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Data Article

# Bone scan images dataset for study of bone metastases in adult breast cancer patients at IICS-UNA, Paraguay

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ABSTRACT

This article presents 582 bone scan images from 291 adult patients who attended the Nuclear Medicine Service at the Instituto de Investigaciones en Ciencias de la Salud (IICS) of the Universidad Nacional de Asunción (UNA), Paraguay, between 2020 and 2024. The images were acquired using trimodal SPECT-CT-PET equipment, model AnyScan SCP, and the MEDISO brand. Approximately 20 mCi of technetium-99m methylene diphosphonate ($^{99m}$Tc-MDP) was administered to each patient, producing whole-body planar images in anterior and posterior projections of the axial and appendicular skeleton with a resolution of 256 × 1024 pixels. The images were labeled according to the final diagnosis by a nuclear physician, covering conditions ranging from joint lesions to bone metastases. This dataset will be helpful for researchers working on bone scan image analysis using artificial intelligence techniques to classify bone metastases.

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Specifications Table

| | |
|---|---|
| Subject | Nuclear Medicine |
| Specific subject area | Bone Scans |
| Data format | PNG (.png) bone scan images whose dimensions are 256 × 1024.<br>Annotations of the classifications in an EXCEL file (.xlsx). |
| Type of data | • Image<br>• Excel File |
| Data collection | The acquisition of bone scan studies was performed on a trimodal SPECT-CT-PET equipment, AnyScan SCP model from MEDISO brand, under the following protocol:<br>• **Bone scan studies:** The adult patient received an intravenous dose of approximately 20 mCi of technetium-99m methylene diphosphonate (99mTc-MDP). Image acquisition was performed with an energy window centered on the 140 keV photopeak of the spectrum, with a window width equal to 20 %. The bone scan images correspond to the anterior and posterior projections. The acquisition matrix is 256 × 1024 pixels. |
| Data source location | The bone scan images dataset for the study of bone metastases in adult breast cancer patients was acquired at the Nuclear Medicine Service of the Department of Biomedical Engineering and Imaging, *Instituto de Investigaciones en Ciencias de la Salud, Universidad Nacional de Asunción* (abbreviated as IICS-UNA), San Lorenzo 111421, Paraguay [1]. |
| Data accessibility | Repository name: Bone scan images dataset for study of bone metastases in adult breast cancer patients at IICS-UNA Paraguay.<br>Data identification number: 10.5281/zenodo.13900966<br>Direct URL to data: https://zenodo.org/records/13900966 |

## 1. Value of the Data

- This dataset is valuable for researching and training professionals in studying pathologies involving bone metastases.
- Nuclear physicians can significantly enhance their diagnostic abilities by incorporating the bone scan dataset into their professional training, thereby empowering them to confidently detect bone metastases and other skeletal abnormalities.
- This dataset is a valuable and scalable resource for digital image processing, as well as for the application and training of artificial intelligence models for bone metastases classification.

## 2. Background

Bone metastases are a frequent complication in advanced stages of breast cancer, significantly impacting the quality of life of patients due to complications such as pathological fractures, spinal cord compression, hypercalcemia, and chronic pain. Early detection of these lesions is crucial to optimize treatment and improve clinical outcomes [2].

Bone metastases may occur in various anatomical regions, including the cranium, upper limbs (scapulae, clavicle, humerus), spine, thorax (rib cage, sternum), and lower limbs (pelvis, sacrum, femur, tibia, and fibula) [3].

Using radiopharmaceuticals such as technetium-99m methylene diphosphonate ($^{99m}$Tc-MDP), bone scan has become a highly sensitive method to identify skeletal anomalies, although they have low specificity. Interpreting skeletal or joint abnormalities requires considering all available information, including the patient's clinical history, recent findings, physical examination, and results from other tests [4,5]. For several decades, bone scans have been used as the primary method for staging and assessing the response to treatment of bone metastases [6].

## 3. Data Description

$^{99m}$Tc-MDP is the radiopharmaceutical used for bone scan imaging in the Nuclear Medicine Service of IICS-UNA.

A bone scan in adults requires a single intravenous injection with an average dose of 500 MBq (300–740 MBq, 8–20 mCi). The administered dose is typically 8 to 10 MBq/kg for adults [5].

The normal distribution of radiolabeled bisphosphonates requires detailed knowledge to interpret the image correctly. The symmetry and homogeneity of tracer uptake should be a top priority. The examination commonly visualizes the renal system and urinary tract, as well as diffuse or focal tracer uptake in the soft tissues [5].

Evaluating increases and decreases in tracer uptake requires identifying abnormalities as either focal or diffuse. An objective assessment of focal or diffuse increased skeletal uptake compares it to the contralateral bone or soft tissue. Descriptions of abnormal findings detail the localization, size, shape, intensity, and number. Focally increased activity occurs more frequently than decreased uptake, which can sometimes be more challenging to identify [5].

Fig. 1 shows images displaying a homogeneous and symmetrical uptake across all bone structures of the skeleton examined. These images represent a normal bone scan pattern and indicate no bone metastases.

Fig. 2 shows images with an increased tracer concentration of high intensity in multiple cranial calottes, the spine in its entire extension, the pelvis with greater intensity in the right sacroiliac joint, both femurs, the proximal third of both humeri, and the manubrium of the sternum. This bone scan pattern indicates disseminated bone metastases and categorizes the findings accordingly.

The classification labels corresponding to the final diagnostic findings for each pair of images are shown at the bottom of Figs. 1 and 2.

The dataset is organized into two folders, each named according to the classification of the images: bone metastases and no bone metastases. Each of these is further subdivided into folders corresponding to the projections generated during the acquisition of the bone scan images, anterior and posterior.

This dataset contains records from 291 adult breast cancer patients between 2020 and 2024, each with images corresponding to anterior and posterior projections, totaling 582 images related to bone pathology diagnoses obtained through bone scans.

The file 'Bone Scan Images Dataset.xlsx' contains the relevant data and diagnoses for each pair of images. Fig. 3 shows the information available in the XLSX file with the following description for each column:

- The “Patient” column contains the anonymized and renamed patient image number.
- The “Image Anterior View” column specifies the anterior projection and patient number.
- The “Image Posterior View” column specifies the posterior projection and patient number.
- The “Format” column indicates the image format (PNG).
- The “Acquisition Date” column specifies the date the bone scan was acquired.
- The “Sex” column indicates the sex of the patient.
- The “Age” column specifies the patient’s age.
- The “Weight” column specifies the patient’s weight.
- The “Height” column specifies the patient’s height.
- The “Diagnosis Classification” column specifies the pathology diagnosed, which could be categorized as bone metastases or no bone metastases.

As shown in Table 1, there is a significant difference in the incidence of breast cancer between women and men, with women being much more affected. Regarding classification, it is notable that from 2020 to 2024, fewer final diagnoses were classified as bone metastases compared to the no bone metastases classification. The average age by classification and sex highlights that patients with bone metastases are younger compared to those without.

**Fig. 1.** Bone scan images of a breast cancer patient with no bone metastases. In the anterior (left) and posterior (right) views, a homogeneous distribution of the radiotracer is observed in the skeleton, with no areas of abnormal uptake that would indicate bone lesions or metastases [Own source].

**Table 1**
Number of patients by diagnosis, sex, number of patients (N), and average age (years).

| Diagnosis | Sex | Number of patients (N) | Average Age (years) |
|---|---|---|---|
| Bone metastases | Female | 60 | 53 |
| N = 60 (21 %) | Male | N/A | N/A |
| No bone metastases | Female | 229 | 55 |
| N = 231 (79 %) | Male | 2 | 59 |
| Total number of patients | | 291 | |

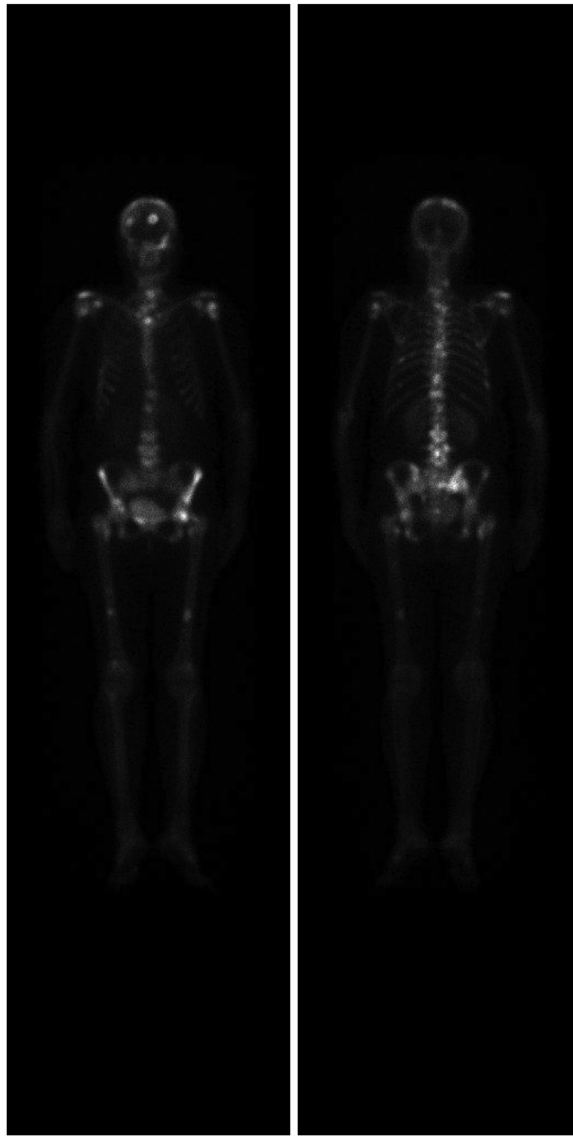

**Fig. 2.** Bone scan images of a breast cancer patient with bone metastases. In the anterior (left) and posterior (right) views, focal areas of increased uptake are identified in the skeleton, suggesting the presence of bone lesions compatible with metastasis [Own source].

Fig. 4 shows how the number of patients with bone metastases and those in the no bone metastases classification varied over the years, with a higher prevalence in the no bone metastases classification and a peak in such cases in 2023.

It is important to note that for 2024, data from only the first eight months were considered; therefore, Fig. 4 shows a decrease in the bar graphs for both classification groups.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PATIENT | IMAGE ANTERIOR VIEW | IMAGE POSTERIOR VIEW | FORMAT | ACQUISITION DATE | SEX | AGE | WEIGHT | HEIGHT | DIAGNOSIS CLASSIFICATION |
| 2 | 1 | A1 | P1 | .png | 2024-02-09 | Female | 53 | 107 | 175 | Bone metastases |
| 3 | 2 | A2 | P2 | .png | 2024-02-08 | Female | 60 | 57 | 160 | Bone metastases |
| 4 | 3 | A3 | P3 | .png | 2023-12-05 | Female | 69 | 98 | 158 | Bone metastases |
| 5 | 4 | A4 | P4 | .png | 2023-11-24 | Female | 46 | 122 | 164 | Bone metastases |
| 6 | 5 | A5 | P5 | .png | 2023-11-24 | Female | 33 | 70 | 164 | Bone metastases |
| 62 | 61 | A61 | P61 | .png | 2024-02-09 | Female | 63 | 102 | 182 | No bone metastases |
| 63 | 62 | A62 | P62 | .png | 2024-02-08 | Female | 52 | 80 | 170 | No bone metastases |
| 64 | 63 | A63 | P63 | .png | 2024-02-07 | Female | 55 | 61 | 150 | No bone metastases |
| 65 | 64 | A64 | P64 | .png | 2024-02-07 | Female | 52 | 85 | 161 | No bone metastases |
| 66 | 65 | A65 | P65 | .png | 2024-02-06 | Female | 39 | 62 | 159 | No bone metastases |

**Fig. 3.** The 'Bone Scan Images Dataset.xlsx' file contains information for each image pair, including patient number, views, image format, acquisition date, demographic details, and diagnostic classification.

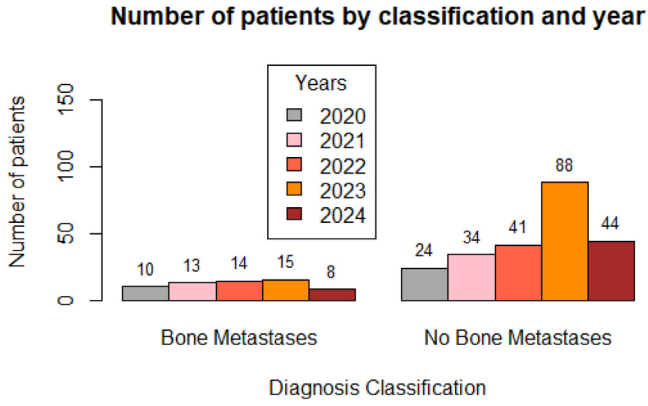


**Fig. 4.** The comparative graph shows the number of patients by classification and year the study was conducted. A higher prevalence is observed in the no bone metastases classification, peaking in 2023.

## 4. Experimental Design, Materials and Methods

This section explains the procedures used to acquire bone scan studies and the organization of the dataset acquired from the Nuclear Medicine Service at IICS-UNA.

a. **Protocol/image acquisition:**

**Instrumentation:** A dual-head gamma camera, the AnyScan SCP model from the MEDISO brand, was part of trimodal SPECT-CT-PET equipment.[1]

The protocol used for bone scan image acquisition is presented below in a general description.

- *Patient preparation:* Patients are interviewed, their data are recorded in a clinical file and informed consent is obtained. Metal objects are removed from the areas of the body to be scanned. The patient should be well hydrated and urinate frequently before, during and after the study.
- *Administration of the radiopharmaceutical:* An intravenous dose of $^{99m}$Tc-MDP, usually about 20 mCi, is administered.
- *Biodistribution of the radiopharmaceutical:* An uptake time after injection is expected for the radiopharmaceutical to be adequately distributed in the body. This time is variable, but there is usually a wait of between 2 to 4 hours for the study.
- **Image acquisition:**
  **Bone scans:**
  - *Patient positioning:* Passive supine decubitus with arms at the sides, and head and feet secured to prevent movement.
  - *Collimator:* LEHR (Low Energy High Resolution).
  - *Energy window:* ±20 % centered at 140 keV.
  - *Image matrix:* 256 × 1024 pixels.
  - *Image representation:* 16-bit grayscale.

- *Image processing:* MEDISO InterView XP software is used to process whole-body images.
- *Medical interpretation:* A nuclear physician examines images to locate normal or abnormal bone pathologies, such as tumors, fractures, diseases, or other abnormalities.

[1] Mediso Medical Imaging Systems, **AnyScan® Family - AnyScan®**, Mediso. Available at: https://mediso.com/global/en/product/anyscanr-family/anyscanr

- *Final report:* The nuclear physician interprets the bone scan images and generates a detailed report containing findings, diagnoses, and recommendations.

b. **Data Organization and Storage:**

- *Folder Structure:* Bone scan images are classified and grouped into individual folders according to classification labels and the image pairs' projection type.
- *Labeling and Recording:* Each pair of images is classified according to the diagnosed pathologies and recorded according to the order in the Excel file.

## Ethics Statement

This manuscript, entitled "Bone Scan Images Dataset for Study of Bone Metastases in Adult Breast Cancer Patients at IICS-UNA Paraguay," was approved by the Research Ethics Committee of the IICS-UNA on September 3, 2024, with code No. M05/2024. Patients signed informed consent for the service. Their personal data remain anonymous, and their pathological states are treated with confidentiality. The head of the Department of Biomedical Engineering and Imaging authorized the use of data from the Nuclear Medicine service.

## Credit Author Statement

**Carolina Elizabeth Villegas Colmán:** Conceptualization, Investigation, Resources, Data curation, Writing - original draft, Visualization.; **Julio César Mello Román:** Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization; **José Luis Vázquez Noguera:** Validation, Writing - review & editing; **Horacio Legal Ayala:** Validation, Writing - review & editing.; **Pastor Pérez Estigarribia:** Validation, Writing - review & editing.; **Benicio Grossling Vallejos:** Investigation, Data curation, Visualization.; **Ronald Rivas:** Investigation, Data curation, Visualization.; **María Gloria Pedrozo:** Investigation, Data curation, Visualization.; **Cynthia Duarte:** Investigation, Data curation, Visualization.; **Graciela Giménez:** Investigation, Data curation, Visualization.; **Andrés Uldera:** Investigation, Data curation, Visualization.; **Marina Arnal:** Visualization, Diagnosis.; **Nicole Barreto:** Visualization, Diagnosis.; **Teresa Rojas:** Investigation, Data curation, Visualization.;

## Data Availability

Bone Scan Images Dataset for Study of Bone Metastases in Adult Breast Cancer Patients at IICS-UNA Paraguay (Original data) (Zenodo).

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## Declaration of Competing Interest

The authors declare that they have no economic interests or personal relationships that could have influenced the work presented in this article.

## Supplementary Materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2024.111191.

## References

[1] C.E. Villegas-Colmán, et al., Bone scan images dataset for study of bone metastases in adult breast cancer patients at IICS-UNA Paraguay, Zenodo (2024), doi:10.5281/zenodo.13900966.
[2] F. Macedo, et al., Bone metastases: an overview, Oncol. Rev. 11 (1) (2017) 43–49, doi:10.4081/oncol.2017.321.
[3] J.C. Santos, et al., Bone metastases detection in patients with breast cancer: does bone scintigraphy add information to PET/CT? Oncologist 28 (8) (2023) e600–e605, doi:10.1093/oncolo/oyad087.
[4] Y. S, L. J., L. F., K. C., L. C., and L. C., Comparing whole body $^{18}$F-2-deoxyglucose positron emission tomography and technetium-99m methylene diphosphonate bone scan to detect bone metastases in patients with breast cancer, J. Cancer Res. Clin. Oncol. 128 (6) (2002) 325–328, doi:10.1007/s00432-002-0342-5.
[5] W. Van den, et al., The EANM practice guidelines for bone scintigraphy, Eur. J. Nucl. Med. Mol. Imaging 43 (9) (2016) 1723–1738, doi:10.1007/s00259-016-3415-4.
[6] G.J.R. Cook, G.K. Azad, V. Goh, Imaging bone metastases in breast cancer: staging and response assessment, J. Nucl. Med. 57 (Supplement 1) (2016) 27S–33S, doi:10.2967/jnumed.115.157867.