WorldCare Clinical
A PreScan Imaging Company

The WCC Note™

Presented by Stephen J. Pomeranz, M.D.

www.wcclinical.com / +1 617-250-5143

A Weekly Guide to Harmonizing Clinical Trial Imaging

Volume 2, Number 1 – January 9, 2008

RADIOLOGY: OTHER MODALITIES

DEXA

Measuring Bone Mineral Density

Dual-energy x-ray absorbimetry, or **DEXA**, is the method most commonly used to measure bone mineral density to evaluate for osteoporosis. It is performed by aiming x-ray beams of two different energies at a bone, usually the spine, hip, or heel. The lower-energy x-rays are absorbed mostly by the soft tissues, while the higher-energy x-rays are absorbed by the soft tissue and bone. The soft-tissue portion can then be subtracted from the total to estimate the density of the bone. The amount of radiation from a DEXA scan is small, about 10% of the normal dose from a chest x-ray.

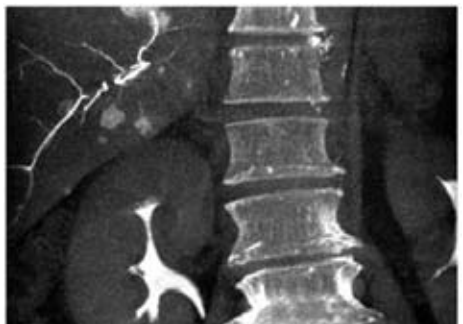
The scan on the left is bone mass; the scan on the right is soft tissue.The lines are used to separate the body regions.

The patient's bone density is then quantified, using a score that compares his or her bone mineral density to the mean, in terms of standard deviations. A negative score indicates a bone density lower than average; a positive score indicates higher than average. There are two ways to measure this score:

- **The "T-score"** compares the patient's bone density to the average for a 30-year-old person of the same sex and ethnicity. This has been proven to be a good predictor of fracture risk. A T-score of –1.0 or higher is considered normal, indicating a bone density one standard deviation below the mean or higher. A T-score of less than –2.5 indicates osteoporosis. Between –1.0 and –2.5 indicates osteopenia, a lesser form of bone loss.
- **The "Z-score"** compares the patient's bone density to the average for someone of the same age, sex, and ethnicity. This is most often used in children and younger adults.

FLUOROSCOPY

"Real-Time" X-Ray Radiography



Fluoroscopy uses the same principle as conventional x-ray radiography, with x-rays shot from a source through the patient to a plate on the other side that measures how many x-rays penetrate through the patient. However, fluoroscopy is a "real-time" version of a conventional x-ray. Conventional x-rays take less than one second, giving us a picture of the body part at a single moment in time. Fluoroscopy allows us

to see the x-rays as a movie, enabling the radiologist to see movement and changes in the body as they happen.

A rotational fluoroscopy image of a hepatic artery injection.

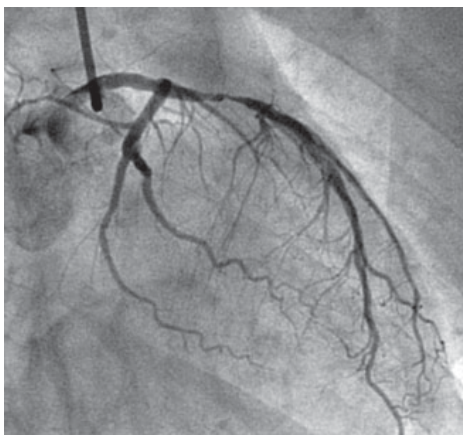
This is useful in several applications, including:

- **Gastrointenstinal/genitourinary imaging**
  - By administering a liquid that appears bright white on x-ray (barium or Gastrografin), the radiologist can see the liquid as it moves through the body. It can be administered:
    - By mouth, to see the esophagus, stomach, or small intestine
    - Into the rectum, to see the large intestine
    - Into the urethra, to see the urethra and bladder
    - Into the vagina, to see the uterus and fallopian tubes
- **Needle placement**
  - A radiologist can watch a needle as it goes into a patient's skin to ensure it is placed properly. Because x-ray is not good at discriminating soft tissues, fluoroscopy is mostly used to help place needles in bones or joints in two types of procedures:
    - Lumbar puncture (spinal tap)
    - Arthrogram (contrast placement within a joint in the arm or leg)
- **Orthopaedic procedures**
  - Orthopaedic surgeons use fluoroscopy to watch the bones as they re-align fractures or place metal in bones
- **Angiography**
  - (See below)

Because of the lower-energy x-rays used, fluoroscopy has poorer resolution than conventional x-ray. If the same x-rays were used for both conventional radiography and fluoroscopy, the radiation dose from fluoroscopy would be extremely high, as it continuously obtains images of the patient to allow for real-time imaging. Even with lower-energy x-rays, fluoroscopy delivers a significant radiation dose; a barium enema examination that takes a few minutes has a similar radiation dose to a CT of the abdomen and pelvis.

ANGIOGRAPHY

Studying blood flow



Coronary angiography studies blood flow.

Angiography is the imaging of blood vessels. Conventionally, this is performed by injecting contrast into a blood vessel through a needle, then watching it flow through the body using fluoroscopy. Although this delivers a significant radiation dose, it also creates real-time images of the blood vessels so the radiologist can see the direction of flow, speed of flow, and contour of the blood vessel with good resolution. Today, conventional angiography is being replaced by CT or MR angiography in many instances. These newer modalities are not only noninvasive, but their resolution and accuracy are continually improving with experience and technological advances.

Conventional angiography also allows the radiologist to place a catheter – a long, very thin tube – into a blood vessel (usually in the neck or leg) and thread it into the vein or artery, directing it to an organ of interest. Once the catheter is inside that organ, the radiologist can either inject contrast to see the organ and surrounding vessels, or use the

the radiologist can either inject contrast to see the organ and surrounding vessels, or use the catheter to administer treatment. Examples include:

- **Coronary angiography**
  - See the coronary blood vessels to look for heart disease
  - Place pacemakers
  - Place stents
  - Open up areas of blood-vessel narrowing that may cause heart attacks
- **Tumor angiography**
  - See the blood flow to a tumor
  - Place coils in a blood vessel to stop the blood flow to a tumor
    - Can be used for malignant tumors
    - Often used to decrease the size of uterine fibroids (uterine artery embolization)
  - Inject toxic materials (alcohol or chemotherapy drugs) into the blood vessel that feeds a tumor
- **Peripheral angiography**
  - See the blood vessels of the arms and legs
  - Open up areas of blood-vessel narrowing

Angiography showing a narrowed area in the carotid artery (arrow).

- **Brain angiography**
  - See the blood vessels of the brain to look for aneurysms or blockages
  - Place stents or other materials to block off aneurysms
  - Open up blocked blood vessels that could cause strokes
- **Bleeding**
  - Find a blood vessel that is leaking, then place coils or other materials in the blood vessel to stop the leaking. This method can be used in patients with:
    - Intestinal bleeding
    - Bleeding anywhere in the body after trauma
    - Bleeding aneurysms in the brain

NEXT ISSUE: WHAT IS ANGIOGENESIS?

WorldCare Clinical
A ProScan Imaging Company

THE WCC NOTE™: Volume 2, Number 1 – January 9, 2008
Contributing Editors: Resham R. Mendi, M.D. (newsletter@wcclinical.com) and Stephen J. Pomeranz, M.D. (newsletter@wcclinical.com)
Managing Editor: Rod Willis (newsletter@wcclinical.com)
Designer: Tom Anneken