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5-2022

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Recommended Citation

Lambertino, Meredith, "CT-Guided Bone Biopsy" (2022). *Student Research Poster Presentations 2022*. 32.
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CT-Guided Bone Biopsy

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What are Bone Biopsies?

A bone biopsy is a minimally invasive procedure in which the radiologist takes a small sample of cells from the bone to be analyzed for diagnosis and plan for future treatments. These biopsies are commonly done to determine if the patient has cancer. The biopsies are most commonly done in the patient's iliac crest since it is associated with few complications (Teerapuncharoen, 2021).

What is CT?

Computed tomography (CT) is a radiology imaging modality in which an x-ray tube rotates around the patient's body part being scanned to create cross-sectional images for diagnosis. (Wright and Johnson, 2019). Patients are frequently given contrast media, intravenously, orally, or rectally, to assist the radiologist with diagnosing any abnormal pathology and it provides better visualization of the patient's vascular system.



(<https://www.sciencelearn.org.nz/images/1120-ct-scanner>)
A typical CT scanner

What is IR?

Interventional radiology (IR) uses minimally invasive procedures to diagnose, evaluate, or treat benign tumors, cancers, fractures, or pain. (Furlong, 2019). Common IR procedures include biopsies, drainages, and ablations. These procedures can either be done for diagnostic or therapeutic benefits for the patient. Using IR for patient care provides for a faster recovery, a less painful procedure, little if any hospital stay, and another option for patients who may not be candidates for surgery. IR cases can include the use of other modalities such as sonography, magnetic resonance imaging (MRI), or computed tomography (CT) (Furlong, 2019).

Equipment Needed

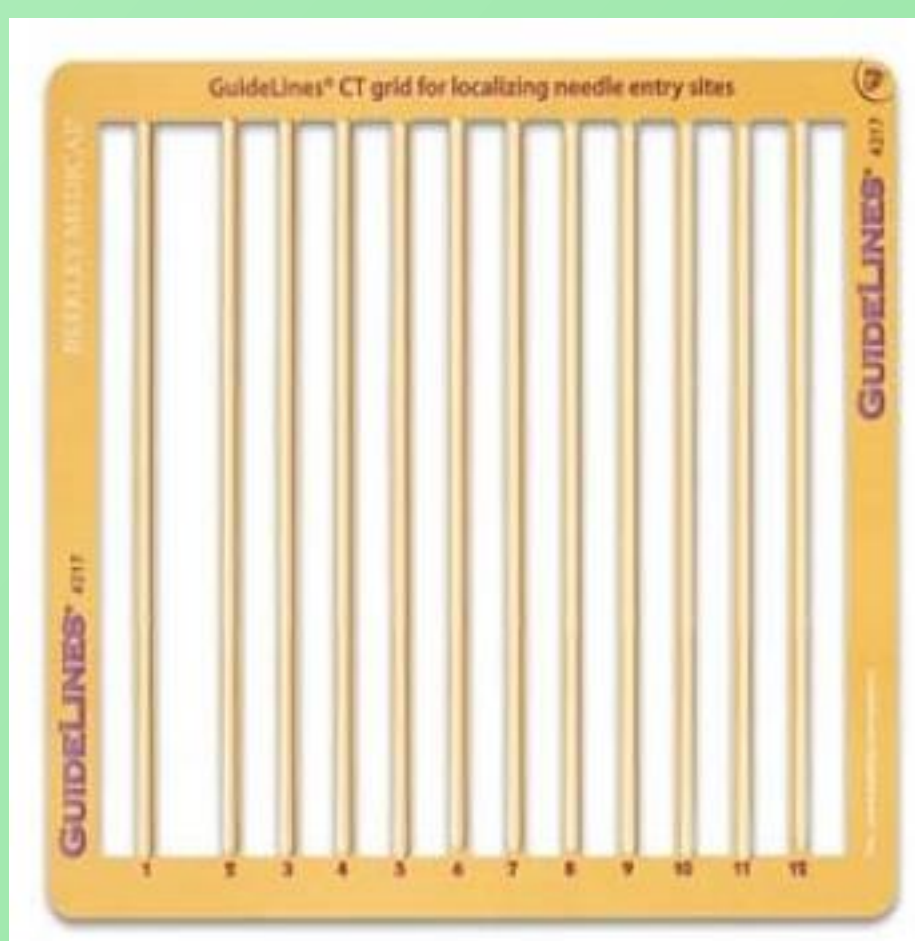
For a patient to be able to have a CT-guided bone biopsy, the technologists must have already gathered and assembled the necessary equipment.

The gantry is a circular device that houses the x-ray tube, digital acquisition system, and detector. It can be tilted forward or backward to match a patient's anatomy of interest (Wright and Johnson, 2019).

The table is connected to both the gantry and the computer. It moves in accordance with the assigned scan protocol. Typically, tables are made of carbon fiber to prevent artifacts. Additional accessories can be added to the table for optimal imaging of specific anatomy (Wright and Johnson, 2019).

The operator console is how the technologist controls the scanner. Typically, there is a keyboard and monitor. This allows the technologist to enter patient data, select a protocol, and set up scanning windows (Wright and Johnson, 2019).

For bone biopsies, sterile drapes must be placed on the patient. All equipment such as needles and guidewires must be sterile. A technologist will lay a CT Localization Grid on the skin over the anatomy of interest. This grid is used to determine where the needle will enter the skin at the location of the biopsy. Physicians and technologists working on the case must be wearing sterile gloves (Munk, 2016). A needle receptacle should be on hand to prevent the need for recapping a needle. A 25-gauge needle is needed to administer lidocaine to the patient at the start of the biopsy. The biopsy tract is planned using either a 20 or 22-gauge needle (Munk, 2016). The bone sample is collected using the Jamshedi needle. The end of this needle has sharp teeth meant for cutting through bone (Munk, 2016).



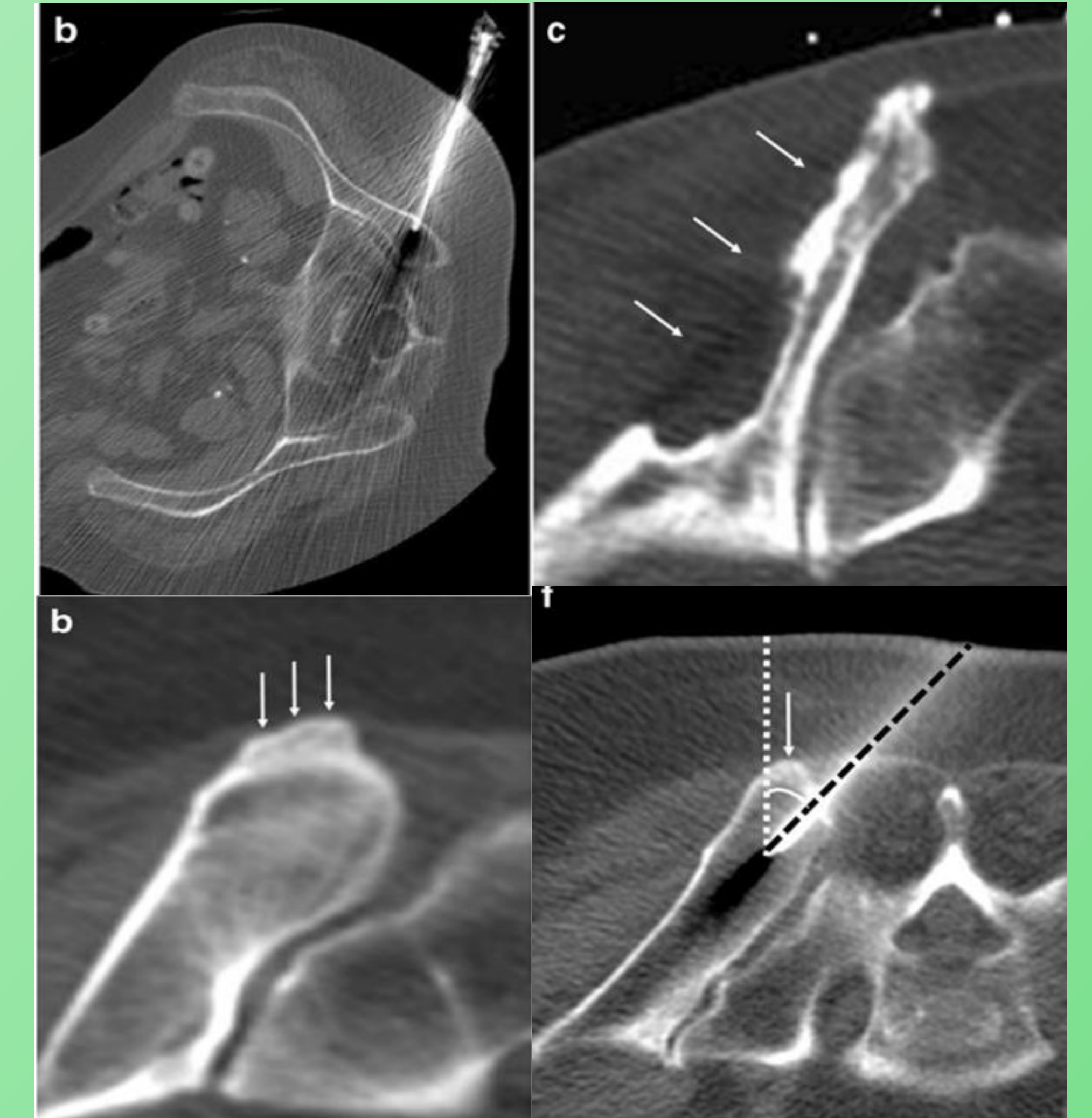
Top left image is the Jamshedi needle used to collect the bone sample.

The top right image is a typical bone biopsy tray.

Image on the left is the CT guide used to determine location of the biopsy.

Case Study: Blind Procedures vs. CT Guided

In a study by Chang et. al., CT-guided biopsies were compared against blind bone biopsies. Blind bone biopsies are typically performed in a doctor's office without any imaging guidance. The study looked to compare which method provided the best samples to get the most accurate pathology reports to better diagnose the patients (Chang et al, 2020). Ninety-eight patients had a blind procedure, and their results were compared against ninety-eight patients who had a CT-guided bone biopsy. All patients were matched against each other based on age and gender. For the blind procedures, the target spot was the posterior iliac crest. The study found that age and gender do not play a role in the diagnostic results of biopsies done with or without CT guidance (Chang et al, 2020). The type of needle used during the procedure did not play a role in getting an adequate sample to be analyzed for diagnosis.



(Chang et. Al, 2020)
CT images from bone biopsies of the iliac crest.

Disadvantages of Blind Bone Biopsies

According to the Chang et. al. study, blind procedures have a chance of providing a poor sample of tissue to be reviewed for diagnosis. Out of the ninety-eight patients, nine cases came back as inadequate. Blind procedures are unable to account for any anatomical differences between patients. This could present a challenge for the biopsy. A patient with significant soft tissue makes it difficult for the doctor performing the biopsy to palpate for bony anatomy as well as they are unable to visualize the amount of soft tissue (Chang et al, 2020). Physicians are limited in their approaches during a blind biopsy. These biopsies are typically done with the patient prone on the table.

Advantages of CT-Guided Biopsies

This study found that the CT-guided biopsies provided the pathologists with better samples to analyze. None of the biopsies from this group led to inadequate samples because the imaging was able to confirm the exact placement of the needle (Chang et al, 2020). Imaging is extremely beneficial when a patient has abnormal anatomy which occurred eighty percent of the time in this study. CT images are also ideal for patients with a higher body mass index. The images allow the radiologists to see how much soft tissue is present before reaching the bone. CT imaging allows the radiologist greater flexibility when choosing an approach for the biopsy (Chang et al, 2020).

Risks vs. Benefits

Benefits	Risks
Brief recovery	Risk of infection occurs less than one in one thousand
Less invasive than surgery	Needle can break the bone
Accurate diagnostic, results about 90 to 93% of the time	Tumor seeding along biopsy tract, occurs only 5 to 10% of the time
Only local anesthesia is used	Bleeding and hematoma

Conclusion

Bone biopsies are an essential, minimally invasive, interventional radiology procedure that helps to diagnose and plan treatment for cancer in the bone. These biopsies are frequently performed under CT guidance because having real-time imaging greatly decreases the chance of complications during or after the procedure. Statistically, studies have found that bone biopsies are done with CT-guidance lead to better diagnosis outcomes for the patients. The CT imaging allows for the needle to be inserted in precisely the correct spot. Biopsies that are done without CT guidance risk cell samples being too small for an accurate diagnosis. Bone biopsies are best performed with CT guidance for both the patient and the interventional radiologist.