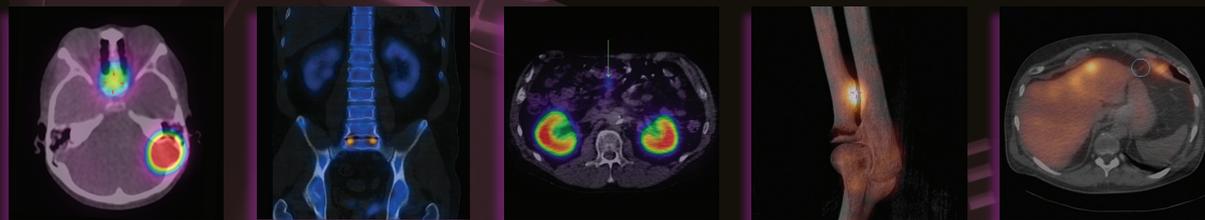


Volume 2



# Clinical case study collection

Philips BrightView XCT nuclear medicine system

**PHILIPS**

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# BrightView XCT

A technologically advanced SPECT/CT system designed entirely for nuclear medicine



At Philips, we are dedicated to providing innovative, integrated solutions to give you the tools you need to accurately diagnose abnormalities early in disease progression. We are tirelessly focused on image quality and flexibility, throughput, and patient care. With that in mind, we have compiled this second volume of actual clinical case studies. Philips thanks those customers who have collaborated with us and contributed their findings to this effort.

We hope that you find this an informative reference in your quest to provide the best in diagnostic care for your patients.

# Five key advantages

## BrightView XCT – Fits you like no other

### 1 Registration confidence with CoPlanar

- No bed index between SPECT and CT, in most cases, for 14 cm axial coverage.

### 2 Flexible breathing

- Tidal respiration (60 sec) for CT-AC to match SPECT breathing
- Breathhold (12 sec) for localization

### 3 High resolution – low dose

- Isotropic voxels – high quality CT images when viewed at any angle
- Sub-mm (0.33 mm) slice thickness for high resolution bone
- Flexible X-ray current (5-80 mA) to fit the clinical need

### 4 Nuclear medicine – tailored workflow

- Same capabilities as BrightView SPECT
- Plan SPECT/CT from the p-scope
- Option for in-room CT acquisition control

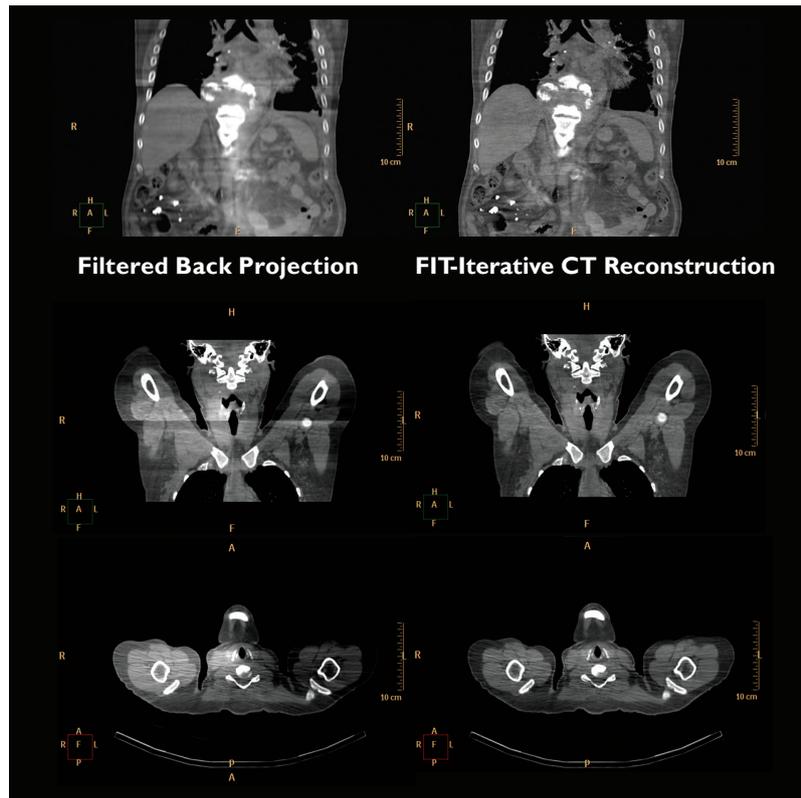
### 5 Fits the nuclear medicine space

- Fits in a small nuclear-medicine-sized room (15'6" × 11'7"; 4.72 × 3.53 M)
- Low system weight (4500 lb; 2045 kg)
- Separate control room not required



# Full Iterative Technology (FIT)

Philips introduces Full Iterative Technology (FIT) – the first hybrid system to provide both iterative SPECT and CT reconstruction capabilities. The advanced CT reconstruction algorithm improves CT image quality by reducing noise and improving uniformity. FIT builds on the value of Astonish SPECT reconstruction, iterative technology that has been proven in practice to improve image quality and reduce dose. This leading technology provides the necessary foundation for advancing future developments in iterative CT reconstruction.



# Cardiology

## Trusted attenuation correction

Confidence in the registration accuracy between SPECT and CT

BrightView XCT has several advantages for cardiac attenuation correction. The gantry rotation can be set to 60 seconds to allow for tidal respiration during multiple respiratory cycles over a single 360° rotation. This technique blurs the CT to match resolution of the SPECT image, leading to excellent diaphragm alignment.

The entire heart volume is sampled in a single 14 cm axial field of view with no stair-step artifacts as a result of the isotropic resolution.

The CT field of view overlaps the SPECT field of view so that little to no table index is required between acquisition steps, resulting in registration confidence.



**Attenuation correction – CT acquisition**



**Attenuation correction – SPECT acquisition**



# 2 Cardiology case study

## Anterior wall attenuation correction

Courtesy of Wollongong Nuclear Medicine, New South Wales, Australia

### Patient information

- 86-year-old female
- Abnormal stress EKG (posterior and lateral hypokinesia); high probability of ischemia

### Procedure

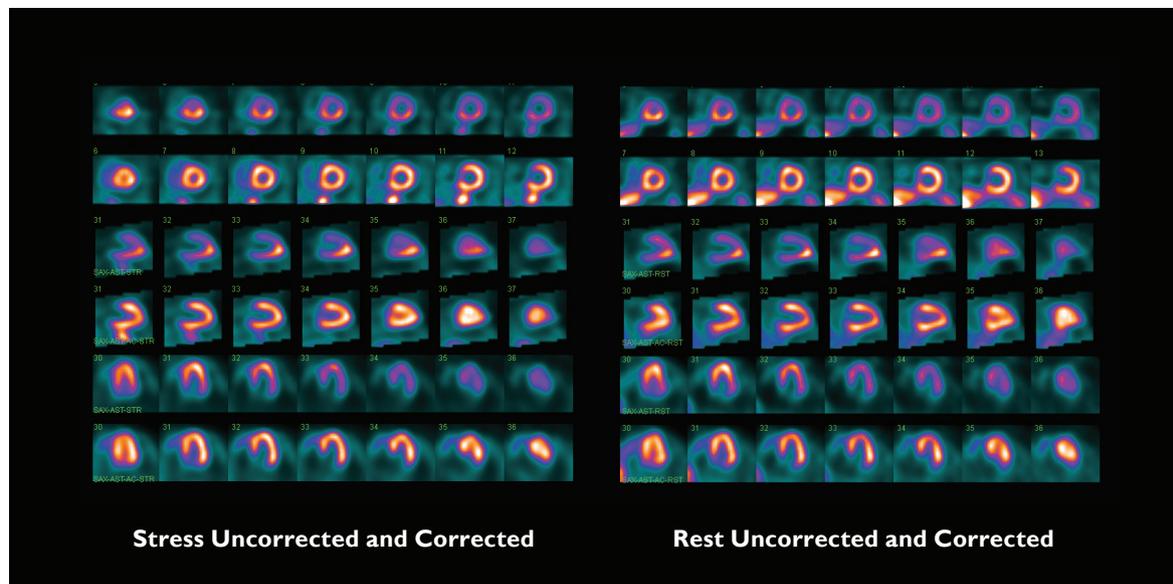
- Tc-99m Myoview perfusion and function

### Findings from SPECT/CT study

- Reduced perfusion in anterior wall which normalized with CT attenuation correction
- Normal study: LVEF = 68%

### Physician impression of SPECT/CT

- SPECT/CT with attenuation correction completely changed the initial high patient probability to low probability



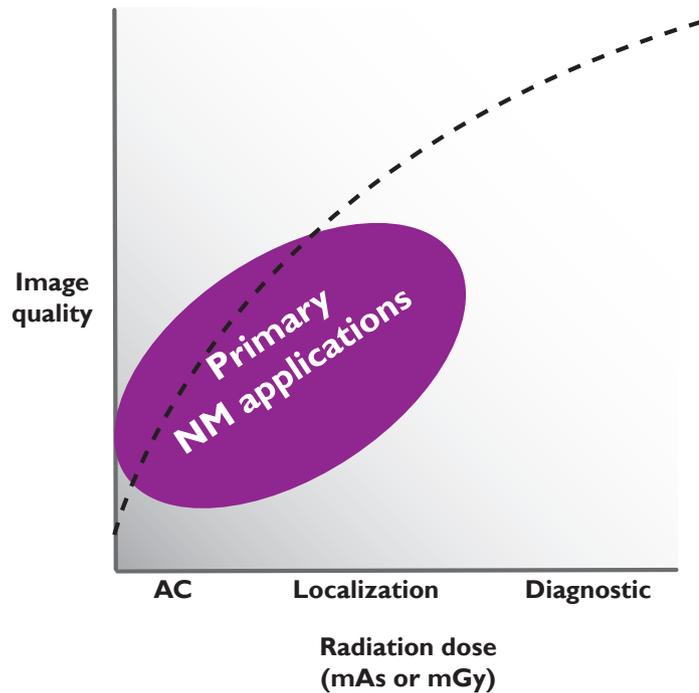
# Oncology

## Low dose localization

Designed entirely for nuclear medicine

BrightView XCT offers premium CT resolution at low dose levels – a fraction of a conventional helical CT.

Flexible breathing protocols during localization studies allow for a breathhold CT acquisition to be obtained in as short a time as 12 seconds. Providing 14 cm of axial coverage in a single breathhold helps to maintain image resolution and required anatomic detail.



# 1 Oncology

## Neuroblastoma

Courtesy of National Center for Child Health and Development, Tokyo, Japan

### Patient information

- 11-year-old female
- Neuroblastoma, post chemotherapy and tumor resection; one year later, tumor found in left posterior cranial fossa on MRI
- Lately tumor growing so pre-surgical MIBG was ordered

### Procedure

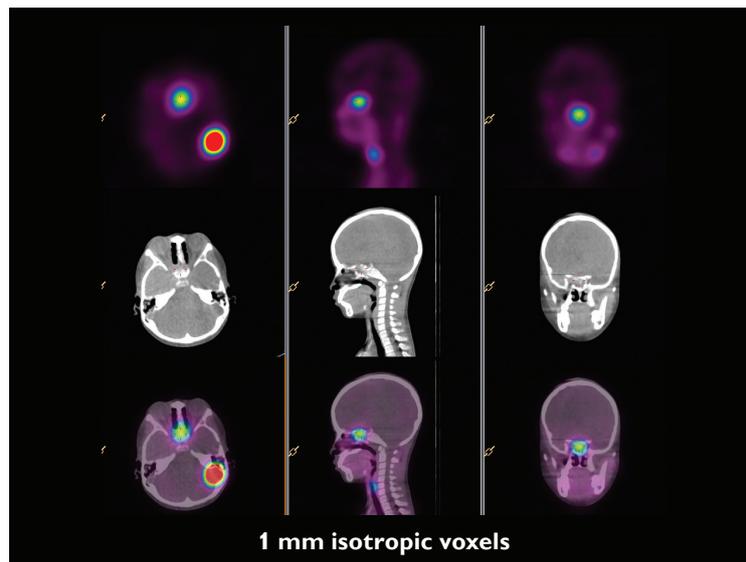
- Tc-99m MIBG scan

### Findings from SPECT/CT study

- Intracranial MIBG uptake seen at left posterior cranial fossa and sphenoidal sinus; check of previous MRI T1-CE found sphenoidal sinus enhanced mass as well as left posterior cranial fossa mass

### Physician impression of SPECT/CT

- Difficult to localize a small lesion by SPECT-only; SPECT/CT shows location easily
- Sphenous sinus uptake was shown correctly and position matched MRI lesion
- Information of a single or multiple lesions is very important
- Biopsy of left posterior cranial lesion was ganglioneuroma, not malignancy



# 2 Oncology

## MAA mapping for radioembolization

Courtesy of University of Washington Medical Center, Seattle, Washington

### Patient information

- 70-year-old male
- Multifocal hepatocellular cancer presenting for MAA mapping and hepatopulmonary shunt study in preparation for Y-90 radioembolization
- Status post coil embolization of gastroduodenal artery, right gastric artery, and supraduodenal branch artery

### Procedure

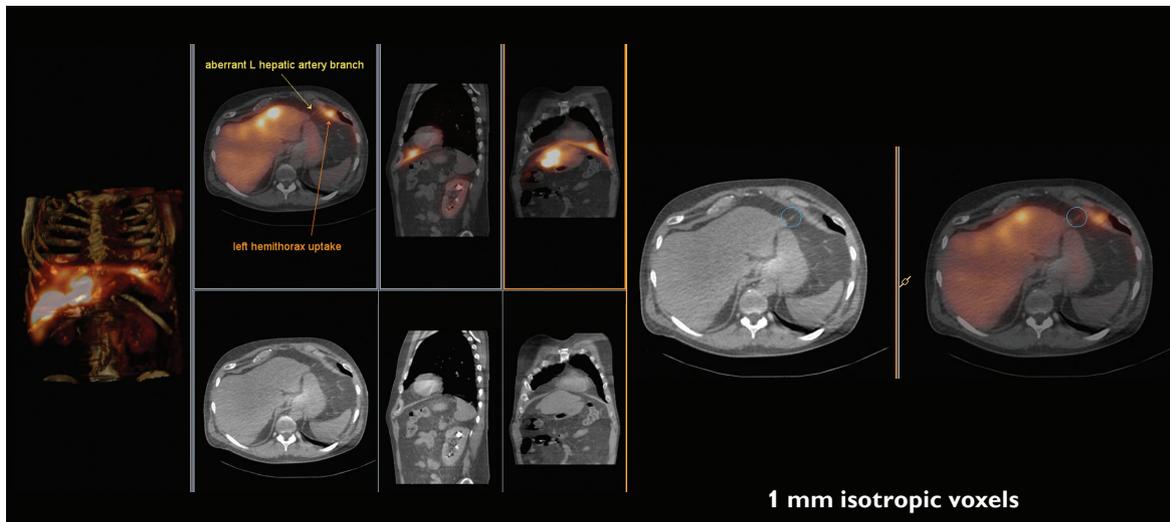
- Tc-99m MAA

### Findings from SPECT/CT study

- Increased uptake in hepatic lobes at known hepatic metastases
- Large extrahepatic focus in left lower hemithorax corresponding with left cardiophrenic recess in inferior mediastinum
- No visual pulmonary uptake, estimated hepatopulmonary shunt ratio 4.91%, within normal limits

### Physician impression of SPECT/CT

- Hepatomeastinal shunt from aberrant mediastinal vessel arising from distal left hepatic artery
- In order to undergo safe Y-90 radioembolization, patient will need coil embolization to avoid damage to left mediastinum



# 3 Oncology

## Carcinoma of the penis

Courtesy of Innsbruck Medical University, Tyrol, Austria

### Patient information

- 58-year-old male
- Carcinoma of the penis
- Localize sentinel lymph node

### Procedure

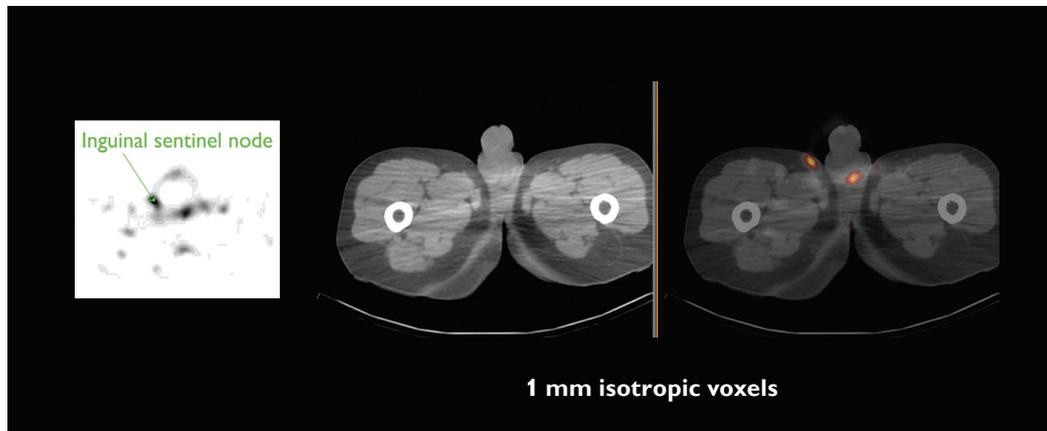
- Tc-99m Colloid

### Findings from SPECT/CT study

- Moderate uptake in the right inguinal region

### Physician impression of SPECT/CT

- SPECT/CT revealed inguinal lymph node, not visible on planar
- Sentinel lymph node was removed; histology showed atrophic lymph node, no sign of malignancy



# 4 Oncology

## Post Lu-177 DOTA-TATE therapy

Courtesy of Innsbruck Medical University, Tyrol, Austria

### Patient information

- 56-year-old female
- Post Lu-177 DOTA-TATE therapy evaluation of neuroendocrine tumor

### Procedure

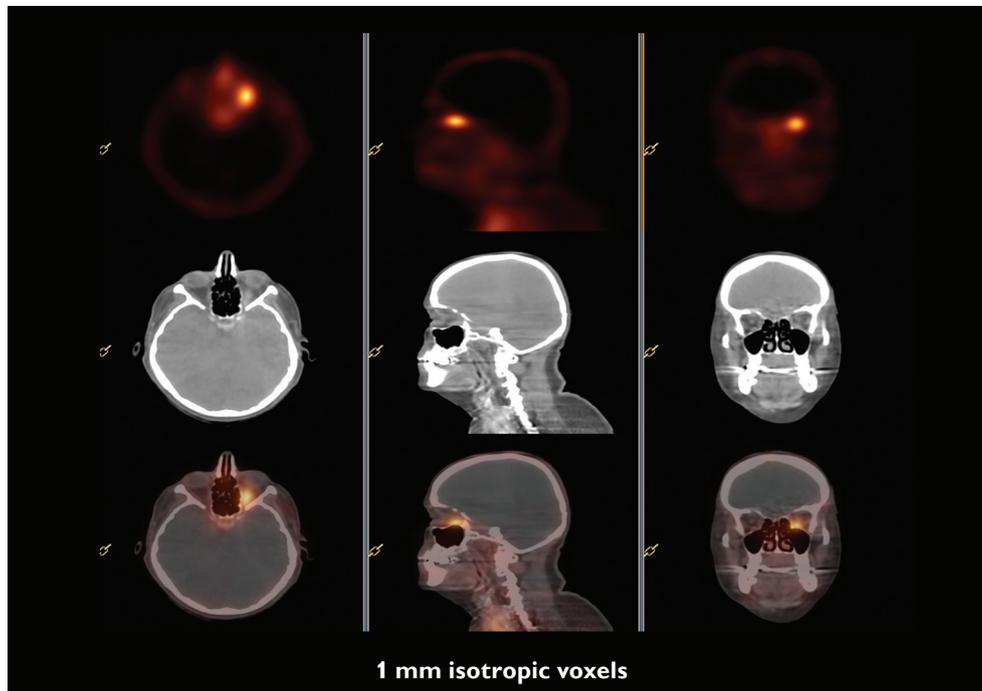
- Lu-177 DOTA-TATE

### Findings from SPECT/CT study

- Somatostatin receptor lesion is located in the musculus rectus inferior

### Physician impression of SPECT/CT

- Patient was referred to a specialized ophthalmologist



# 5 Oncology

## Incidental pulmonary nodule

Courtesy of Nepean Nuclear Medicine and PET, Sydney, Australia

### Patient information

- 81-year-old female
- Breast cancer; three weeks of left sternal pain with positive regional lymph nodes

### Procedure

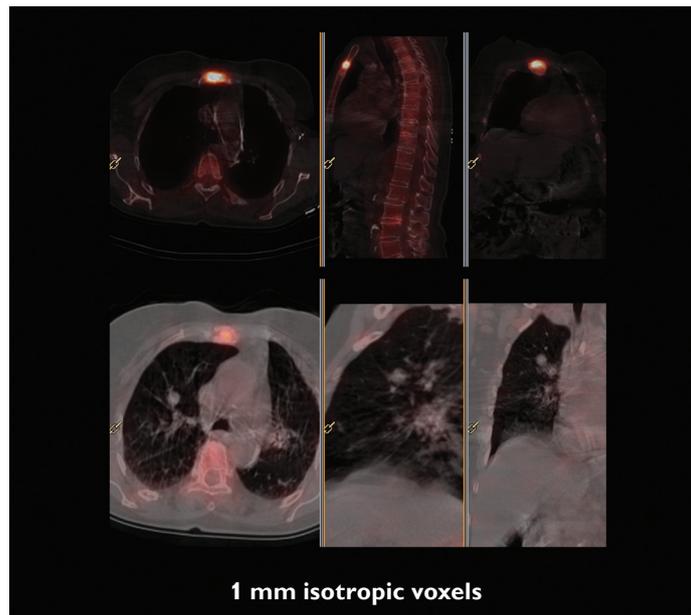
- Tc-99m HDP bone scan

### Findings from SPECT/CT study

- Intense uptake in manubrium consistent with recent fracture with evidence of ongoing new bone formation; no skeletal metastases; end-plate degeneration at L2-3 and L4-5
- Incidental finding of pulmonary nodule in right upper lobe

### Physician impression of SPECT/CT

- Identified fracture instead of metastatic disease
- Incidental finding of pulmonary nodule which will help for further surveillance



# 6 Oncology

## Benign reactive lymph node

Courtesy of University of Washington Medical Center, Seattle, Washington

### Patient information

- 73-year-old male
- Nonfunctioning pancreatic endocrine tumor; pancreaticoduodenectomy with clear margins, negative lymph nodes six years ago
- Multiple Octreoscans; last two years – stable focus of uptake in mid abdomen without findings on CT, unclear significance

### Procedure

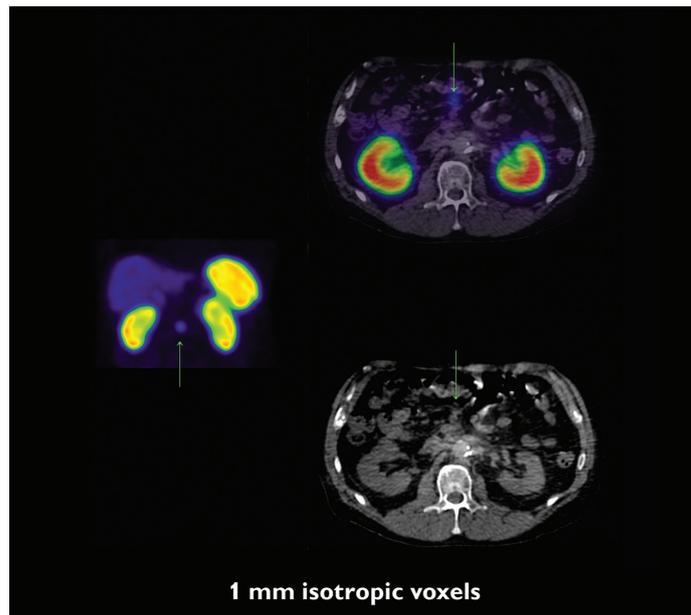
- In-111 Octreotide

### Findings from SPECT/CT study

- Focus of mid abdominal uptake again seen
- SPECT/CT correlates precisely with soft tissue density located within the mesentery posterior to transverse colon, 8.3 cm anterior to L1 vertebral body endplate

### Physician impression of SPECT/CT

- SPECT/CT demonstrated uptake to a normal-sized mesenteric lymph node; this had not been possible on planar images
- Uptake within benign reactive lymph nodes is a known false positive in Octreoscans



# 7 Oncology

## Right breast mass

Courtesy of Fletcher Allen Health Care University, Burlington, Vermont

### Patient information

- 55-year-old female
- Three-month history of nonexertional chest discomfort, left arm numbness, shortness of breath

### Procedure

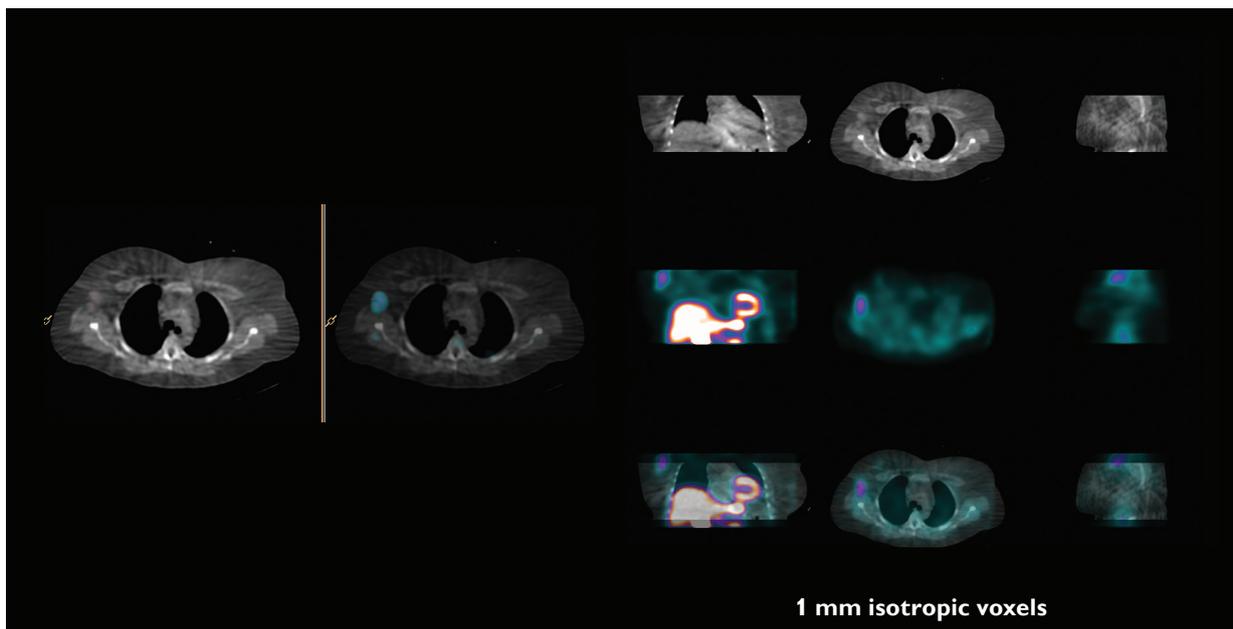
- Tc-99m Sestamibi

### Findings from SPECT/CT study

- Normal stress test
- Mass with uptake of MIBI in axillary part of right breast seen on low dose CT

### Physician impression of SPECT/CT

- Patient underwent diagnostic breast mammography and ultrasound followed by biopsy
- Infiltrating ductal carcinoma on pathology



# 8 Oncology

## Metastatic neuroblastoma

Courtesy of Clinique Universitaires St-Luc, Brussels, Belgium

### Patient information

- 4-year, 10-month-old female
- Metastatic neuroblastoma, surgery unable to find lymph nodes
- Prior MIBG scan positive in right groin, decided to rescan after SPECT/CT installed, then schedule surgery

### Procedure

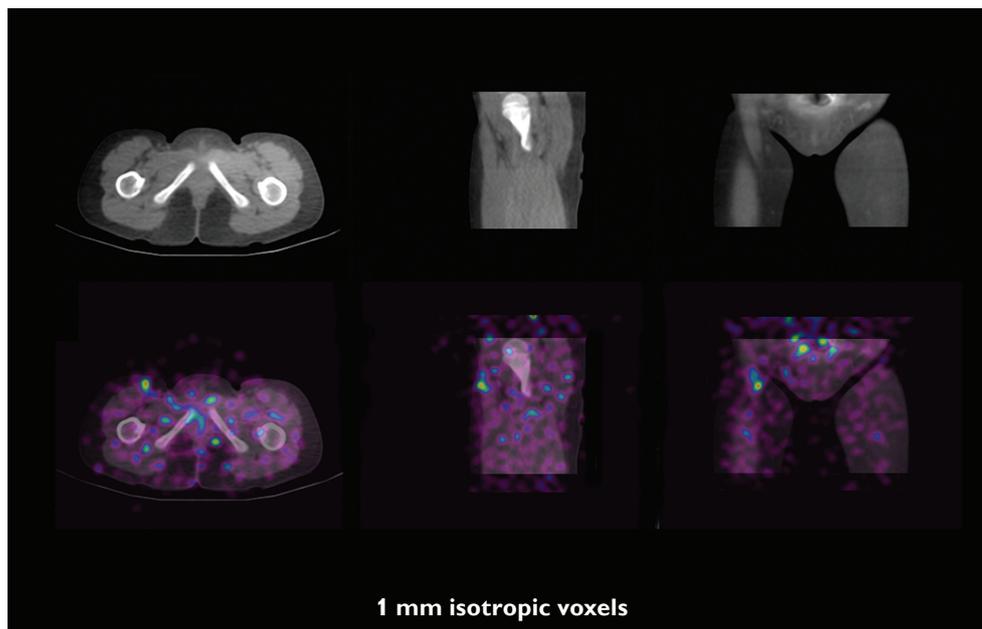
- I-123 MIBG

### Findings from SPECT/CT study

- Discrete focus of abnormal activity in right groin; fusion with CT indicates abnormality is in root of the sartorius muscle, extremely rare site of metastasis from a neuroblastoma

### Physician Impression of SPECT/CT

- Surgery with assistance of gamma probe allowed removal of a single intramuscular metastasis; SPECT/CT demonstrated the focus of MIBG did not correspond to a lymph node



# 9 Oncology

## Lymphoscintigraphy of the penis

Courtesy of The Harley Street Clinic, London, UK

### Patient information

- 85-year-old male
- Penile cancer

### Procedure

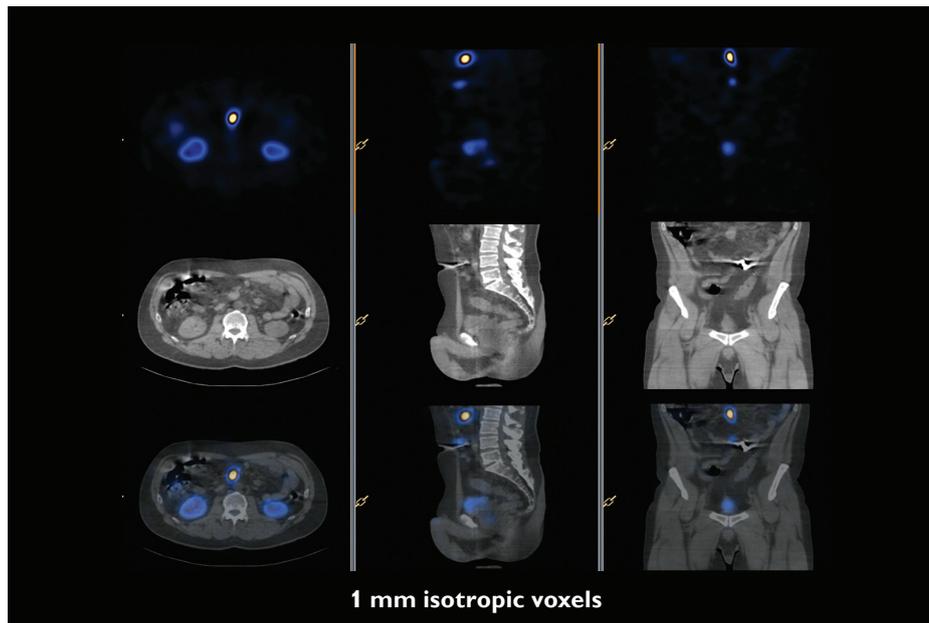
- Tc-99m Nanocolloid

### Findings from SPECT/CT study

- Localization of sentinel nodes in left and right inguinal-femoral regions
- Measurement of depth from skin surface taken to assist surgeon

### Physician impression of SPECT/CT

- Helped to assist surgeon in location of sentinel lymph nodes prior to biopsy
- Astonish reconstruction software assists greatly as the SNI doses are very low, so count recovery reconstruction assists in image quality



# 10 Oncology

## Sarcoma in pubic symphysis

Courtesy of Sydney X-Ray, Sydney, Australia

### Patient information

- Rule out osteitis pubis

### Procedure

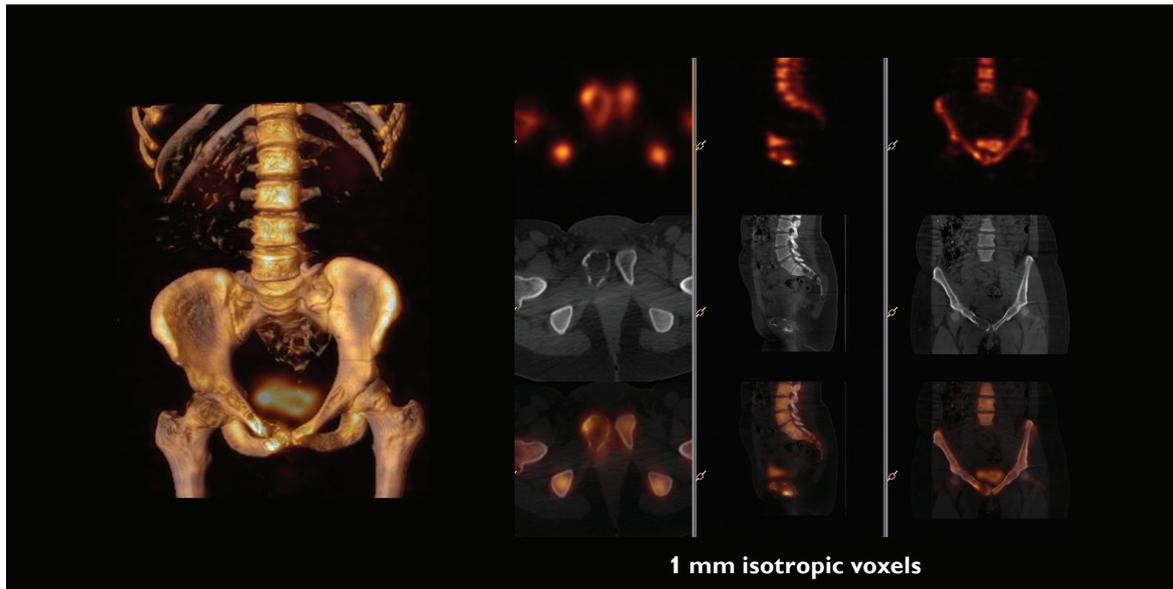
- Tc-99m bone scan

### Findings from SPECT/CT study

- Early and delayed planar images were consistent with a severe osteitis pubis
- SPECT/CT, however, clearly demonstrated a lytic lesion in right pubic symphysis

### Physician impression of SPECT/CT

- Rather than continued ineffective treatment of suspected osteitis pubis, a biopsy was performed which confirmed sarcoma; patient then proceeded to appropriate treatment



# 11 Oncology

## Pheochromocytoma in adrenal nodule

Courtesy of University of Washington Medical Center, Seattle, Washington

### Patient information

- 63-year-old female
- Hyperparathyroidism; bilateral adrenal nodules on CT, left suspicious for malignancy
- Evaluate for pheochromocytoma in one or both adrenal nodules

### Procedure

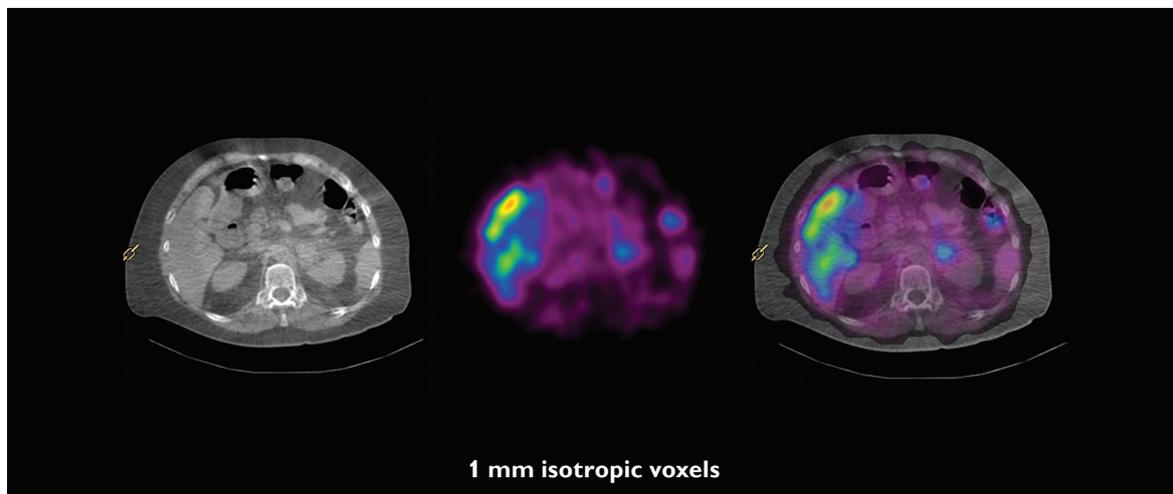
- I-123 MIBG

### Findings from SPECT/CT study

- Intense uptake within 3 cm left adrenal nodule consistent with pheochromocytoma
- Mild diffuse uptake in right adrenal gland, likely physiologic; second pheochromocytoma cannot be excluded

### Physician impression of SPECT/CT

- Intense uptake in left adrenal region seen on planar images but could not be confidently localized to adrenal gland; SPECT/CT readily localized uptake to the suspicious nodule
- Given clinical suspicion for bilateral pheochromocytoma, contrast resolution of SPECT was necessary to demonstrate no significant uptake in left adrenal gland
- Successful left adrenalectomy and discontinuation of catecholamine-blocking medicine, confirming correct finding of unilateral pheochromocytoma



# 12 Oncology

## Calcification of tibial-fibular ligament

Courtesy of Washington Hospital Center, Washington DC

### Patient information

- 63-year-old male
- Lung cancer, assess for bony metastases

### Procedure

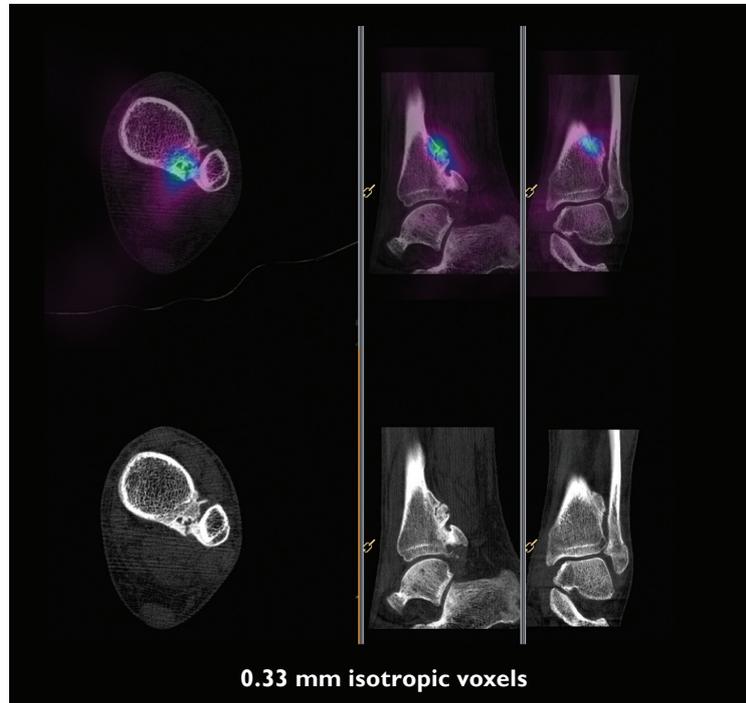
Tc-99m MDP bone scan

### Findings from SPECT/CT study

- Calcification of left tibial-fibular ligament

### Physician impression of SPECT/CT

- SPECT/CT helped precisely identify post-traumatic calcification of a ligament as etiology of activity on bone scan
- Fracture and/or metastasis was ruled out



# 13 Oncology

## Thyroid cancer

Courtesy of Washington Hospital Center, Washington DC

### Patient information

- 47-year-old male
- Thyroid cancer; evaluate for metastatic disease and staging

### Procedure

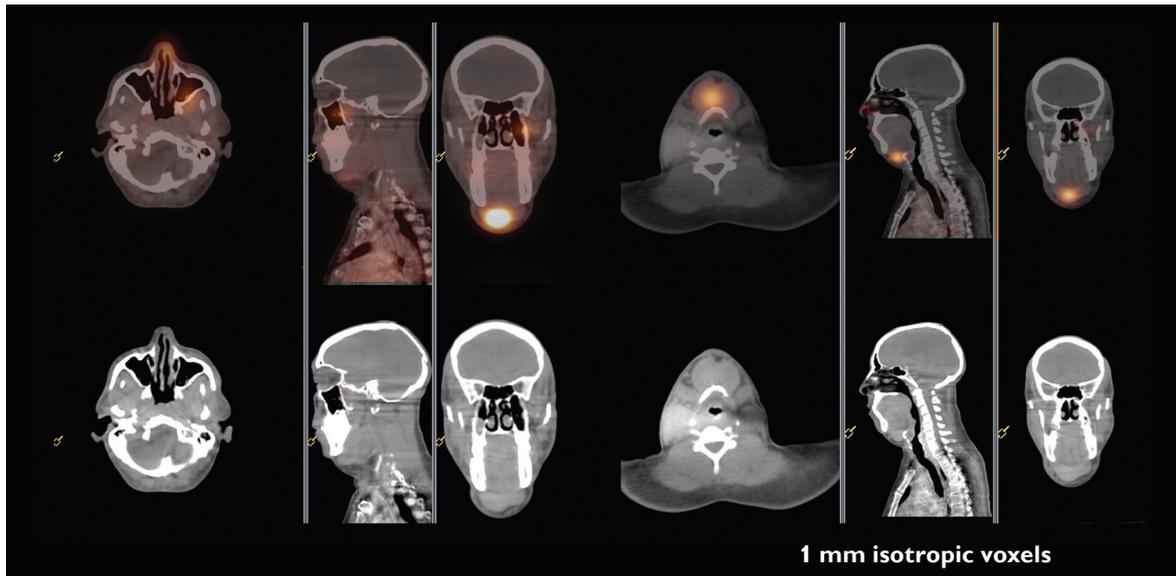
- I-124 scan

### Findings from SPECT/CT study

- SPECT/CT Head/Neck – sinus polyp, submental lymph node metastases
- SPECT/CT Chest – macronodular lung metastases (known)

### Physician impression of SPECT/CT

- Precisely identified sinus polyp activity as inflammatory and not metastatic, identified a large submental lymph node metastasis, identified known macronodular pulmonary metastases
- I-124 imaging as part of dosimetry provides low resolution SPECT images and requires proper anatomic localization achieved with SPECT/CT



# 14 Oncology

## Neuroendocrine tumor of ileum

Courtesy of University Hospital of Halle, Halle, Germany

### Patient information

- 47-year-old male
- Suspected neuroendocrine tumor after abdominal lymph node biopsy, unknown primary; gastroscopy, rectal procto-colonoscopy, and endosonocapsule without pathologic findings

### Procedure

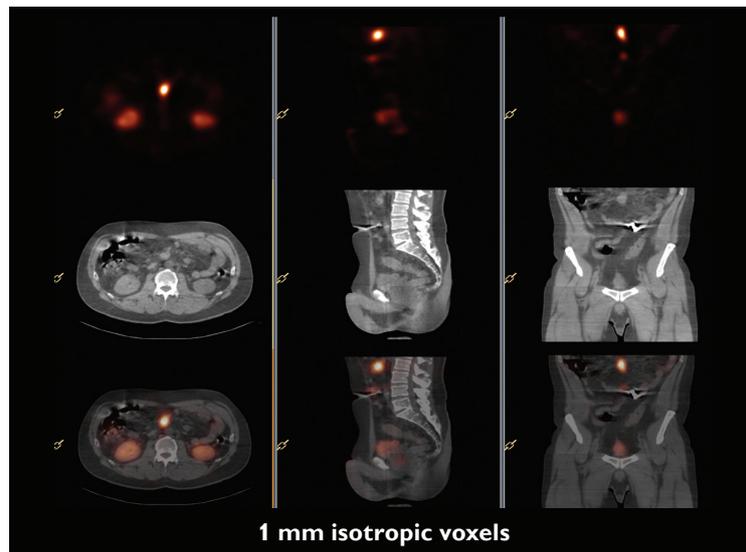
- In-111 Octreotide scan

### Findings from SPECT/CT study

- High intensive focus on ileum loop
- High intensive focus in middle abdomen, area of pathological lymphadenopathy

### Physician impression of SPECT/CT

- Clear localization of pathological somatostatin-receptor binding led to total resection of primary tumor located in ileum
- Pathology showed well differentiated neuroendocrine carcinoma of ileum with infiltration of mesenterial fat tissue, serosa, lymphatic vessels, and locoregional lymph node metastasis
- Follow-up is planned with Octreoscan and evaluation for DOTA-TATE therapy



# 15 Oncology

## Melanoma at the right ear

Courtesy of Innsbruck Medical University, Tyrol, Austria

### Patient information

- 68-year-old male
- Excision of melanoma at right ear
- Localize sentinel lymph node

### Procedure

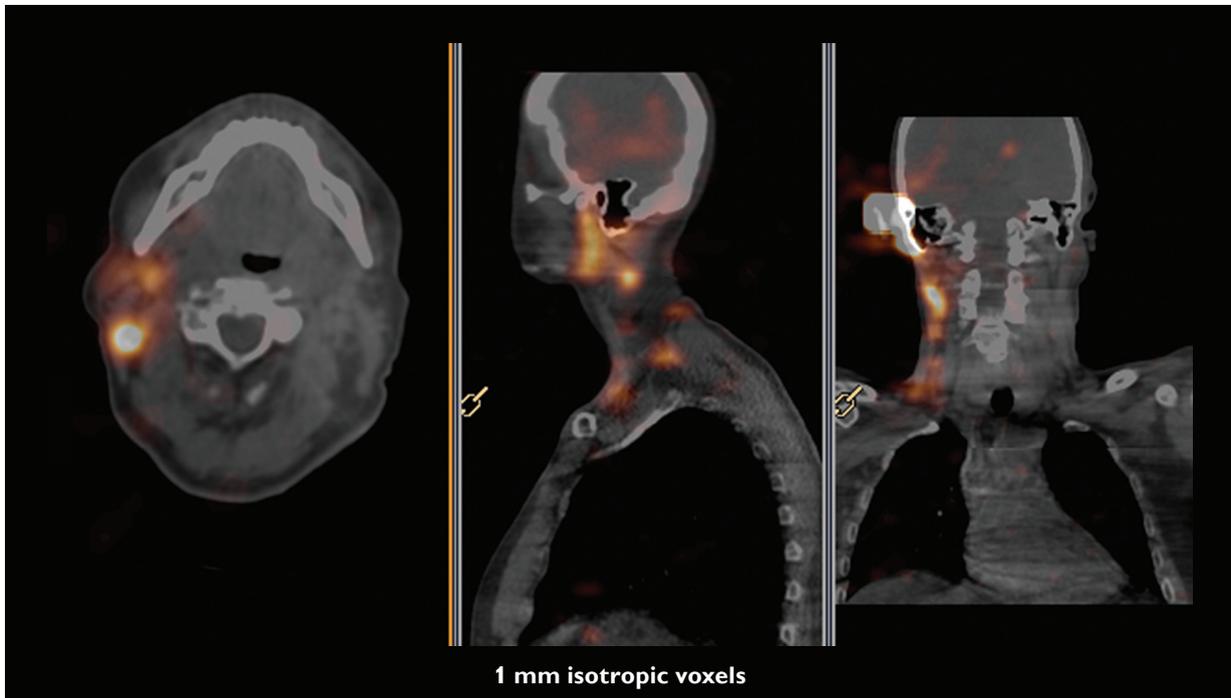
- Tc-99m Colloid

### Findings from SPECT/CT study

- Hot spot dorsal to right jaw angle and additional hot spots downstream in cervical region

### Physician impression of SPECT/CT

- Sentinel node dorsal to right jaw was only visible on SPECT/CT, not visible on planar
- Sentinel lymph node was extracted and showed no sign of malignancy



# 16 Oncology

## Pheochromocytoma

Courtesy of Nepean Nuclear Medicine and PET, Sydney, Australia

### Patient information

- 52-year-old male
- Left adrenal mass

### Procedure

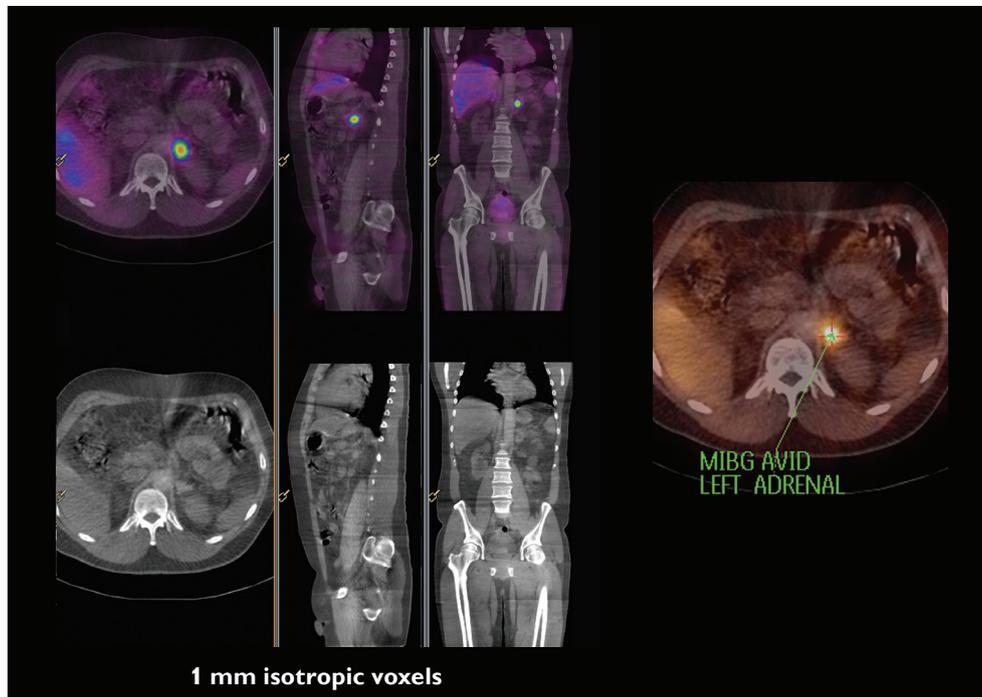
- I-123 MIBG

### Findings from SPECT/CT study

- Abnormally increased MIBG uptake in the left adrenal gland suspicious of pheochromocytoma

### Physician impression of SPECT/CT

- Strong indication of pheochromocytoma which influences treatment



# 17 Oncology

## Bilateral breast cancer

Courtesy of Innsbruck Medical University, Tyrol, Austria

### Patient information

- 58-year-old female
- Cancer in left breast, ductal carcinoma in situ right breast
- Localize sentinel lymph nodes

### Procedure

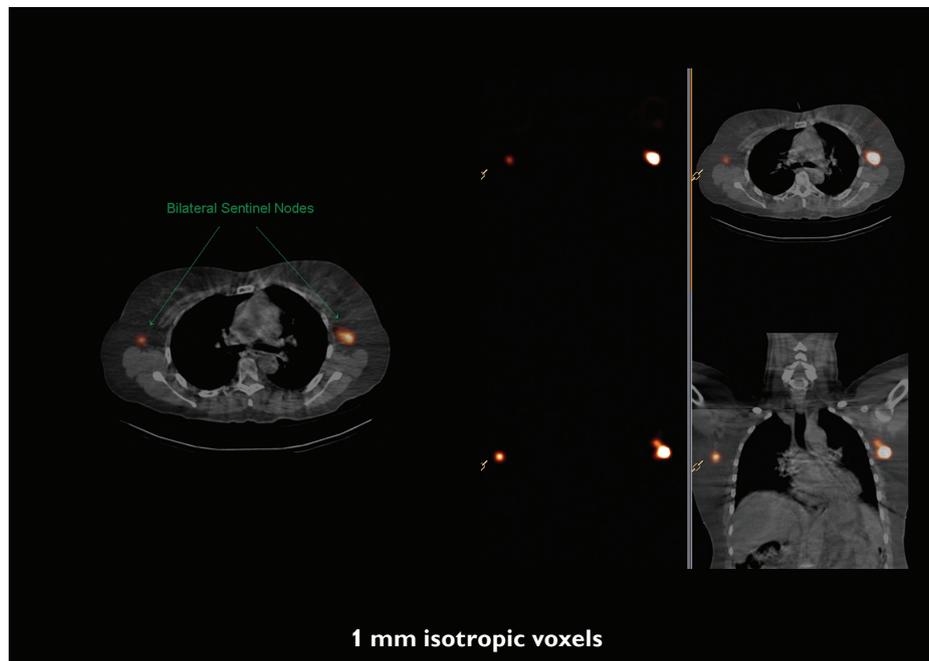
- Tc-99m Colloid

### Findings from SPECT/CT study

- Sentinel lymph nodes in bilateral axillary regions; right side next to 4th rib, left side intercostal space of 4th to 5th ribs

### Physician impression of SPECT/CT

- Exact localization of sentinel nodes using ribs as reference
- Sentinel lymph nodes were resected and showed no sign of malignancy



# 18 Oncology

## Left adrenal mass

Courtesy of Washington Hospital Center, Washington DC

### Patient information

- 52-year-old male
- Left adrenal mass on CT; evaluate for pheochromocytoma and metastases

### Procedure

- I-123 MIBG

### Findings from SPECT/CT study

- Left adrenal gland pheochromocytoma with central necrosis, no evidence of metastases elsewhere

### Physician impression of SPECT/CT

- SPECT/CT helped precisely correlate I-123 MIBG avid tissue to the mass described but not adequately characterized by the prior CT images alone



# 19 Oncology

## Hemangioendothelioma

Courtesy of Washington Hospital Center, Washington DC

### Patient information

- 64-year-old female
- Hemangioendothelioma; post tumor resection involving proximal right tibia and right medial cuneiform

### Procedure

- Tc-99m MDP bone scan

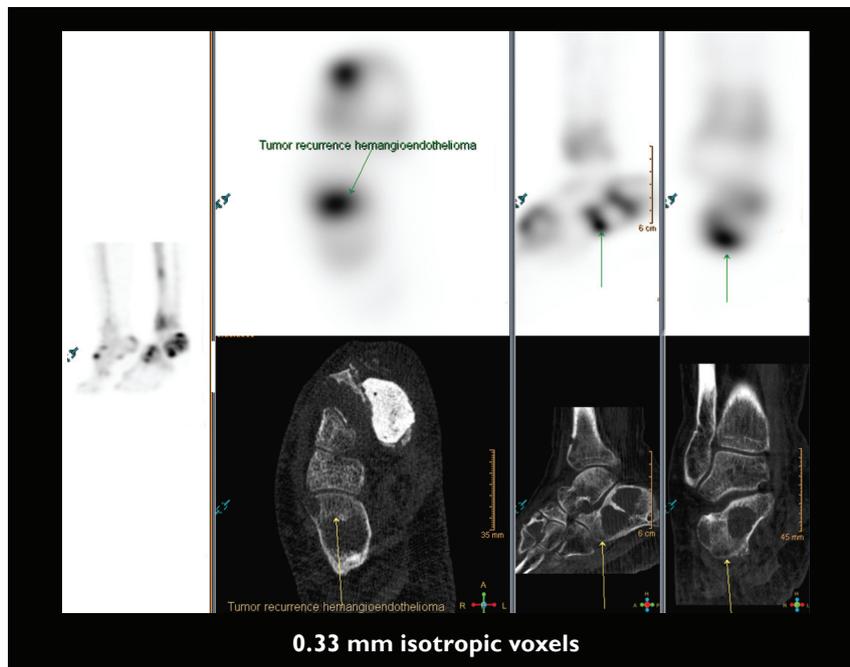
### Findings from SPECT/CT study

- Right-sided distal tibia and right calcaneum tumor recurrence

- Post-surgical inflammatory changes of proximal right tibia and medial cuneiform

### Physician impression of SPECT/CT

- In the setting of post-surgical changes and lytic nature of the tumor, SPECT/CT helped correctly identify tumor recurrence in new sites; lytic lesions are not greatly avid with bone agents
- SPECT/CT helped identify activity (malignancy) in periphery of the lytic lesions



# 20 Oncology

## Sclerotic bony metastases

Courtesy of Washington Hospital Center, Washington DC

### Patient information

- 85-year-old male
- Prostate cancer, assess for bony metastases

### Procedure

- Tc-99m MDP bone scan

### Findings from SPECT/CT study

- Right pubic ramus metastasis extending into anterior aspect of right acetabulum

### Physician impression of SPECT/CT

- On planar images, activity appears to be in superior lip of right acetabulum, common site for degenerative changes
- SPECT/CT helped precisely identify location to areas of sclerotic bony metastases. Management is 100% different



# 21 Oncology

## Multiple degenerative mutations of spine

Courtesy of University Hospital Freiburg, Germany

### Patient information

- 63-year-old female
- Colon carcinoma, persisting pain in spine

### Procedure

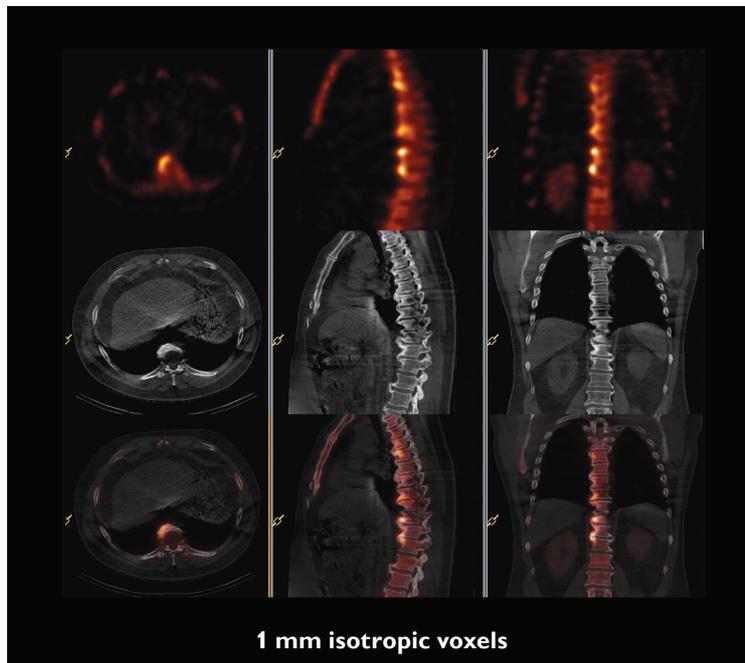
- Tc-99m DPD bone scan

### Findings from SPECT/CT study

- Focal uptake in right paramedian thoracic spine at 5th, 9th, 10th, and 12th thoracic vertebral bodies; distinct osteochondrosis in same region
- No focal uptake in region of the bone island in transverse process of 5th thoracic vertebral body

### Physician impression of SPECT/CT

- No proof of bone metastases; multiple obvious degenerative mutations in the spine



# 22 Oncology

## Lung cancer evaluation for bone mets

Courtesy of Huadong Hospital, Shanghai, China

### Patient information

- 72-year-old male
- Lung cancer; evaluate for metastases

### Procedure

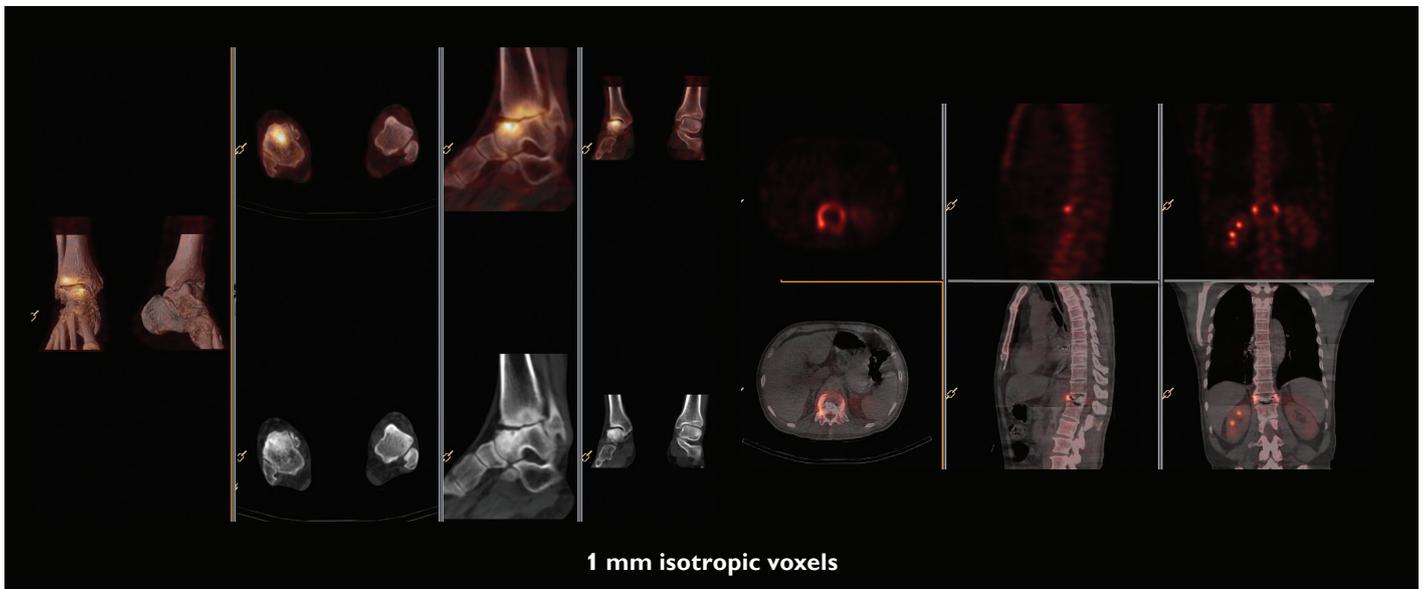
- Tc-99m MDP bone scan

### Findings from SPECT/CT study

- T12 compression fracture
- Right ankle joint degeneration

### Physician impression of SPECT/CT

- No metastases were identified; active treatment



# Orthopedics

High resolution – low CT dose

Unique combination of design and technology



The high resolution CT images of the BrightView XCT are a result of the small detector element size (<200 microns). It has been shown (Optimizing Detector Size in X-ray Imaging; Kachelrieb & Kalender; IEEE 2005) that significant dose reductions can be achieved with such fine sampling. Our design allows for very high resolution (0.33 mm thick) CT slices, ideal for extremity bone imaging. Additionally, high image quality is apparent with data viewed at any angle, not just the transverse data.

# 1 Orthopedics

## Multiple fractures in Down's Syndrome patient

Courtesy of Sutherland Nuclear Medicine, Sydney, Australia

### Patient information

- 44-year-old female
- Down's Syndrome; injury to left foot and ankle, difficulty explaining location and severity of pain

### Procedure

- Tc-99m HDP bone scan

### Findings from SPECT/CT study

- Acute fracture of distal left fibula
- Fracture of anterolateral lip of left distal fibula
- Injury, possible incomplete fracture of base of 2nd metatarsal, bone contusion of base of 4th metatarsal

### Physician impression of SPECT/CT

- Provided detail and clarity to the extent of injury that planar imaging was unable to identify
- Diagnosis of multiple fracture sites helped patient management by necessitating immobilization in a patient that was unable to fully understand and cooperate



# 2 Orthopedics

## Early pars stress fracture

Courtesy of Frimley Park Hospital NHS Foundation Trust, Surrey, United Kingdom

### Patient information

- 16-year-old male
- Sudden onset back pain in junior professional football player, no improvement with physiotherapy; MRI normal

### Procedure

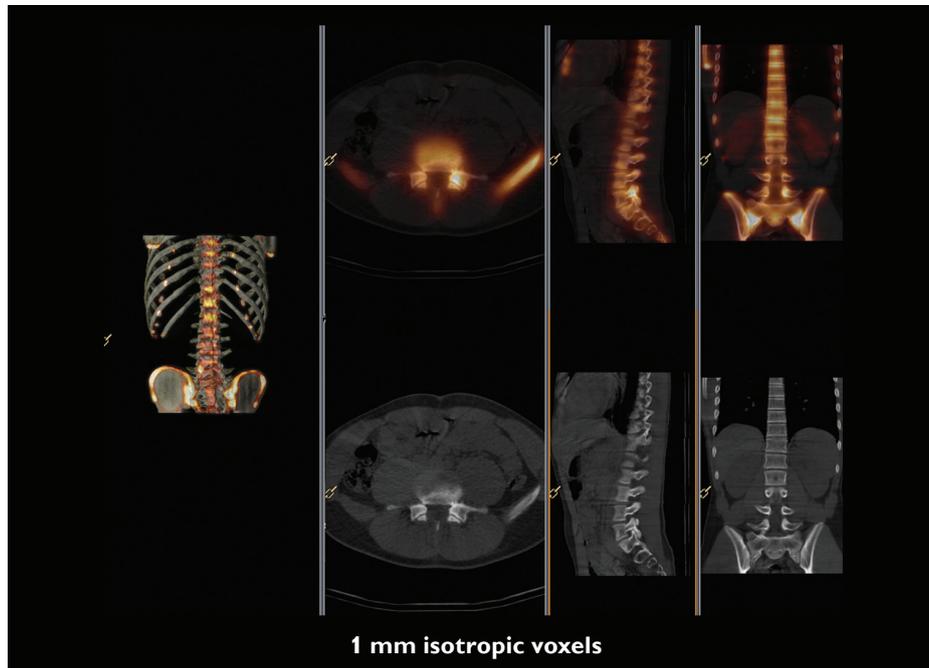
- Tc-99m MDP bone scan

### Findings from SPECT/CT study

- Increased uptake in L5 pars interarticularis, normal facet joint

### Physician impression of SPECT/CT

- Early stress fracture not visualized on other imaging
- Critical diagnosis in a professional football player



# 3 Orthopedics

## Scaphoid fracture

Courtesy of The Royal Wolverhampton Hospitals NHS Trust, Surrey, United Kingdom

### Patient information

- 22-year-old male
- 12 weeks post scaphoid fracture, still tender

### Procedure

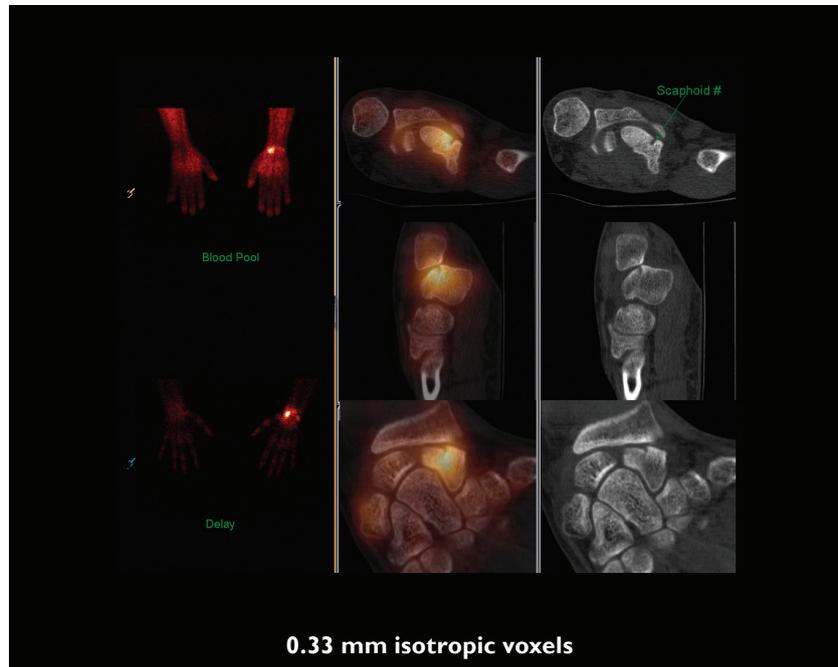
- Tc-99m MDP bone scan

### Findings from SPECT/CT study

- Confirmed scaphoid fracture with incomplete union

### Physician impression of SPECT/CT

- SPECT/CT provided information that allowed more aggressive orthopedic treatment with subsequent good outcome
- Fracture now healed and patient is symptom-free



# 4 Orthopedics

## Right foot pain

Courtesy of Nepean Nuclear Medicine and PET, Sydney, Australia

### Patient information

- 47-year-old male
- Right foot pain

### Procedure

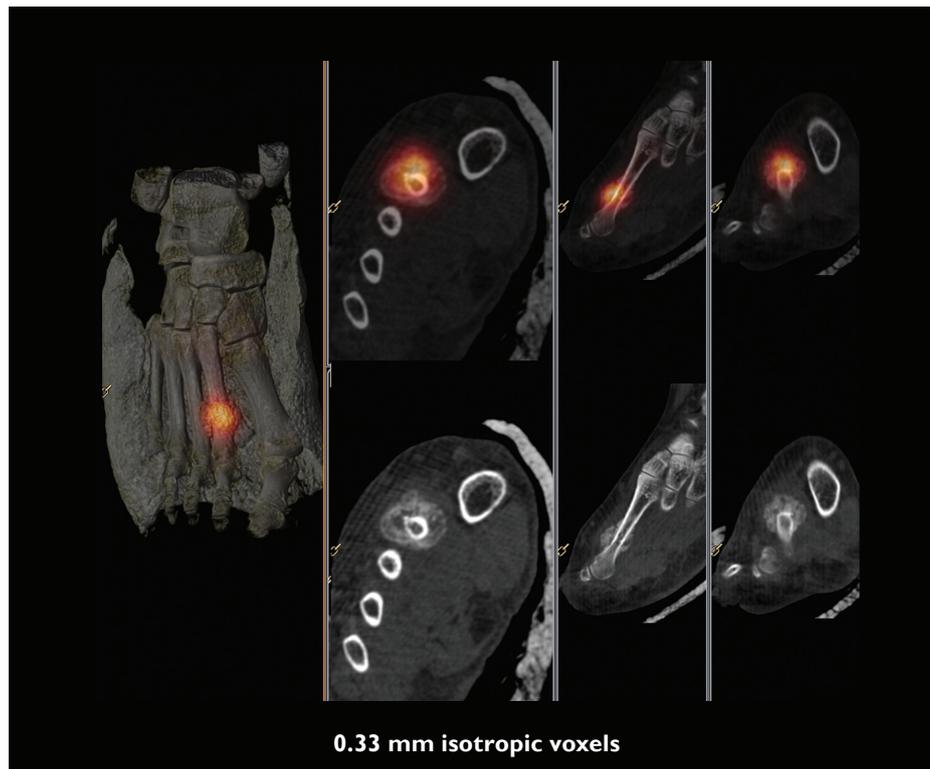
- Tc-99m HDP bone scan

### Findings from SPECT/CT study

- Active and osteoblastic process at right 2nd metatarsal shaft consistent with recent fracture

### Physician impression of SPECT/CT

- SPECT/CT confirmed fracture and excluded infection and other causes which led to appropriate management



# 5 Orthopedics

## Torus palatini

Courtesy of University of Washington Medical Center, Seattle, Washington

### Patient information

- 51-year-old female
- Long history of multiple bony growths in maxilla, mandible, hands, right shoulder, likely hereditary multiple exostosis
- Bony growth in hard palate causing bleeding; look for malignant transformation

### Procedure

- Tc-99m MDP bone scan

### Findings from SPECT/CT study

- Mild uptake in oropharynx corresponding to large growth on CT with well-corticated margins and small medullary space; has appearance of torus palatini
- Minimal uptake within exostoses in mandible, shoulder, and calvarium

### Physician impression of SPECT/CT

- CT clarified the hard palate growth was a torus palatini rather than exostosis
- Concern of malignant transformation excluded despite troubling clinical history



# 6 Orthopedics

## Biceps enthesopathy

Courtesy of GZA Sint-Augustinus, Antwerp, Belgium

### Patient information

- 49-year-old male
- Chronic elbow pain (mostly right); rule out epicondylitis radialis

### Procedure

Tc-99m MDP bone scan

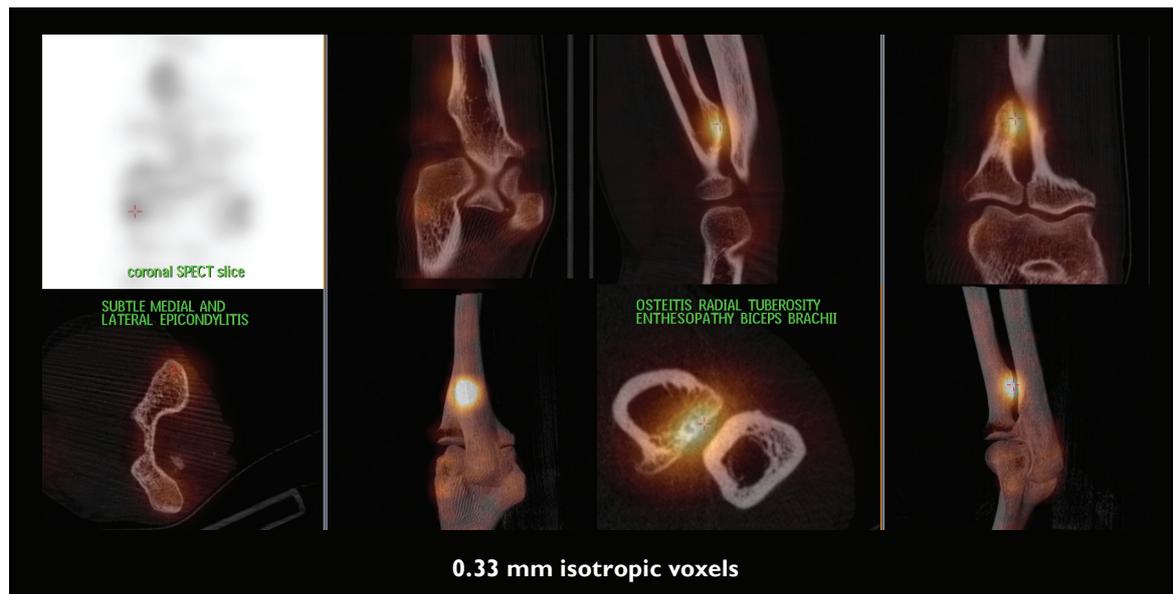
### Findings from SPECT/CT study

- Planar images show hot spot on bilater proximal forearm, possibly radius

- SPECT/CT of right elbow accurately localizes the intense uptake to radial tuberosity, compatible with biceps enthesopathy
- Only subtle increased uptake at medial and lateral epicondyle

### Physician impression of SPECT/CT

- Clearly visualizes focal bone lesion – different diagnosis than orthopedic surgeon suspected
- Compared to planar images (difficult anatomical interpretation), SPECT/CT gives more accurate localization of hot spot and shows no evident stress fracture



# 7 Orthopedics

## Osteonecrosis

Courtesy of Universitair Ziekenhuis Brussel, Brussels, Belgium

### Patient information

- 30-year-old female
- Lupus nephritis (under immunosuppression) and sickle cell disease with pain in right knee, medial aspect of right foot, and left ankle

### Procedure

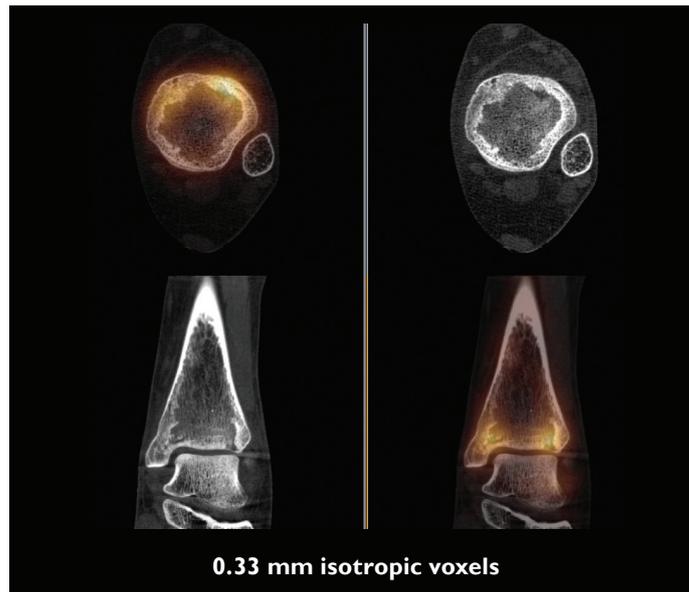
- Tc-99m MDP bone scan

### Findings from SPECT/CT study

- MDP accumulation corresponding with a serpiginous margin of increased density which runs along arc-like radioluscent lesions, characteristic for osteonecrosis in a healing phase
- Bone infarctions within the epiphysis with a necrotic center of medullar bone surrounded by viable marrow and bone

### Physician impression of SPECT/CT

- Osteonecrosis with signs indicating repair; could be due to embolization of small feeding blood vessels related to sickle cell disease or induced by corticosteroid use



# 8 Orthopedics

## Calcaneal fracture

Courtesy of Sydney X-Ray, Sydney, Australia

### Patient information

- Right heel pain for a few months

### Procedure

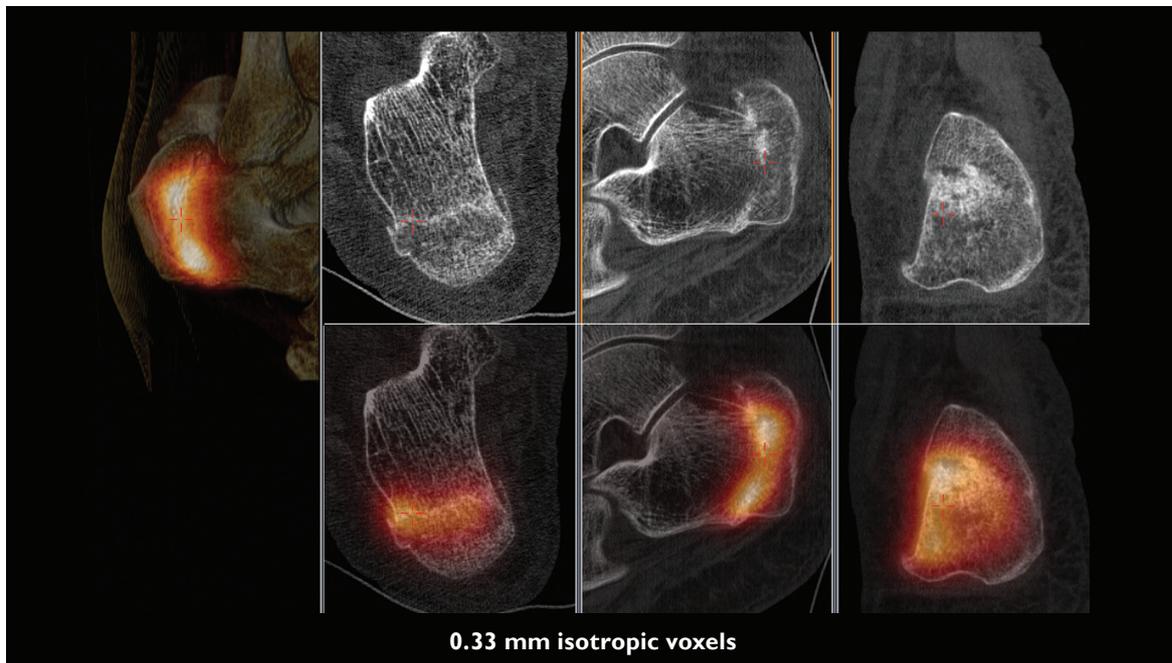
- Tc-99m bone scan

### Findings from SPECT/CT study

- Intense uptake in right calcaneus along a fracture line posteriorly in the CT, which also demonstrated malalignment and impaction of the fracture

### Physician impression of SPECT/CT

- Patient was managed appropriately for the stress fracture and orthopedic review was arranged to assess the malalignment of the fracture
- No further imaging was required



# 9 Orthopedics

## Cervical spine pain

Courtesy of Innsbruck Medical University, Tyrol, Austria

### Patient information

- 59-year-old female
- Cervical spine pain x 1 year; fusion of C5-6 and C6-7 in 2003
- MRI showed no significant clinical information

### Procedure

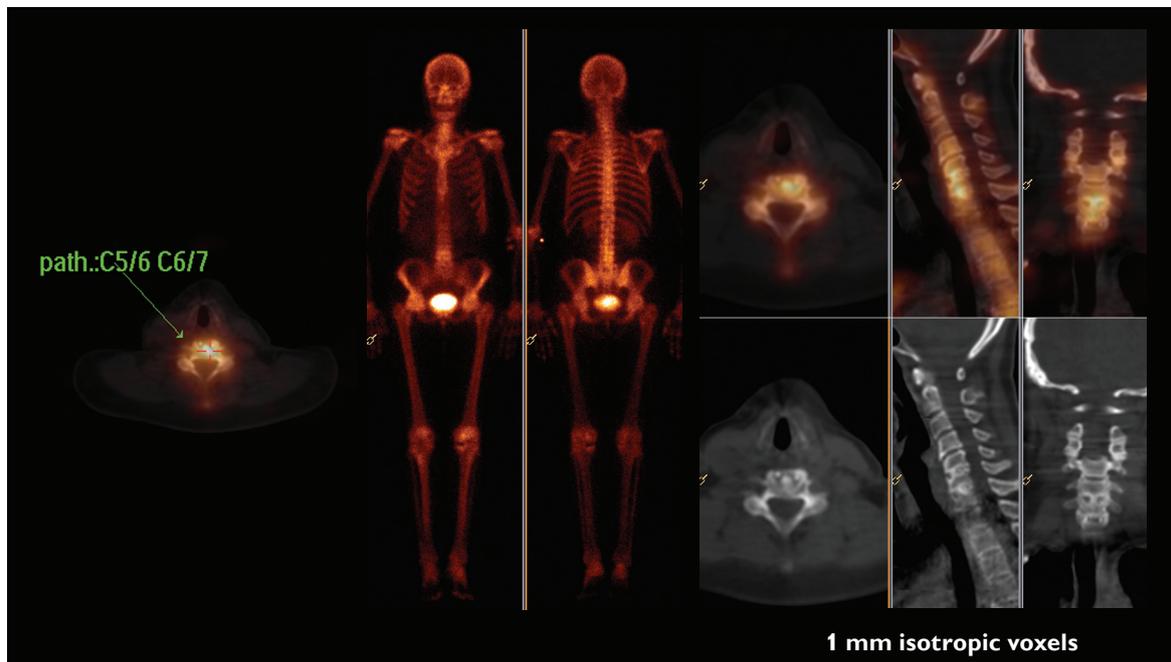
- Tc-99m DPD bone scan

### Findings from SPECT/CT study

- Pathologic bone metabolism in fusion area of C5-6 and C6-7
- Easing/relaxation of the “cage” material used in the operation

### Physician impression of SPECT/CT

- SPECT/CT guided physician to perform an infiltration of cervical spine in fusion area



# 10 Orthopedics

## Navicular arthropathy

Courtesy of Sydney X-Ray, Sydney, Australia

### Patient information

- 80-year-old
- Severe right ankle pain with suspected stress fracture

### Procedure

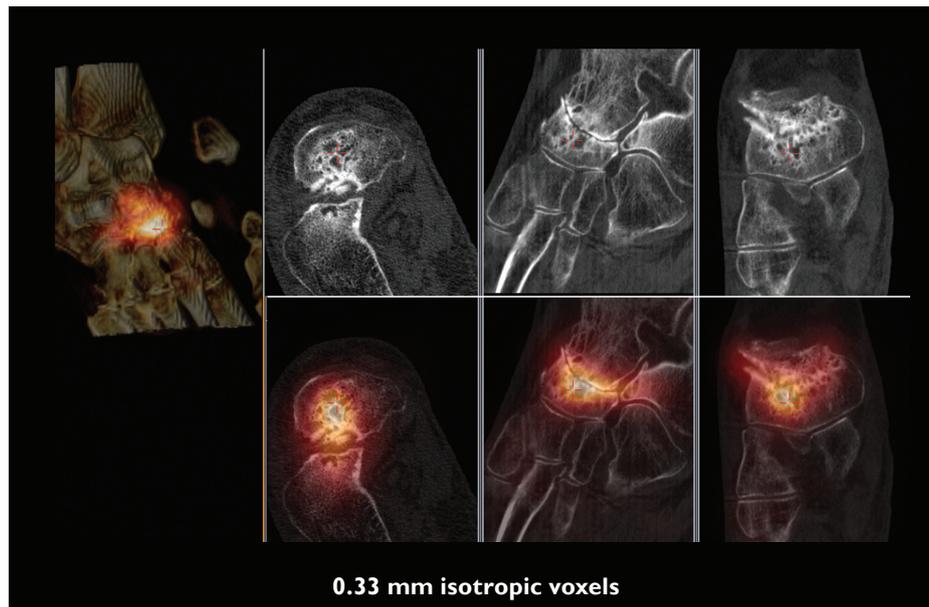
- Tc-99m bone scan

### Findings from SPECT/CT study

- Markedly increased vascularity and delayed uptake in the hind foot; demonstrated intense uptake in right talo navicular region with severe degenerative change on low dose CT (sub articular cyst formation, joint narrowing and Peri articular sclerosis)

### Physician impression of SPECT/CT

- Patient treated appropriately for inflammatory arthropathy of right talo navicular joint rather than incorrectly for a stress fracture which may not have been appreciated without SPECT/CT



# 11 Orthopedics

## Sacroiliitis

Courtesy of Fletcher Allen Health Care University, Burlington, Vermont

### Patient information

- 40-year-old male
- Chronic back pain radiating to lower extremities, rule out occult fractures, assess active disease and guide level for facet injection or MBB +/- RFA
- MRI showed L4-5 disc degeneration and facet arthropathy L4-5, L5-S1

### Procedure

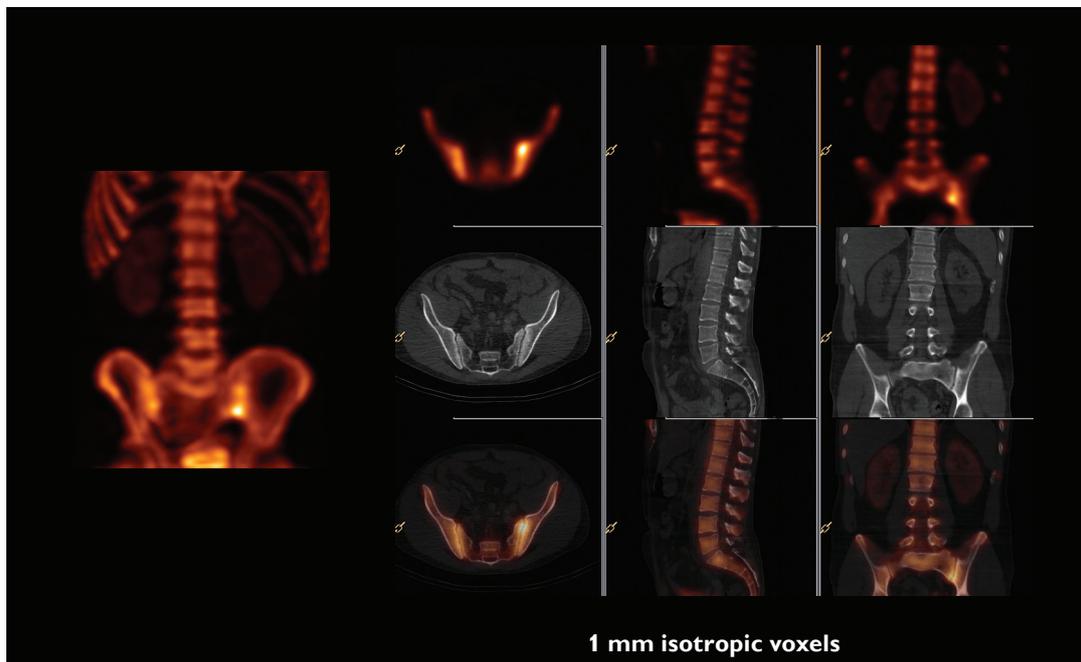
- Tc-99m bone scan

### Findings from SPECT/CT study

- No significant uptake in facet joints nor discogenic endplate changes
- Intense uptake associated with SI joints consistent with sacroiliitis

### Physician impression of SPECT/CT

- Patient referred from ortho/spine clinic to rheumatology clinic



# 12 Orthopedics

## Guide facet block or medial branch block

Courtesy of Fletcher Allen Health Care University, Burlington, Vermont

### Patient information

- 47-year-old male
- Low back pain in construction worker, increasing throughout the day
- MRI showed L3-4, L4-5, L5-S1 disc degeneration, lateral bulges L3-4, L4-5
- Bone scan to guide facet blocks or MBB +/- RFA and possible fusion

### Procedure

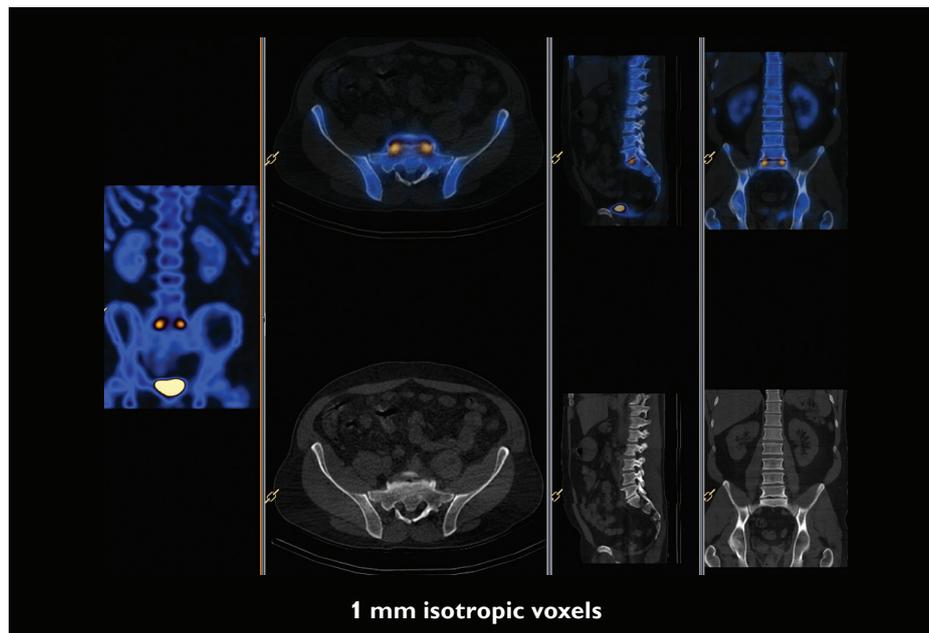
- Tc-99m bone scan

### Findings from SPECT/CT study

- Planar uptake increased L5-S1 but could be mistaken for facet joints
- SPECT/CT clearly identifies increased uptake corresponding to discogenic endplate changes L5-S1

### Physician impression of SPECT/CT

- Patient was offered medial branch block with radiofrequency ablation of medial branch if diagnostic MBB is effective
- If MBB is ineffective, L5-S1 spinal fusion will be offered



# 13 Orthopedics

## Facet joint arthropathy

Courtesy of Washington Hospital Center, Washington DC

### Patient information

- 61-year-old male
- Right-sided back pain

### Procedure

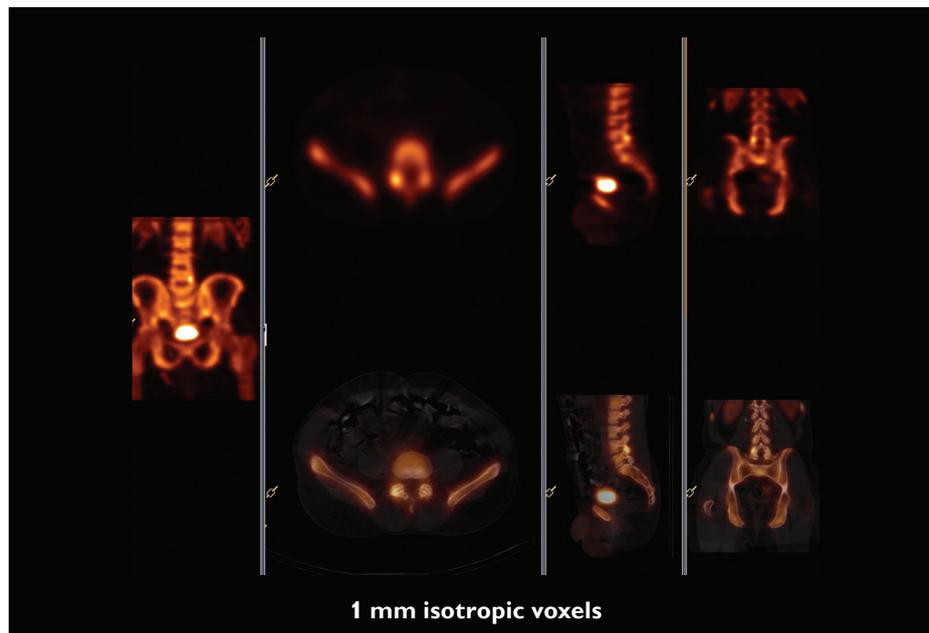
- Tc-99m MDP bone scan

### Findings from SPECT/CT study

- Right-sided L4-5 facet joint arthropathy
- No evidence of spondylolysis, spondylolisthesis, or pars fracture

### Physician impression of SPECT/CT

- Demonstration of inflammatory process versus fracture as etiology of back pain
- Guided referring physician to conservative medical management



# 14 Orthopedics

## Stress fracture of tibia

Courtesy of Wollongong Nuclear Medicine, New South Wales, Australia

### Patient information

- 34-year-old male
- Six-week history of left proximal tibia pain, query AVN or osteomyelitis

### Procedure

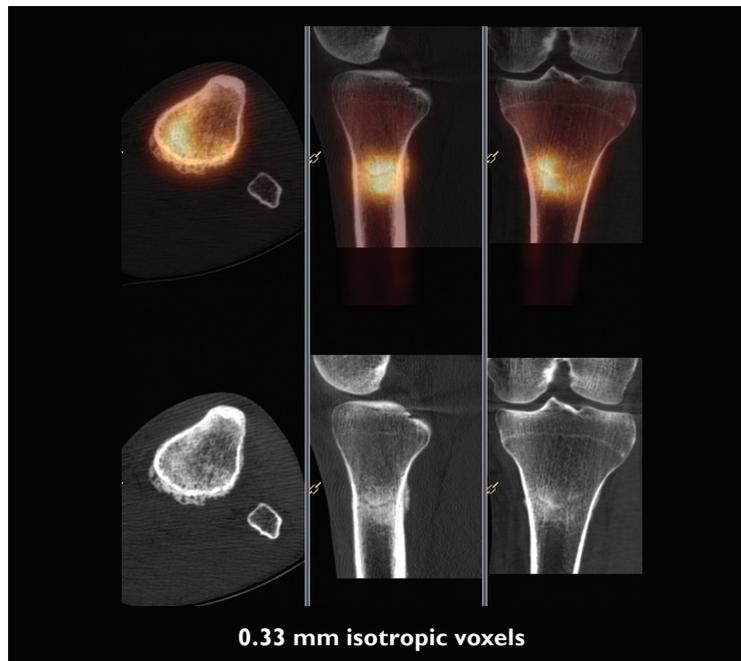
- Tc-99m HDP bone scan

### Findings from SPECT/CT study

- Intense HDP uptake in left proximal tibia, associated with fracture line seen in the low dose CT
- Recent stress fracture of left proximal tibia

### Physician impression of SPECT/CT

- SPECT/CT allowed clear localization and diagnosis of fracture, ruling out AVN and osteomyelitis



# 15 Orthopedics

## Pseudoarthrosis

Courtesy of Sutherland Nuclear Medicine, Sydney, Australia

### Patient information

- 52-year-old male
- Right shin pain, no clear trauma

### Procedure

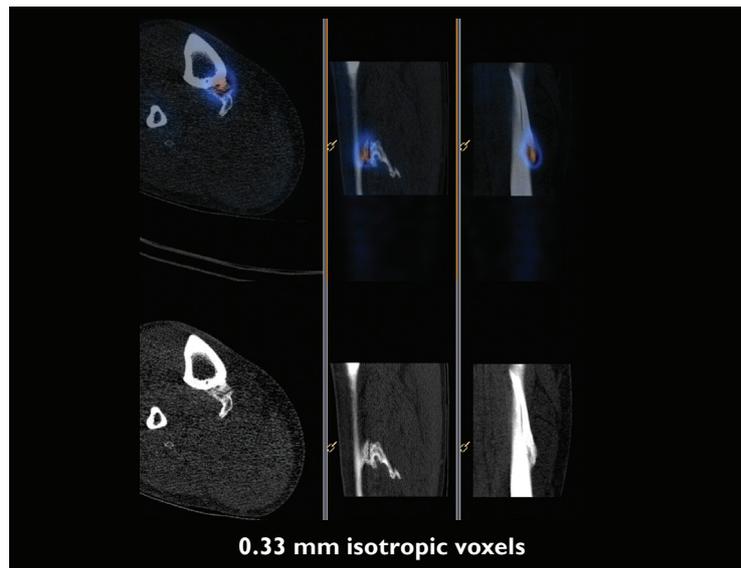
- Tc-99m HDP bone scan

### Findings from SPECT/CT study

- Exostosis at medial margin of right tibia with avid uptake at its base, correlates to incomplete fusion/pseudoarthrosis rather than acute injury
- Second focus of new bone formation and corresponding pseudoarthrosis

### Physician impression of SPECT/CT

- Without SPECT/CT, delayed images would have been diagnosed as stress fracture of tibia
- SPECT/CT helped find it was an old injury with incomplete fusion and corresponding pseudoarthrosis rather than acute injury, therefore changed patient's treatment



# 16 Orthopedics

## Atypical insufficiency fractures

Courtesy of Wollongong Nuclear Medicine, New South Wales, Australia

### Patient information

- 73-year-old female
- Known stress fractures of femora related to long-term bisphosphonate therapy; increasing low back pain

### Procedure

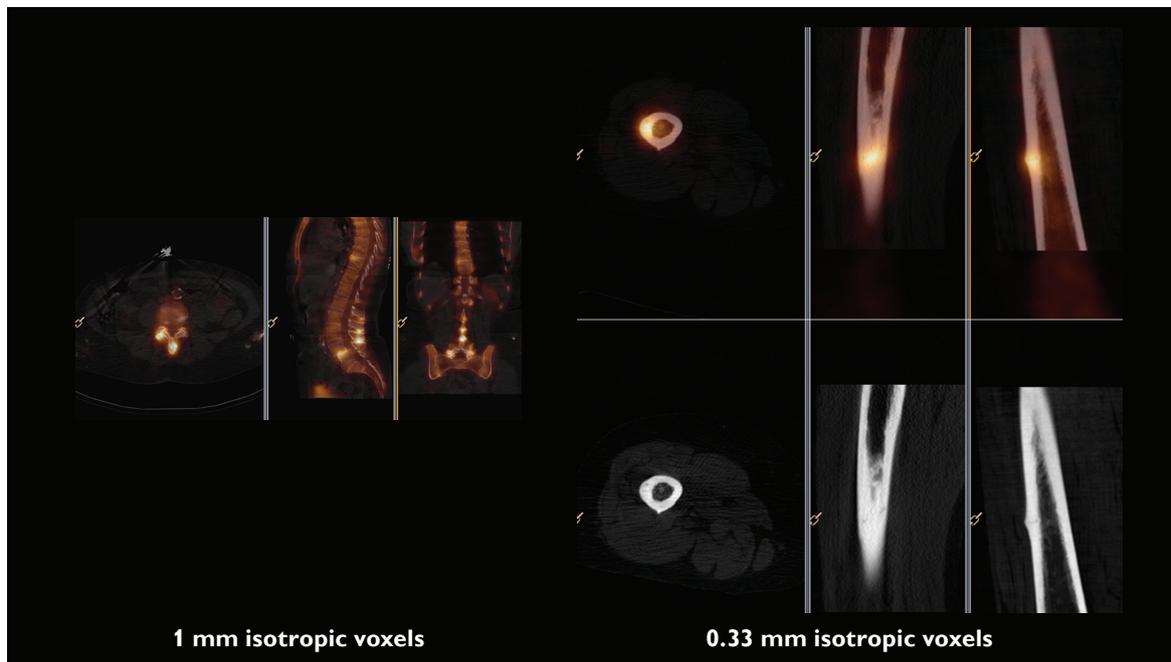
- Tc-99m HDP bone scan

### Findings from SPECT/CT study

- Presence of reaction to resolving stress/insufficiency fractures in lateral cortical margins of both distal femora
- Evidence of bilateral L5-S1 facet joint and L4-5 right facet joint arthropathy

### Physician impression of SPECT/CT

- Revealed atypical insufficiency fractures of both femora, secondary to long-term bisphosphonate therapy – a new, recently described, and controversial condition



# Infection

## Isotropic voxels

High quality images regardless of viewing angle

By acquiring in isotropic voxels, BrightView XCT provides the same high resolution in all orientations of the CT images. Coronal and sagittal slices will have the same resolution as the transverse slices, without the stair-step artifact common to non-isotropic techniques.



Localization – CT acquisition



Localization – SPECT acquisition

# 1 Infection

## Pelvic graft infection

Courtesy of North Carolina Baptist Hospital, Winston-Salem, North Carolina

### Patient information

- 60-year-old male
- Right side pelvic pain; CT showed mass on right side, rule out infected pelvic graft

### Procedure

- In-111 WBC scan

### Findings from SPECT/CT study

- Increased activity in right groin adjacent to graft (femoral artery anastomosis) corresponding to edema and cellulitis in right groin, likely infection

### Physician impression of SPECT/CT

- SPECT/CT showed the uptake was not over the bone and confirmed the CT findings



# 2 Infection

## Foot and shin ulcers

Courtesy of Wollongong Nuclear Medicine, New South Wales, Australia

### Patient information

- 80-year-old female
- Ulcers on right heel and left lower shin; rule out osteomyelitis

### Procedure

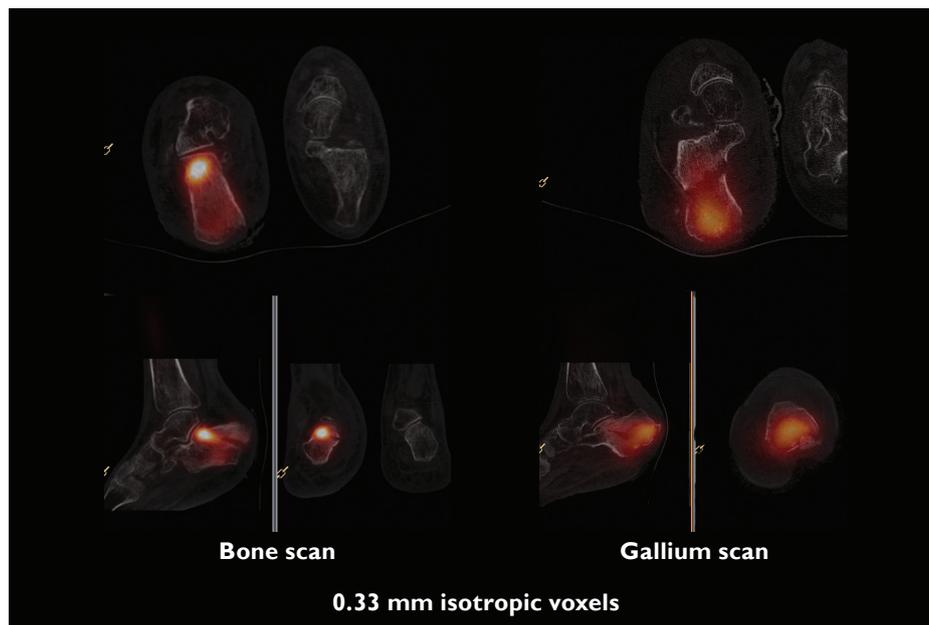
- Tc-99m HDP bone scan and Ga-67 scan

### Findings from SPECT/CT study

- Bone findings – highly suspicious for osteomyelitis of right calcaneus inferiorly; may represent periosteal reaction of left shin but may be osteomyelitis
- Gallium findings – mild Gallium uptake in calcaneum, faint uptake in shin
- Combined – does not suggest osteomyelitis

### Physician impression of SPECT/CT

- SPECT/CT demonstrated superb localization of Gallium distinct from MDP uptake region, excluding osteomyelitis
- Antibiotics were changed to reflect a non-osseous infection



# 3 Infection

## Apophysitis verses Brodie's abscess

Courtesy of Nepean Nuclear Medicine and PET, Sydney, Australia

### Patient information

- 10-year-old female
- Localized pain in left calcaneus medioposteriorly with low-grade fever

### Procedure

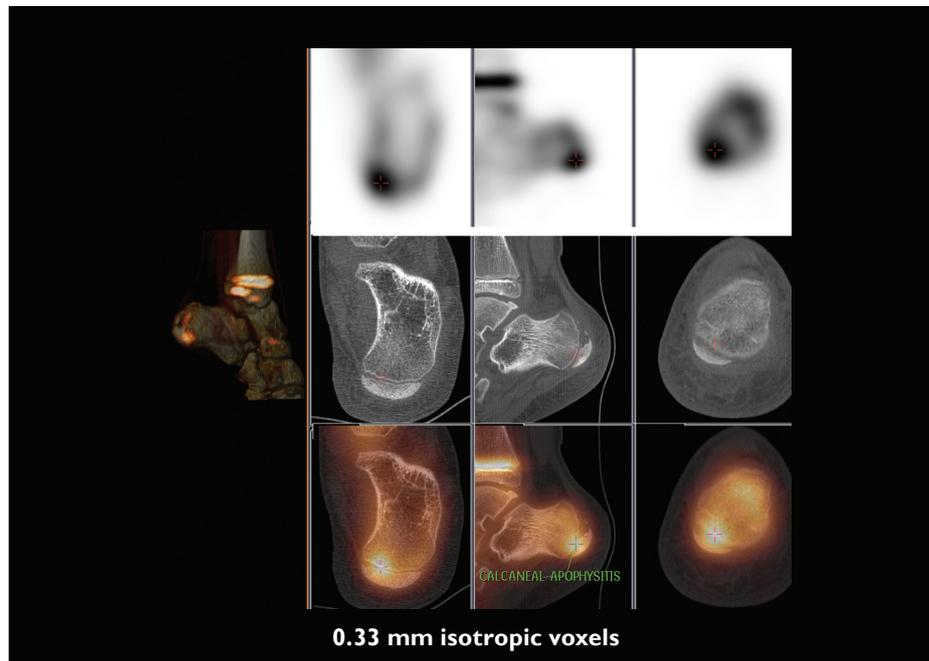
- Tc-99m HDP bone scan

### Findings from SPECT/CT study

- Consistent with left calcaneal apophysitis
- No evidence of Brodie's abscess

### Physician impression of SPECT/CT

- Able to exclude Brodie's abscess, therefore changed management of patient



# 4 Infection

## Osteomyelitis with sequester

Courtesy of GZA Sint-Augustinus, Antwerp, Belgium

### Patient information

- 5-year-old male
- Fever, pain of distal thigh, limping; rule out osteomyelitis

### Procedure

- Tc-99m MDP bone scan

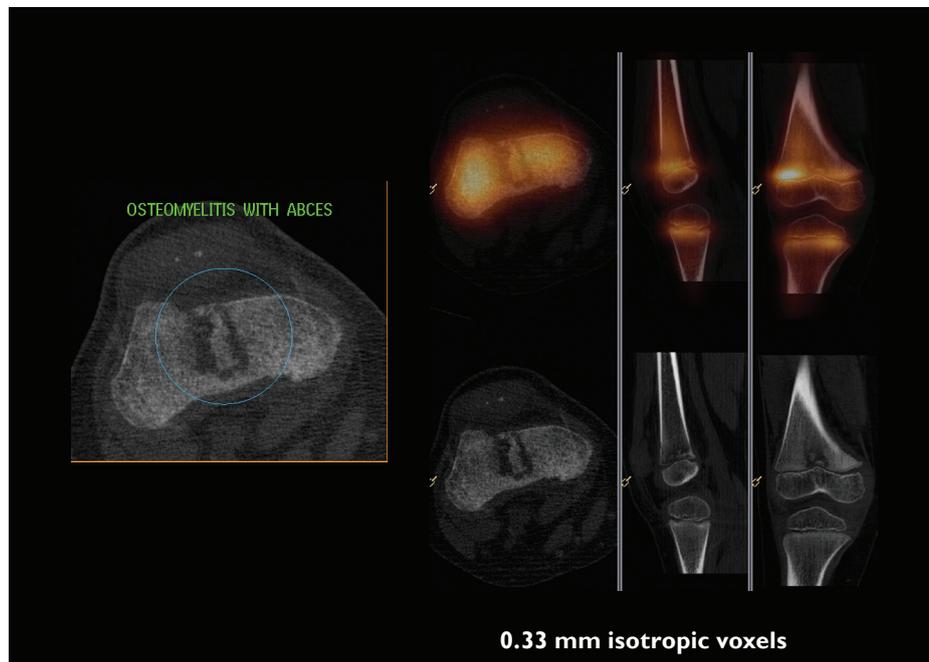
### Findings from SPECT/CT study

- Planar images show hyperemia and diffuse increased uptake in distal right femur

- SPECT/CT confirms increased uptake of distal femoral growth plate with a central defect; on low dose CT, there is a clear central endomedullary irregular lesion suspect for abscess or bone sequester

### Physician impression of SPECT/CT

- Classic bone scan diagnosis of osteomyelitis
- SPECT/CT showed addition of intra-osseous sequester, which requires more intensive antibiotic therapy and follow-up (possible surgery)



# 5 Infection

## Occult fracture

Courtesy of Universitair Ziekenhuis Brussel, Brussels, Belgium

### Patient information

- 30-year-old female
- Persistent pain two months following surgery for halux valgus; rule out osteomyelitis

### Procedure

- Tc-99m Granuloscint

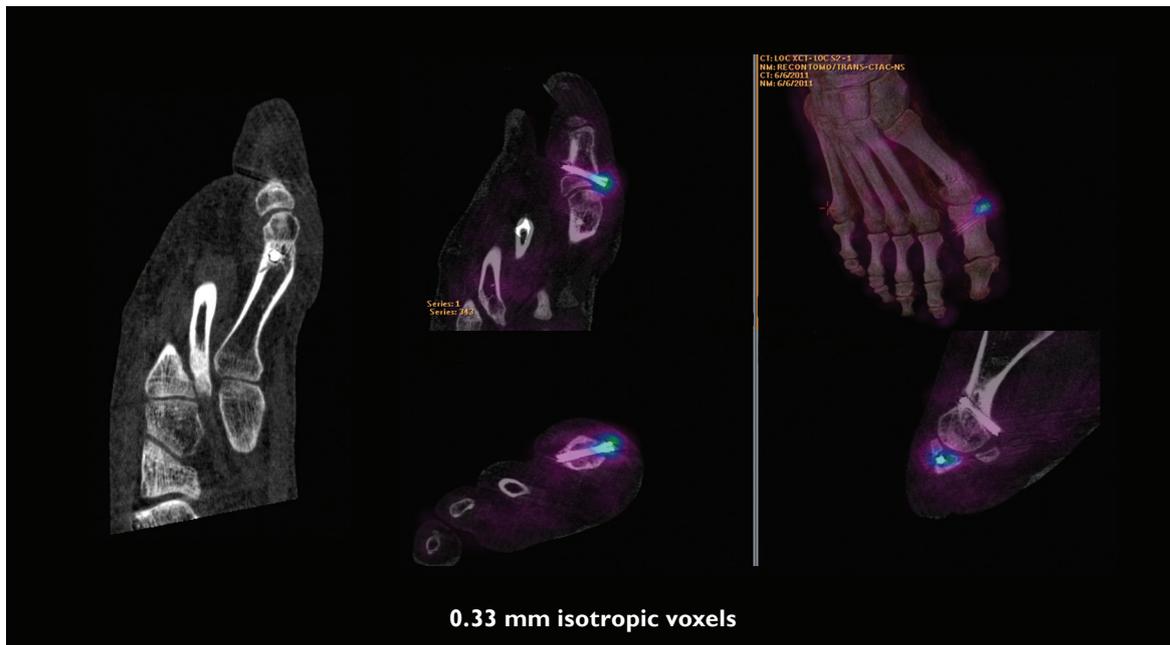
### Findings from SPECT/CT study

- WBC accumulation in soft tissue surrounding head of the screw

- Some bone resorption at proximal level of the screws, no increased bone uptake nor interruption of the bony cortex; osteomyelitis was excluded
- Straight radioluscent line at metaphysis of metatarsal bone marks presence of recent non-displaced transcortical occult fracture

### Physician impression of SPECT/CT

- This single examination rules out the important diagnosis of osteomyelitis, confirms soft tissue infection, and demonstrates an occult fracture as source of the pain



# Other localization

## Workflow tailored for nuclear medicine

Continue working the way you already do

Having all of the capabilities of the popular BrightView SPECT camera, BrightView XCT simplifies workflow to help improve clinical results and lower lifecycle costs.

The low complexity design is compact, fitting in a standard nuclear-medicine-sized room. An in-room CT control option allows you to be closer to your patient and avoid the costs associated with a separate control room. SPECT/CT planning is done from the nuclear medicine p-scope, as simple as planning for a SPECT-only procedure.



**Compact, low complexity design suitable  
for a standard nuclear-medicine-sized room**

# 1 Other localization

## Pulmonary embolism

Courtesy of Affiliated Hospital of Xuzhou Medical College, Jiangsu, China

### Patient information

- 72-year-old male
- Gasping and chest pain

### Procedure

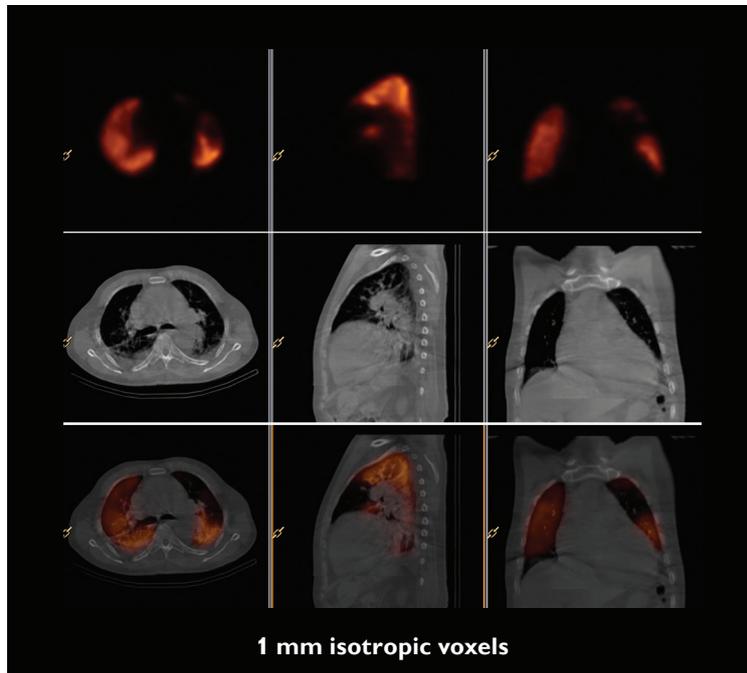
- Tc-99m MAA lung perfusion

### Findings from SPECT/CT study

- Significant defect in the lingular segment of the superior lobe of the left lung; pulmonary embolism should be considered

### Physician impression of SPECT/CT

- Based on the SPECT/CT findings, thrombolysis therapy was recommended



# 2 Other localization

## Biliary leak

Courtesy of North Carolina Baptist Hospital, Winston-Salem, North Carolina

### Patient information

- 59-year-old male
- Abdominal pain post recent cholecystectomy; displaced tube post surgery

### Procedure

- Tc-99m HIDA

### Findings from SPECT/CT study

- Extraluminal activity extending from gallbladder fossa was noted in the right paracolic gutter and pelvis; positive biliary leak

### Physician impression of SPECT/CT

- SPECT/CT showed the leak and extent of the leak; CT only showed leak around liver



# 3 Other localization

## Lymphatic fluid leak

Courtesy of Osaka City University Hospital, Osaka, Japan

### Patient information

- 59-year-old female
- Esophageal cancer; two-week leakage of lymphatic fluid after esophagectomy

### Procedure

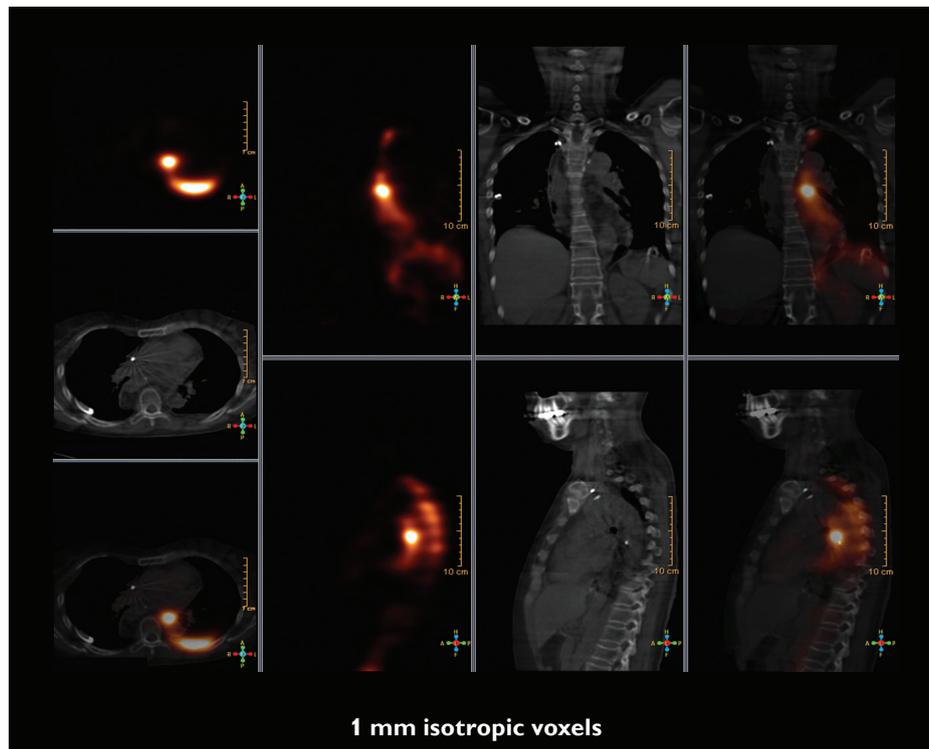
- Tc-99m HAS-D

### Findings from SPECT/CT study

- Uptake of leak point was found in middle of the mediastinum, placed between the bronchus and aorta

### Physician impression of SPECT/CT

- The surgical ligation of main lymph duct was easily planned as a result of accurate regional identification of the lymphoid leak point by SPECT/CT



# 4 Other localization

## Hyperparathyroidism

Courtesy of Nepean Nuclear Medicine and PET, Sydney, Australia

### Patient information

- 46-year-old female
- Hyperparathyroidism; assess for parathyroid adenoma

### Procedure

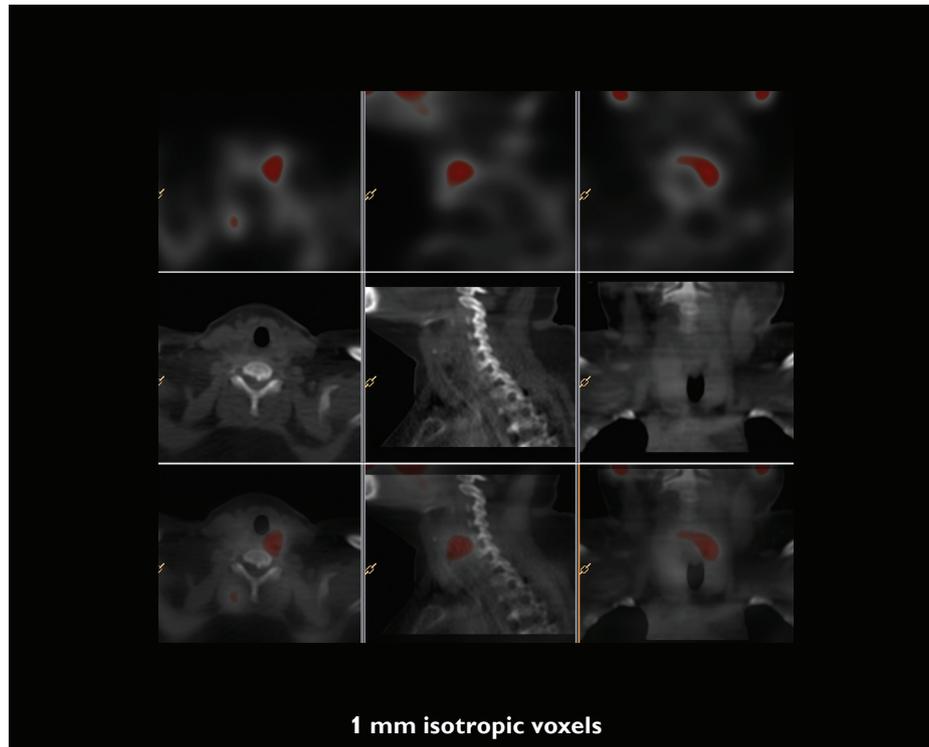
- Tc-99m Sestamibi

### Findings from SPECT/CT study

- Moderate focal retention present at superoposterior aspect of left thyroid lobe

### Physician impression of SPECT/CT

- Identified and localized parathyroid adenoma which helped with surgical planning



# 5 Other localization

## Lung perfusion with unusual anatomy

Courtesy of University of Washington Medical Center, Seattle, Washington

### Patient information

- 27-year-old female
- Complex congenital heart disease; transposition of great arteries, dextrocardia, bilateral superior vena cava
- Single functional ventricle and multiple pulmonary AVMs
- New onset of palpitations and dyspnea; evaluate for worsening of R-L shunt

### Procedure

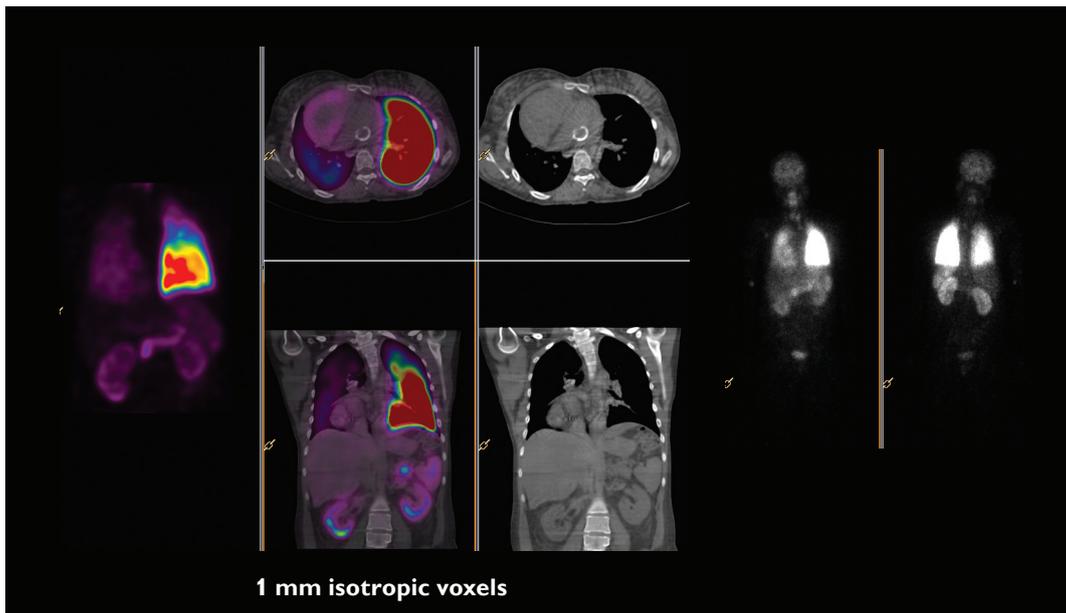
- Tc-99m MAA perfusion and Tc-99m DTPA ventilation

### Findings from SPECT/CT study

- Significantly decreased perfusion to entire right lung, focally more severe perfusion defect in lateral aspect of right upper lobe seen better on SPECT/CT
- 32% right-to-left shunt likely explains the patient's symptoms

### Physician impression of SPECT/CT

- SPECT/CT provided additional anatomic information to better understand the perfusion in patient with unusual anatomy
- Planar images were challenging to interpret



# 6 Other localization

## Venogram

Courtesy of Osaka City University Hospital, Osaka, Japan

### Patient information

- 74-year-old female
- Illustrate accurate regions and degrees of venous embolisms of the lower limb

### Procedure

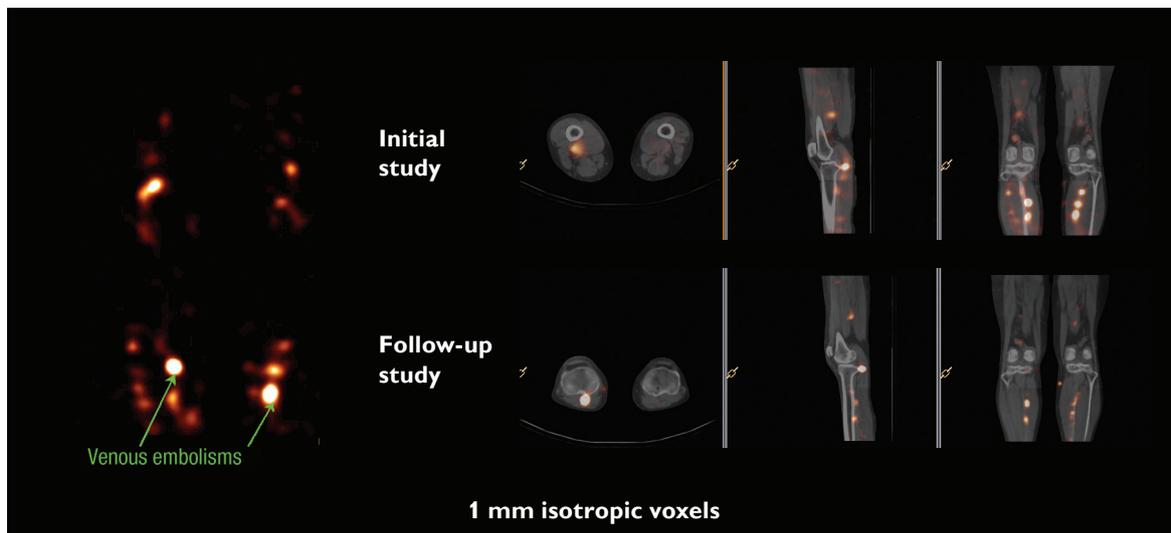
- Tc-99m MAA venogram

### Findings from SPECT/CT study

- Before warfarization, many uptakes were found in both lower limbs along the veins on the SPECT/CT; found to be venous embolisms
- Two weeks after warfarization, fewer uptakes of both lower limbs were illustrated than before the treatment

### Physician impression of SPECT/CT

- Warfarization treatment was initiated as a result of accurate regional identification and degree of venous embolism on the SPECT/CT
- After treatment, the comparison SPECT/CT easily showed a therapeutic response so warfarization was able to be stopped



# 7 Other localization

## GI bleeding

Courtesy of Wollongong Nuclear Medicine, New South Wales, Australia

### Patient information

- 70-year-old female
- GI blood loss resulting in anemia, requiring blood transfusions; multiple efforts to identify source including 2 x endoscopy

### Procedure

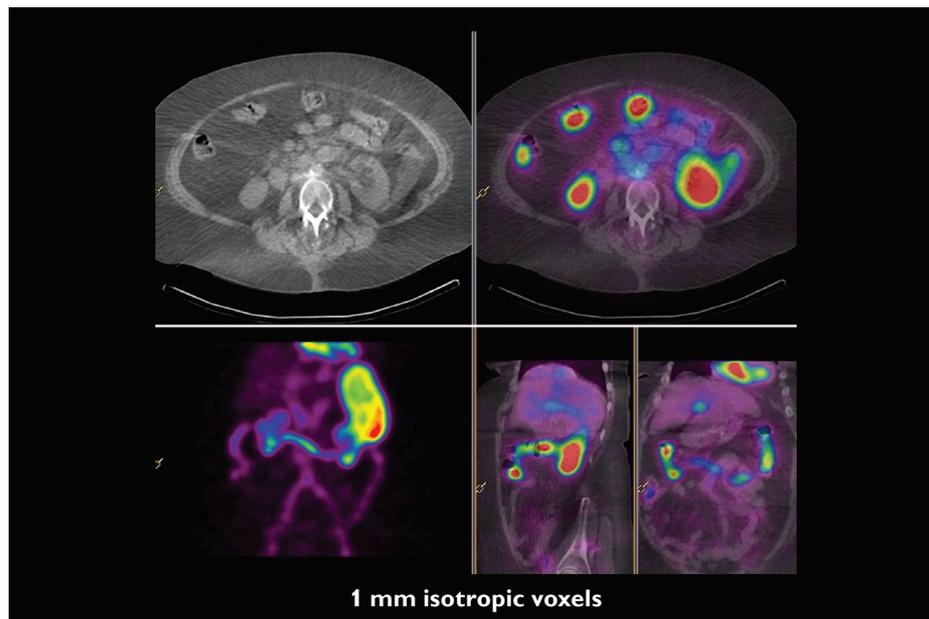
- Tc-99m tagged RBCs

### Findings from SPECT/CT study

- No active bleed in early phase
- At 24 hours, abnormal activity in entire transverse colon, halfway along ascending colon and entire descending colon prior to sigmoid junction; ultrasound confirmation was recommended

### Physician impression of SPECT/CT

- SPECT/CT provided a specific target to allow subsequent endoscopic confirmation of source of bleeding; endoscopy demonstrated lesion in ascending colon region (hemangioma/angiodysplasia)



# 8 Other localization

## Hyperparathyroidism

Courtesy of Washington Hospital Center, Washington DC

### Patient information

- 54-year-old female
- Hyperparathyroidism; identify parathyroid adenoma

### Procedure

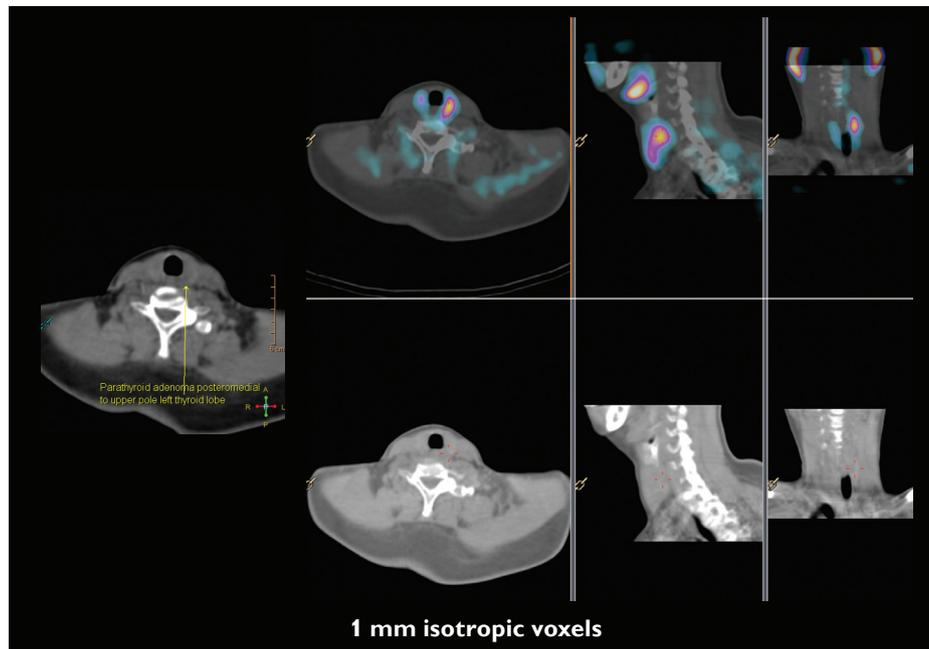
- Tc-99m Sestamibi

### Findings from SPECT/CT study

- Extrathyroidal MIBI focus posteromedial to upper pole of left thyroid lobe
- No evidence of ectopic parathyroid tissue in mediastinum

### Physician impression of SPECT/CT

- SPECT/CT helped precisely identify parathyroid adenoma location
- Precise surgical guidance was achieved for resection



# Case study acquisition parameters

Case study	CT scan parameters	SPECT scan parameters	Page
1 Cardiology	5mA; 60 seconds	Astonish; 4 iterations, 8 subsets, Hanning filter 1.0	7
2 Cardiology	5mA; 60 seconds	Astonish; 4 iterations, 8 subsets, Hanning filter 1.0	8
1 Oncology	2mA; 12 seconds	Astonish; 2 iterations, 12 subsets, Hanning filter 1.2	10
2 Oncology	30mA; 12 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 1.0	11
3 Oncology	20mA; 24 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 1.2	12
4 Oncology	80mA; 24 seconds	Astonish; 2 iterations, 15 subsets, Hanning filter 1.2	13
5 Oncology	20mA; 12 seconds	Astonish; 4 iterations, 8 subsets, no filter	14
6 Oncology	30mA; 12 seconds	Astonish; 3 iterations, 8 subsets, no filter	15
7 Oncology	5mA; 60 seconds	MLEM; Butterworth; cutoff 0.66, Order 5.0, 30 iterations	16
8 Oncology	5mA; 12 seconds	OSEM; Butterworth; cutoff 0.50, Order 5.0, 16 iterations, 8 subsets	17
9 Oncology	20mA; 12 seconds	Astonish; 3 iterations, 16 subsets, no filter	18
10 Oncology	80mA; 24 seconds	Astonish; 4 iterations, 8 subsets, no filter	19
11 Oncology	20mA; 12 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 1.0	20
12 Oncology	80mA; 24 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 2.0	21
13 Oncology	20mA; 12 seconds	Astonish; 4 iterations, 8 subsets, Hanning filter 2.0	22
14 Oncology	20mA; 12 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 1.0	23
15 Oncology	20mA; 24 seconds	Astonish; 4 iterations, 16 subsets, Hanning filter 1.2	24
16 Oncology	20mA; 12 seconds	Astonish; 3 iterations, 8 subsets, no filter	25

Case study	CT scan parameters	SPECT scan parameters	Page
17 Oncology	20mA; 24 seconds	Astonish; 4 iterations, 16 subsets, Hanning filter 1.2	26
18 Oncology	30mA; 12 seconds	Astonish; 6 iterations, 8 subsets, Hanning filter 0.95	27
19 Oncology	80mA; 24 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 2.0	28
20 Oncology	20mA; 12 seconds	Astonish; 6 iterations, 8 subsets, Hanning filter 2.0	29
21 Oncology	30mA; 12 seconds	Astonish; 4 iterations, 15 subsets, no filter	30
22 Oncology	Chest: 20mA; 12 seconds Ankle: 80mA; 24 seconds	Chest: Astonish; 4 iterations, 16 subsets, no filter Ankle: Astonish; 4 iterations, 16 subsets, no filter	31
1 Orthopedics	80mA; 24 seconds	Astonish; 3 iterations, 8 subsets, no filter	33
2 Orthopedics	20mA; 12 seconds	Astonish; 3 iterations, 8 subsets, no filter	34
3 Orthopedics	20mA; 12 seconds	Astonish; 4 iterations, 8 subsets, no filter	35
4 Orthopedics	80mA; 24 seconds	Astonish; 4 iterations, 8 subsets, no filter	36
5 Orthopedics	80mA; 24 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 1.0	37
6 Orthopedics	80mA; 24 seconds	Astonish; 3 iterations, 8 subsets, no filter	38
7 Orthopedics	80mA; 24 seconds	Astonish; 2 iterations, 32 subsets, no filter	39
8 Orthopedics	80mA; 24 seconds	Astonish; 2 iterations, 8 subsets, no filter	40
9 Orthopedics	20mA; 24 seconds	OSEM; Butterworth; cutoff 0.60, Order 1.0, 3 iterations, 8 subsets	41
10 Orthopedics	80mA; 24 seconds	Astonish; 2 iterations, 8 subsets, no filter	42
11 Orthopedics	20mA; 12 seconds	Astonish; 4 iterations, 16 subsets, Hanning filter 1.3	43

## Case study acquisition parameters continued

Case study	CT scan parameters	SPECT scan parameters	Page
12 Orthopedics	20mA; 12 seconds	Astonish; 4 iterations, 16 subsets, Hanning filter 1.3	44
13 Orthopedics	20mA; 12 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 2.0	45
14 Orthopedics	80mA; 24 seconds	Astonish; 3 iterations, 8 subsets, no filter	46
15 Orthopedics	80mA; 24 seconds	Astonish; 3 iterations, 8 subsets, no filter	47
16 Orthopedics	20mA; 12 seconds	Astonish; 3 iterations, 8 subsets, no filter	48
1 Infection	30mA; 12 seconds	Astonish; 3 iterations, 8 subsets, Hanning filter 2.0	50
2 Infection	80mA; 24 seconds	Astonish; 3 iterations, 8 subsets, no filter	51
3 Infection	80mA; 24 seconds	Astonish; 4 iterations, 8 subsets, no filter	52
4 Infection	80mA; 24 seconds	Astonish; 3 iterations, 8 subsets, Hanning filter 1.5	53
5 Infection	80mA; 24 seconds	Astonish; 2 iterations, 32 subsets, no filter	54
1 Other localization	20mA; 12 seconds	Astonish; 3 iterations, 8 subsets, no filter	56
2 Other localization	20mA; 12 seconds	Astonish; 3 iterations, 8 subsets, Hanning filter 2.0	57
3 Other localization	20mA; 12 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 1.0	58
4 Other localization	20mA; 12 seconds	Astonish; 4 iterations, 8 subsets, no filter	59
5 Other localization	30mA; 12 seconds	Astonish; 2 iterations, 16 subsets, Hanning filter 1.0	60
6 Other localization	Initial: 20mA; 12seconds; Follow-up: 30mA; 12 seconds	Initial & Follow-Up: Astonish; 2 iterations, 16 subsets, Hanning filter 1.5	61
7 Other localization	80mA; 24 seconds	Astonish; 2 iterations, 8 subsets, no filter	62
8 Other localization	20mA; 12 seconds	Astonish; 6 iterations, 16 subsets, no filter	63

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