

# Case Study

## xSPECT<sup>1</sup> Imaging in a Patient with Diffuse Skeletal Metastases

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Case study data provided by Ludwig-Maximilians University, Munich, Germany

### HISTORY

A 70-year-old woman with history of breast carcinoma treated with surgery and chemotherapy underwent <sup>99m</sup>Tc MDP bone scintigraphy for routine follow-up. A planar bone scan was performed initially 3 hours after IV injection of 18.5 mCi (685 MBq) of <sup>99m</sup>Tc MDP. Patient height and weight: 1.65 meters/5'5" and 57 kg/125.6 lbs. Planar <sup>99m</sup>Tc MDP bone study (Figure 1) shows increased uptake in the left proximal humerus (long arrow), which was suspicious for metastases. A small focal area of increased uptake in the cervical

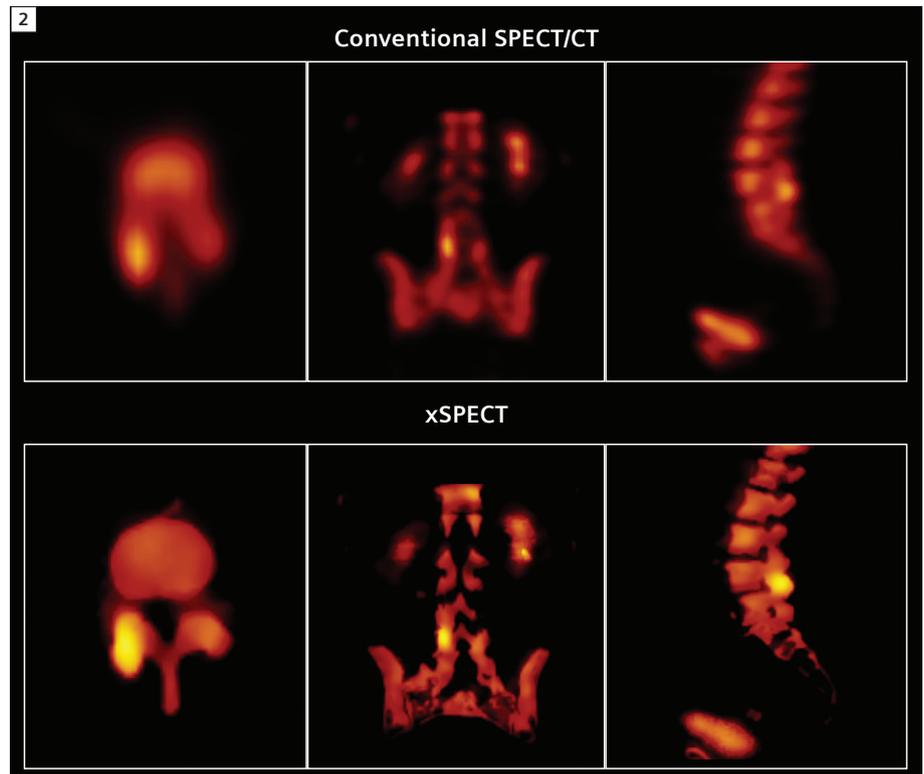
and lower lumbar vertebrae (short arrow) appears to be related to degenerative changes. Thoracic and lumbar vertebral uptake seem normal along with that of extremities, ribs and pelvis. Both kidneys are well visualized.

A SPECT/CT study of the lumbar vertebrae was performed following the planar scan to better characterize the lumbar vertebral uptake. SPECT data was initially

reconstructed using OSEM3D (Flash3D) together with CT attenuation and scatter correction. SPECT and CT data were also used to generate xSPECT<sup>1,2</sup> bone images. xSPECT Bone<sup>1</sup> technology is an application context-based solution, whereby tissue boundaries are extracted from CT via a linear-attenuation-coefficient-based segmentation in order to improve image resolution.



1 <sup>99m</sup>Tc MDP planar bone study.



2 Conventional SPECT/CT and xSPECT slices through the lumbar vertebrae.

## ANALYSIS

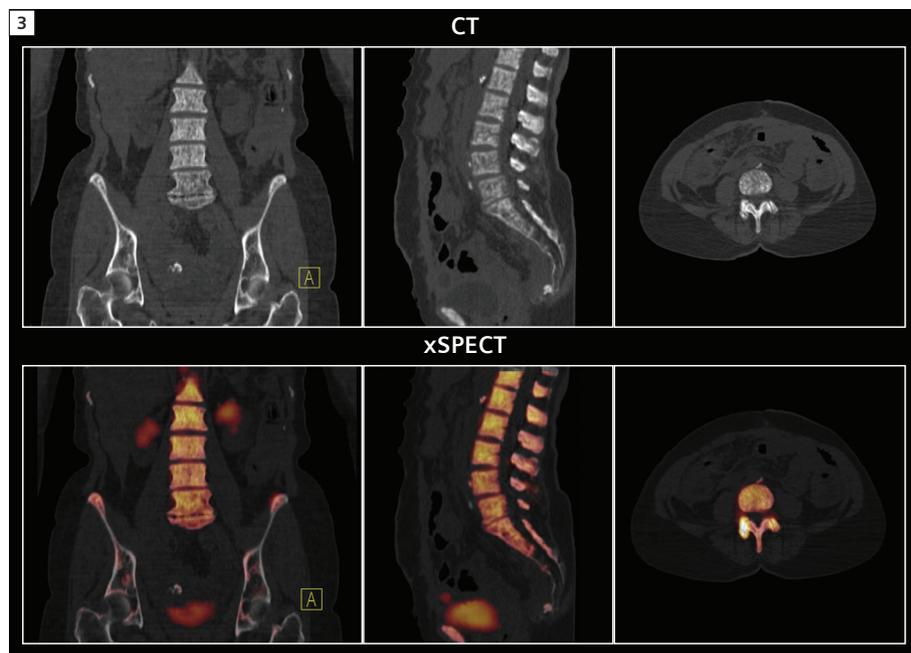
xSPECT shows higher intensity of uptake secondary to facet arthropathy in the right facet joint in L5 vertebrae compared to conventional SPECT/CT (Figure 2), as well as clear and sharp delineation of lamina, spinous process and spinal canal. Uptake of tracer in the lumbar vertebrae appears uniform.

Visual evaluation of the CT and fused images (Figure 3), however, show a different clinical picture. CT shows diffuse sclerosis involving all the lumbar vertebrae, including the body of the sacrum and the lamina and spinous processes. Such diffuse sclerosis could potentially reflect diffuse osseous metastases. Visually the  $^{99m}\text{Tc}$  MDP uptake in the sclerotic vertebrae appear uniform without any focal increase. Visualization of kidneys and bladder activity exclude a "superscan" appearance.

Using xSPECT-based quantification<sup>1,2</sup> of SPECT tracer concentration in Bq/ml and using injected dose and patient height and weight information, the standard uptake value (SUV) of individual voxels, as well as volumes, could be calculated (Figure 4).

## COMMENTS

Absolute quantification of tracer concentration in the lumbar vertebrae with the new modality, xSPECT, shows 157 kBq/ml of  $^{99m}\text{Tc}$  MDP in the center of the body of L3 vertebrae (arrow) with an SUV average (SUV<sub>avg</sub>) of 14.95, which is



3 CT and xSPECT images of lumbar vertebrae.

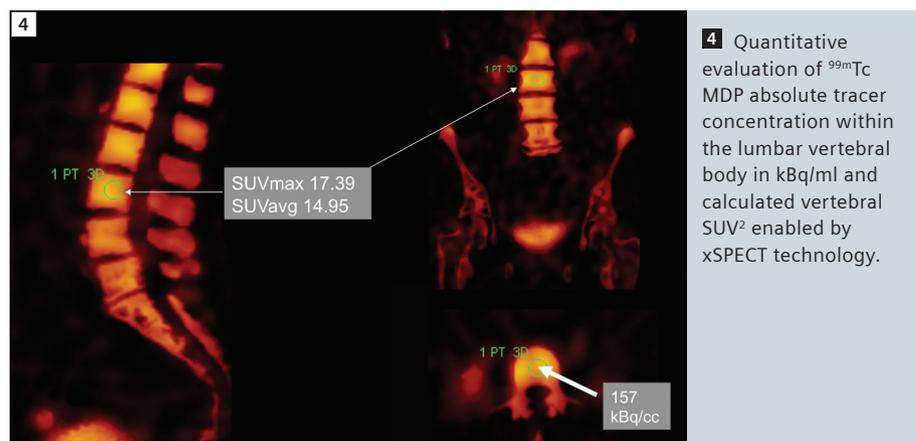
approximately 2 times higher than that of normal (SUV average of 7.02).<sup>2,3</sup> This high SUV within the lumbar vertebrae along with a diffuse sclerosis on CT is reflective of diffuse osseous metastases. The planar bone study did not show diffuse vertebral hypermetabolism and both kidneys were visualized, excluding a superscan appearance. This can be explained by response of the diffuse vertebral metastases to chemotherapy, but with persistent higher level of vertebral metabolism, due to the increased bone turnover within the sclerotic component, as evident in the increased tracer concentration and SUV

within the vertebrae.

Measurements using xSPECT data in lumbar vertebrae of 8 normal female patients<sup>2,3</sup> (average 64 years of age; injected dose 537 +/- 82 MBq) yielded average bone tracer activity concentration (AC) of 56.70 +/- 17.21 kBq/ml and average SUV of 7.02 +/- 1.67.<sup>2</sup>

## EXAMINATION PROTOCOL

Scanner	Symbia™ with xSPECT Technology
Dose	18.5 mCi /685 MBq of $^{99m}\text{Tc}$ MDP
Scan Delay	3 hour post injection
Parameters	32 frames, 25 sec/frame
CT	130 kVp, 90 eff mAs, 3 mm slice



4 Quantitative evaluation of  $^{99m}\text{Tc}$  MDP absolute tracer concentration within the lumbar vertebral body in kBq/ml and calculated vertebral SUV<sup>2</sup> enabled by xSPECT technology.

1. xSPECT, Symbia Intevo and xSPECT Quantification are not licensed according to Canadian law, are pending 510(k) clearance, and are not yet commercially available in Canada, the United States or in all countries worldwide. Due to regulatory reasons, its future availability cannot be guaranteed. Please contact your local Siemens organization for further details.
2. These are preliminary quantitative values defined on prototype system with prototype calibration, and are based on research. There can be no guarantee that customers will achieve the same results. Final results may vary.
3. Cachovan, Michal; Vija, A. Hans.; Hornegger, Joachim; Kuwert, Torsten1. "Quantitative bone SPECT with a novel multimodal reconstruction", J. Nucl. Med. Meeting Abstracts, 2013; Vol.TBD