

Multimodality Assessment of Tumor Response to Therapy

In collaboration with Rex Moats at the Children's Hospital of Los Angeles, neuroblastoma tumor cells are implanted into the femur of a mouse and subsequently imaged with MDP, a bone imaging agent, and I-123 MIBG, a neuroendocrine tumor specific agent. The FastSPECT II imager was significantly redesigned to address the need for high resolution gamma-ray imaging to identify early responses to therapy. FastSPECT II has been outfitted with the high resolution, 100 μm pinhole aperture and configured for 18:1 magnification. High sensitivity has been preserved by sacrificing the size of the field of view, which results in significant challenges in animal positioning.

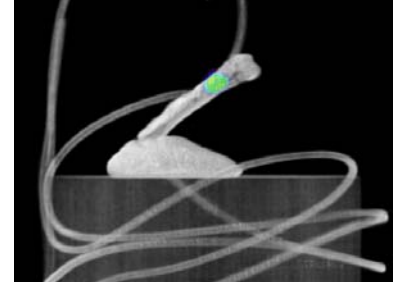


Figure 1. CT/ $^{99\text{m}}\text{Tc}$ SPECT image of an anion exchange microcolumn implanted the medullary compartment of an excised mouse femur obtained on the Dual Modality Imager.

A synthetic bone lesion was created to aid in development of imaging protocols utilizing the high magnification aperture. Anion exchange microcolumns with bed volumes of 100 to 300 nanoliters were constructed from medical grade PVC tubing and AG 1-X2 Resin (BIO-RAD). The microcolumns were implanted in the mouse leg to simulate a bone tumor (Figure 1).

The microcolumns are rechargeable, qualitatively resemble the neuroblastoma lesions and allowed numerous imaging sessions with a single live animal with minimal morbidity. Utilizing the synthetic lesion phantom, a new animal holder was designed. A laser alignment system was also designed and installed to facilitate animal positioning.

The Dual Modality Imager has produced SPECT/CT fusion images with both $^{99\text{m}}\text{Tc}$ -MDP and ^{123}I -MIBG imaging agents. Initial high magnification images with $^{99\text{m}}\text{Tc}$ -MDP have been obtained on FastSPECT II (Figure 2). A longitudinal study of tumor size and response to therapy with a bisphosphonate drug will be performed.

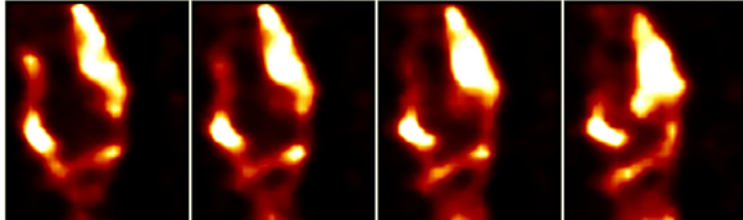


Figure 2. Stitched coronal $^{99\text{m}}\text{Tc}$ -MDP SPECT images of the distal femur and knee show expansile and destructive changes secondary to a neuroblastoma tumor. The isotropic voxel size is 100 μm , and the field of view is ~ 6.5 mm.

Implantable microcolumn: a dynamic SPECT phantom

The dynamic enhancement profile of lesions has been correlated to pathology and can be useful for detection and characterization of malignancy. The anion exchange microcolumns developed in the Rex Moats collaboration, have been used as dynamic imaging phantoms. Sodium pertechnetate and KI solutions were applied sequentially to the microcolumn to independently vary uptake and washout rates. List mode data acquisition imaging on FastSPECT II in the high magnification configuration allowed post-acquisition optimization of the temporal resolution. Five second time windows for this phantom with an estimated peak activity of 300 μCi were achieved.