

# <sup>99m</sup>Tc-Pyrophosphate—A New Bone-Seeking Nuclide

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A new bone-seeking nuclide, <sup>99m</sup>Tc-Sn-pyrophosphate (P<sub>2</sub>O<sub>7</sub><sup>4-</sup>), was developed by Raymond Marty, John Denny, and Michael McKamey\* of the Division of Nuclear Medicine, Swedish Hospital Seattle, Wash. This nuclide was made available to selected hospitals on a clinical research basis in September 1972.

This agent has many advantages over its predecessors, <sup>85</sup>Sr, <sup>87m</sup>Sr, and <sup>18</sup>F. Its bone-seeking ability accompanied by low radiation dose, short half-life, rapid blood clearance, low gamma energy (140 keV) and nontoxicity enable excellent quality and rapid bone scans to be performed.

## Method

Ten to 15 mCi of <sup>99m</sup>Tc-pyrophosphate is administered intravenously. The patient is adequately hydrated during the next 4 hr before scanning (the optimum dose-to-scanning time). Immediately before scanning the patient voids to remove accumulated activity in the bladder. Scanning commences with views of the pelvis and most of the skeleton is imaged. Scanning in this institution is performed on a Nuclear-Chicago HP gamma camera with a high-resolution low-energy collimator. The views obtained are as follows: AP pelvis, right and left hips and upper femur, anterior chest, right and left ribs, right and left shoulders, right and left lateral skull, posterior pelvis, lumbar spine, dorsal spine and cervical spine, and posterior right and left ribs, accounting for approximately 12-15 projections, the lower and upper extremities being included in some cases. Three hundred thousand counts are collected over the anterior pelvis, and the remaining images are for preset time. Approximate time per view is 200 sec resulting in a camera time for all views of approximately 1½ hr. The quality of the scans is shown in Figs. 1-3.

## Cases

EN, 60-year-old woman with previous diagnosis of carcinoma of breast and lung lesion in 1971, followed by pneumonectomy, presented with bone pain in the left hip in December 1972. X-rays of the skeleton were normal except for early destructive changes in the intertrochanteric region of the left hip. Bone scanning revealed lesions in the right ribs, right clavicle, and right hip and upper femur. This patient was subsequently treated with x-radiation to these sites (Fig. 1).

RW, 58-year-old white man, presented with a lesion in the left lung demonstrated on chest x-ray, questionable diagnosis of bronchogenic carcinoma, and complaint of occasional pain in the right chest. Pre-operative bone scan showed lesions of the skull, sternum, and right ribs (Fig. 2).

MP, 50-year-old woman, had carcinoma of the colon resected in July 1972. She presented in January 1973 with pain in the right shoulder and left leg. The bone scan showed lesions in the right clavicle and left pelvis superior to the acetabulum. X-rays were initially normal. A pathological fracture was later found in the right clavicle (Fig. 3).

## Summary

Technetium-99m-pyrophosphate provides us with a high-quality, rapid method of evaluating bone disease (compared with <sup>85</sup>Sr) which has greatly improved patient management as far as pre-operative evaluation and pre-irradiation evaluation in suspected metastatic bone disease. It is hoped that in the near future a high-speed rectilinear scanner with minification will greatly reduce the scanning time and enable more cases to be handled each day. The new Divcon Collimator for the Nuclear-Chicago camera would also reduce scanning time if camera images are preferred.

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\*Labeling procedure is a modified technique of G. Subramanian (1).

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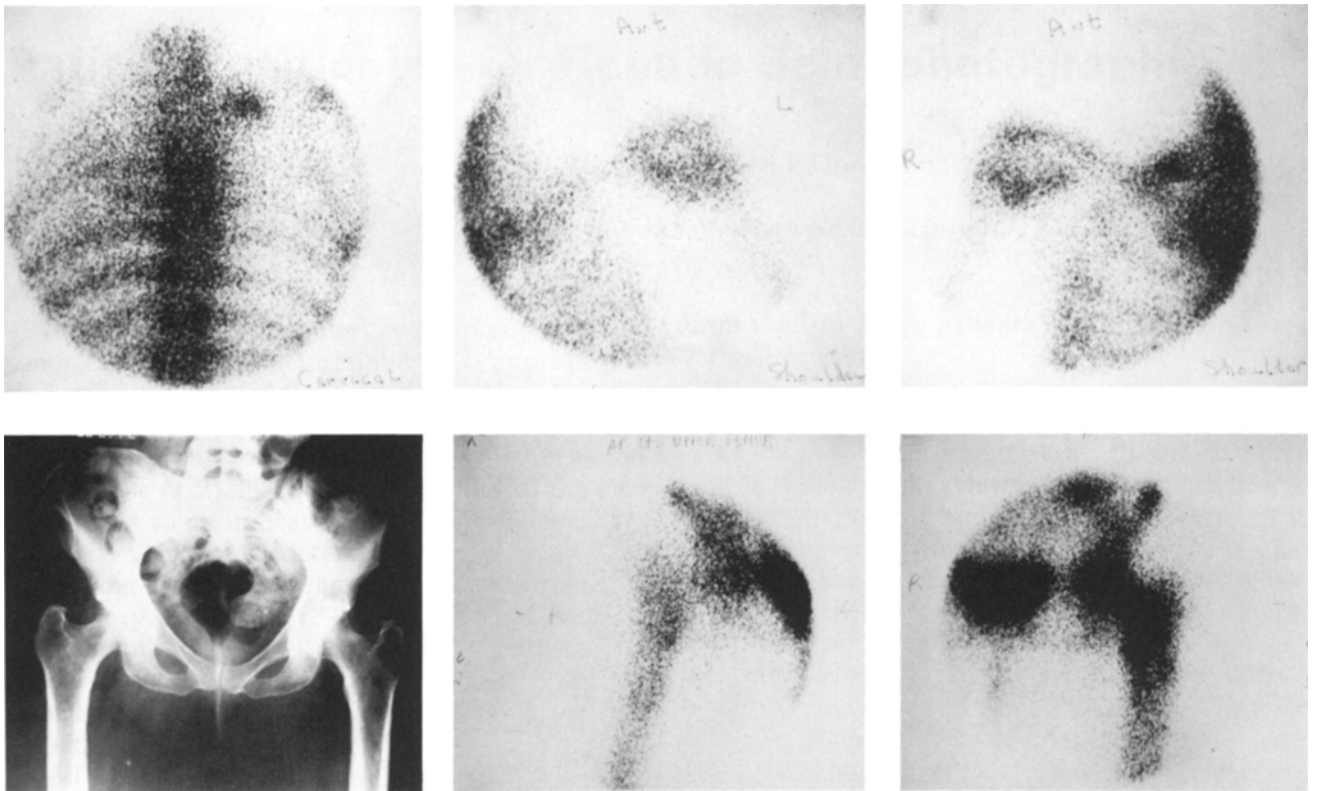


FIG. 1. Bone scanning in Patient EN revealed lesions in right ribs, right clavicle, and right hip and upper femur, and questionable lesion in left femur.

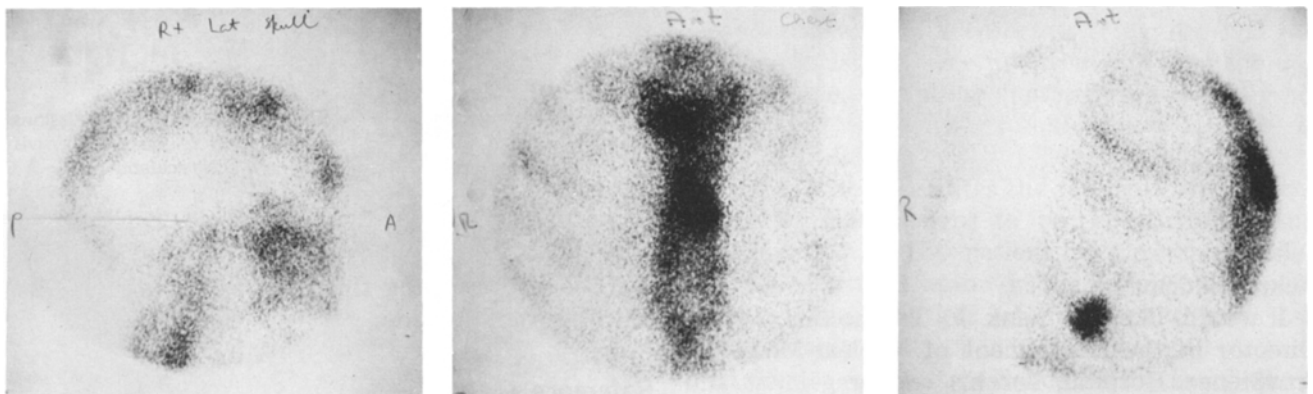
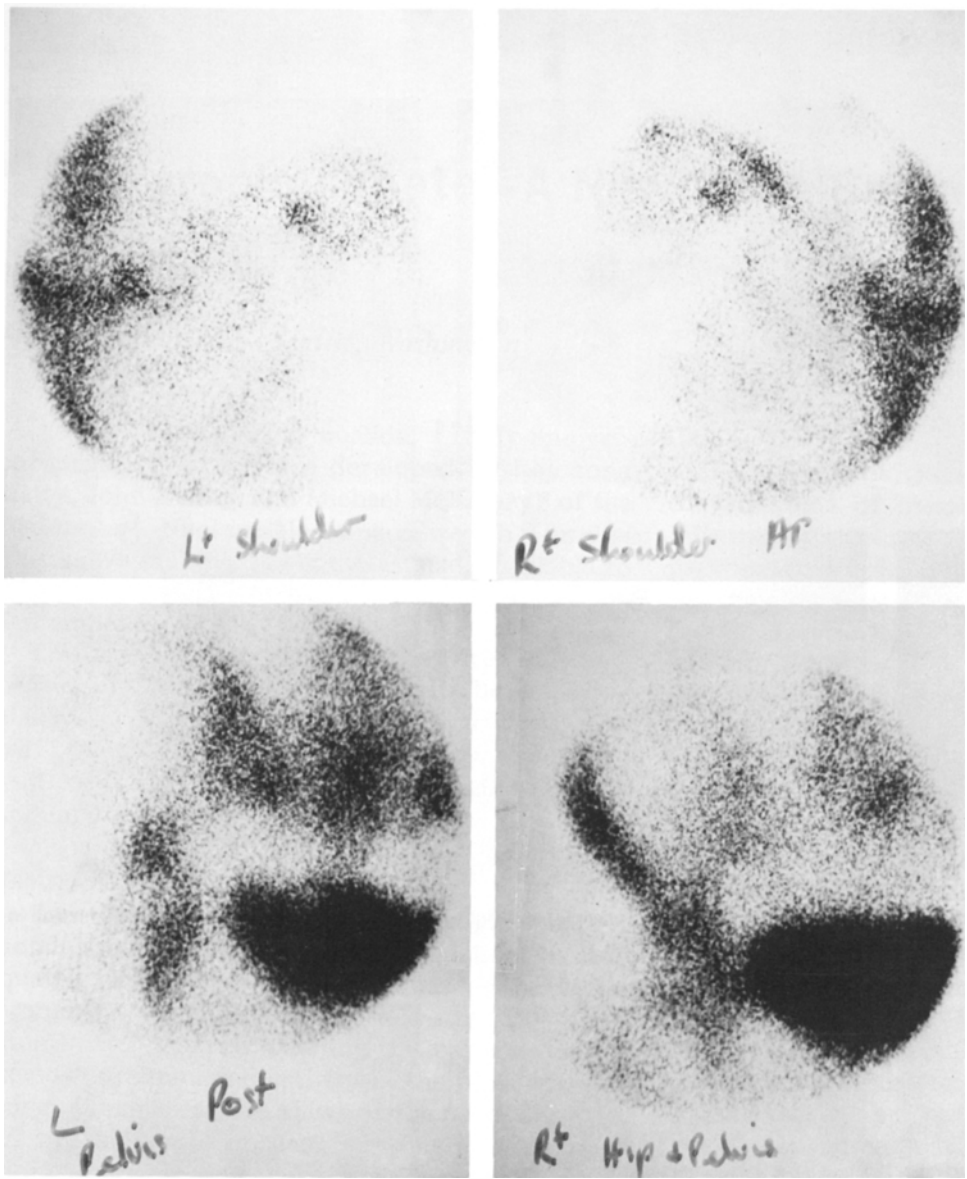


FIG. 2. Pre-operative bone scanning of Patient RW showed lesions of skull, sternum, and right ribs.

Currently, referring physicians are being encouraged to refer patients with suspected carcinoma of breast, prostate, and lung to be scanned before surgical intervention. Our experience to date is small but extremely encouraging and requests for this examination are increasing dramatically. The information gained far outweighs the patient cost and time.

### Conclusion

Bone scanning has improved dramatically in the past few years using first  $^{85}\text{Sr}$ , then  $^{87\text{m}}\text{Sr}$  and  $^{18}\text{F}$ , and now this new  $^{99\text{m}}\text{Tc}$ -pyrophosphate. We now feel confident that, armed with this new product, we can offer a service previously not feasible either due to patient preparation and scanning time (as in  $^{85}\text{Sr}$ ) or patient cost (as in  $^{18}\text{F}$ ).



**FIG. 3.** Bone scan showed lesions in right clavicle and left pelvis superior to the acetabulum.

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**Reference**

1. Subramanian G, McAfee JG, Bell EG, et al: <sup>99m</sup>Tc-labeled polyphosphate as a skeletal imaging agent. *Radiology* 102: 701-704, 1972