate debris activates tissue phagocytes but cannot be broken down by cellular enzymes. The continued secretion of proinflammatory cytokines and proteolytic enzymes damages the bone and cartilage and further activates immune cells. The heightened inflammatory response leads to osteolysis and, eventually, loosening of the prosthesis (2).

The infection rate after primary total-knee arthroplasty is approximately 1%, but the treatments of aseptic loosening and infected hardware are very different. Therefore, it is extremely important to differentiate them. Often the initial study is a bone scan; however, it has a variable sensitivity of 67%–100% for diagnosing an infected knee replacement (3,4).

## CONCLUSION

In this patient, the orthopedic surgeon was clinically concerned about infection and wanted the patient to expeditiously undergo a 1-stop-shop scan to exclude it. We performed the  $^{99m}\text{Tc}$ -sulfur colloid scan followed by the  $^{111}\text{In}$ -labeled leukocyte scan and then the 3-phase bone scan to complete the triple-tracer protocol. This sequence takes the shortest amount of time and has higher accuracy than the bone scan alone (4).

## DISCLOSURE

No potential conflict of interest relevant to this article was reported.

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