

## Division of Nuclear Medicine Procedure / Protocol University Hospital and The American Center

Three Phase Bone Scan and Joint Scan  
UPDATED: March 2017

CPT CODE: 78315

### Indications:

#### Three Phase Bone:

This scan is requested for examination of blood flow to a specific region, and to determine whether there is a bone scan lesion with associated hyperperfusion. Typical examples include:

- Trauma (e.g. stress fractures and tendonitis)
- Infection (acute osteomyelitis or septic arthritis)
- Complex Regional Pain Syndrome, CRPS (formally known as Reflex Sympathetic Dystrophy, RSD)
- Benign primary tumor (e.g. osteoid osteoma, aneurismal bone cyst, giant cell tumor)
- Malignant primary tumor
- Cold injury (frostbite)
- Soft tissue tumors (to determine whether adjacent bone involved)
- Other skeletal lesions with expected associated flow abnormalities
- Heterotropic ossification
- Avascular necrosis

#### Joint Scan:

To establish multifocal inflammatory joint disease (to include but not limited to possible multisite septic arthritis, rheumatoid arthritis, acute synovitis, and other inflammatory joint diseases.

### Patient Prep:

No preparation prior to injection; however, patient should be instructed after injection to drink four 8-ounce glasses of liquid before returning for the scan and encouraged to empty their bladder frequently. Patient will be asked to empty their bladder before imaging. Patient should be encouraged to drink plenty of fluids for at least 24 hours after radiopharmaceutical administration to aide in the clearance.

Pediatric patients less than 18 years of age also:

- Schedule with AFCH Campground for IV placement prior to first appointment.
- A Foley catheter with collection bag should be in place at time of delayed scan (second appointment) for sedated and non-toilet trained children. \*\*Only necessary if pelvis is region of interest.\*\*

### Scheduling:

Allow 60 minutes for time of injection, flow and blood pool images and allow 60 minutes for delayed imaging. Delayed imaging should be scheduled at least 3-6 hours post injection.

Note: General anesthesia (pediatric or adult) and sedated (pediatric) cases delayed imaging (second appointment) should have the duration increased to 90 minutes.

### Radiopharmaceutical & Dose:

99mTc-MDP (99mTc-HDP can be substituted if requested)

Half Dose (standard, actual reduction is 40% lower than full dose)

- Pediatric (>40kg) and Adult
  - Prescribed dose 15.0 mCi +/- 20% and weight based per nomogram/NMIS
- Pediatric ≤ 40kg
  - Prescribed dose formula is 0.25 mCi/kg +/- 20%; a minimum of 1.0 mCi.
  - Children over 40kg see adult half dose above, 0.25 mCi/kg produces a higher dose than desired or needed when greater than 40 kg.

Full Dose Adult (when with dual isotope study)

- Prescribed dose is 25.0 mCi +/- 20% and weight based per nomogram/NMIS.

### Imaging Devices:

GE Infinia Hawkeye 1, 2, 3, GE Millennium VG or GE Optima 640 with LEHR collimators

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**Acquisition Parameters:**

**Blood Flow and Blood Pool**

Infinia Hawkeye 1, 2, and 3 & Optima	Three Phase Bone or Joint Scan Blood Flow	Three Phase Bone or Joint Scan Blood Pool Static	Joint Scan Blood Pool Whole Body
<b>Protocol Names</b> USER to Bone Folder to	Three phase bone		Whole Body Bone
<b>Key Parameters</b>			
Detector 1 Label	Flow View: R Ant L	Early View: R Ant L	Early WB: R Ant L
Detector 2 Label	Flow View: L Post R	Early View: L Post R	Early WB: L Post R
# Frames	24		
Frame Time (sec)	1.0		Scan speed: 15cm/min = 155 sec
Phase Time (sec)	180.0		
Stop on Time		300 seconds	
Stop on Counts		<leave blank>	
Mode	H		
Start Angle	0		
Patient Location	Feet First Supine		
Use Body Contour	No	No	Yes
Matrix	128x128	256x256	256 x1024
Zoom	1.0 (Adjust as needed)		1.0
Pan X	0.0		
Pan Y	0.0		
<b>Corrections</b>			
Energy Session	Tc99m		
Selected Collimator	LEHR		
Detector 1 & 2 - (%)	10.0		
Detector 1 & 2 Peak	140.0		
Detector 1 & 2 + (%)	10.0		
<b>Admin Parameters</b>			
Body Part	Chest		
Body Side	Other		
<b>Location Parameters</b>			
Default	Infinia 71.51 cm / Optima 90 cm		

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### Blood Flow and Blood Pool (continued)

Millennium VG	Three Phase Bone or Joint Scan Blood Flow Parameters	Three Phase Bone or Joint Scan Blood Pool Parameters (Static)	Joint Scan Blood Pool Parameters (Whole Body)
Protocol Names Acquisition Menu- Skeletal Menu	Bone Flow DYNA	Bone STAT	Half Dose Bone Scan or Bone Scan (full dose)
<b>Scan Tab</b>			
Label	Bone Flow	Bone	Whole Body Bone
Pharmaceutical	<leave blank>		
Dose	<leave blank>		
Isotope	TC99M		
Heads	√ Head 1 and 2		
<b>Head 1</b>			
Collimator	VP45		
View	Flow View: R Ant L	Early View: R Ant L	Early WB: R Ant L
<b>Head 2</b>			
Collimator	VP45		
View	Flow View: L Post R	Early View: L Post R	Early WB: L Post R
<b>Stop Conditions</b>			
Count		<leave blank>	
Time		300 seconds	
No. of Intervals	1		
Delay	0		
Time	180.0		
Frame Rate	1.0(do not adjust manually)		
Frame Time	1.0		
<b>Extended Tab</b>			
<b>Energy Window</b>			
Center / Low % / High %	140.0 / 10.0 / 10.0		
<b>Corrections</b>			
Energy	√		
Linearity	√		
Sensitivity	√		
<b>Home Position</b>			
None	√	None	None
Dropbox	<leave blank>		
<b>Rate</b>			
Normal	√		
Frame Size (drop box)	128	256	256 x 1024
<b>Mirror</b>			
No	√		
<b>Transform</b>			
Center X / Center Y	0.0 / 0.0		
Zoom	1.0 (Adjust if needed)		1.0
Rotation	0 (Adjust if needed)		0
<b>Patient Position (dropbox)</b>	Supine		

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<b><u>Personal Tab</u></b>			
Birthdate	Auto filled when patient is selected on the worklist. Manual entry when worklist is unavailable.		
Sex			
Accession Number			

### Delayed Imaging

See the acquisition parameters in the Limited/Multiple or Whole Body Bone Protocol.

### Imaging Procedure:

Three Phase Bone	Joint Scan
<ol style="list-style-type: none"> <li>1. A nuclear medicine technologist will verify the patient with 2 forms of identification (i.e. DOB, spelling the name, MR #). A brief description of the test will be explained to the patient.</li> <li>2. Patient will be instructed to remove all large metal objects from the area of interest. Position the area of interest, ensuring that the affected area and opposite extremity are in the field of view. <b>It is important to keep the collimator as close to the patient as possible.</b> Tape can be used to immobilize. Set up camera for flow study using a predefined computer acquisition protocol.</li> </ol>	
<p><b>Note:</b></p> <p>a) In the case of foot symptoms, the plantar aspect is usually preferred for the flow study unless otherwise indicated by a nuclear medicine physician. Distal tibia/fibula lesions should be flowed posteriorly. For hands, palmar view.</p> <p>b) If the area of interest is an upper extremity do not inject in the afflicted extremity. Inject in the contralateral side.</p>	<p>Perform a flow study of the most symptomatic or involved region, above and below symptomatic joint. If a most symptomatic joint is not identifiable consult with reading MD; flow may be not necessary.</p>
<ol style="list-style-type: none"> <li>3. Using proper technique, using a bolus injection technique do flow study by injecting the radiopharmaceutical followed by a 10 cc saline flush. Place a radioactive marker on the collimator next to the lateral aspect of the right extremity while the images are going.</li> <li>4. Immediately following the flow images, set up camera for blood pool images using a predefined computer acquisition protocol typically anterior and posterior views. Obtain <b>additional</b> lateral or tangential/orthogonal views of the lesion site or symptomatic joint including the opposite extremity. Place a radioactive marker on the collimator next to the lateral aspect of the right extremity.</li> </ol>	
	Joint Scan also includes a whole body blood pool scan.
Continued on the next page.	

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5. Process the images and show a nuclear medicine or resident physician prior to letting the patient leave, in case additional views are necessary.
  - The patient will be instructed to return to the Radiology department at his/her scheduled imaging time.
  - When patient returns, he/she will first be instructed to use the bathroom to empty the bladder.
  - The nuclear medicine technologist will verify 2 forms of identification with the patient.
  - Repeat same views as early images.
  - Special Views to be considered and validated with the reading MD if a history of the following exist (not limited to)
    - i. Cancer, whole body scan
    - ii. Cold injury (frostbite), 24-hr delay images

### Image Process/Display/PACS:

1. Compress the 1 sec/frame flow images (anterior vs. posterior) to **3 sec/frame**.
  - a. Load anterior and/or posterior images to New. **Image** → **Reframe** → Output 3
    - i. Should end up with 60 total images. Save image this image set.
  - b. Select the proper screen format and grid size in order to fit all the frames on one screen.
  - c. Adjust the intensities and zoom if needed. Annotate the images (include # of sec per frame)
  - d. **Screen capture DatabaseStudyB&W** this file. File, Exit.
    - i. Change screen capture name to **"View" Flow 3 sec/frame Screen Capture**
2. Select the 1 sec/frame flow images (anterior vs. posterior) of the **patient** and click on **Load to New**.
  - a. View the images and choose the frame numbers that show bolus flow to region of interest and include 5 to 10 frames after blood reaches region of interest. (Just looking for initial blood pool images).
  - b. Once the frame numbers are selected go to **Image** → **Copy** → Range (input selected frames i.e. 3-12). Save this image set.
  - c. Load reduced image set to New. Select the proper screen format and grid size in order to fit all the frames on one screen.
  - d. Adjust the intensities and zoom if needed. Annotate the images (include # of sec per frame)
  - e. **Screen capture DatabaseStudyB&W** this file. File, Exit.
    - i. Change screen capture name to **"View" Flow 1 sec/frame Screen Capture**
3. Select all static blood pool images and delay images and click on **WB & Spots Bone Review**. Make sure all labels are correct and that the intensities are appropriate.
  - a. **Screen capture DatabaseStudyB&W** this file. File, Save & Exit.
    - i. Change screen capture name to **Blood Pool and Delayed Statics Screen Capture**
4. Send all raw data (including reframed dynamics) and Screen Caps (except for **WB&Spots\_Results**) to **ALIArchive**.

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### **Interpretation:**

#### **Three Phase Bone:**

The use of the triple phase bone scan is to compare the perfusion and blood pool images with the delayed bone images.

- Acute osteomyelitis (OM) is the most common indication. An abnormal scan suggesting acute OM requires an intense focal abnormality on all 3 phases early arterial, venous, and delayed. The study is abnormal prior to the development of X-ray changes.
- In Complex Regional Pain Syndrome (formally known as reflex sympathetic dystrophy) the scan is very sensitive when the disease is early (before atrophic skin changes) and generally has increased flow and an unusual periarticular pattern of increased uptake. Some patients (~15%, especially children or lower limb involvement) have reduced flow and reduced limb bone uptake.
- Malignant bone tumors have increased flow (and blood pool), Benign lesions often have normal flow unless additional processes occur (e.g. fracture of simple cyst).

#### **Joint Scan:**

Abnormalities are shown by blood pool and static images - increased flow to synovia of affected joints in blood pool image and increased uptake to periarticular regions of affected joints.

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