



# Breast Imaging

Medical imaging technologies can show changes to the breast such as cancer and pre-cancerous growths, as well as non-cancerous growths.

## **Breast imaging is more than just mammography.**

Many people are familiar with the most common technique for breast imaging: mammography, which is an X-ray of the breast.

But even a mammogram doesn't show everything, so other imaging technologies are also used. The most common ones are ultrasound and magnetic resonance imaging (MRI), but there are others, such as PET and CT.

## **Sometimes you can feel it, but sometimes you can't.**

Most experts recommend that women do regular breast self-examinations (BSE). But BSE is not a substitute for regular mammograms, which can show changes to the breast that patients and doctors can't see with the naked eye or feel by hand.

- [~0.75 cm sphere] Average size of lump found in breast during routine mammograms.
- [~1.5 cm sphere] Average size of lump found in breast by women who regularly do breast self-exams.
- [~ 3.75 cm sphere] Average size of lump found in breast by women who are not doing regular breast self-exams.

## **You try it.**

Touch these models to search for lumps. Press the button to find out where the lumps are.

## **Need a hint?**

Some models have more than one lump. One model has no lumps.



# Mammography: Breast X-ray

## Why would you have a mammogram?

- As part of an annual physical exam, if you are a woman age 40 or older or you are at high risk for breast cancer. (This is called a *screening mammogram*.)
- If an abnormality is detected in your screening mammogram. (This is called a *diagnostic mammogram*.)
- If you have symptoms such as a lump, pain, thickening, nipple discharge, or a change in breast size or shape. (This is also a *diagnostic mammogram*.)

## How does mammography work?

The technologist positions the patient's breast on a film cassette and then compresses the breast with a paddle. The x-ray source is briefly turned on.

- Some types of tissue, such as fat, absorb few X-rays, allowing more X-rays to reach the film. This shows up as a bright area on the negative, and therefore as a dark area on the final image.
- Other types of tissue, such as some tumors, absorb more X-rays, so fewer X-rays reach the film. This shows up as a dark area on the negative, and as a light area on the final image.

During a typical screening mammogram, two images of each breast are taken, one from the top and one from the side. The procedure usually takes 10 to 15 minutes.

Mammograms are considered the "gold standard" in breast cancer detection. But they are not perfect: they don't show everything, and they are not easy to interpret.

See for yourself, in the activity below.

## What is being done to improve mammography?

### *Digital mammography*

In digital mammography, the x-rays that pass through the breast strike electronic detectors--similar to those in digital cameras--rather than film. Researchers are investigating whether digital mammography is any better than convention (film) mammography at detecting cancer.

[caption:] Conventional (above) and digital (below) mammograms of the same patient.

### *Computer-aided detection (CAD)*

After the radiologist has viewed the mammograms, CAD software marks possible areas of concern, prompting the radiologist to re-examine these areas. While this *decreases* the number of false negatives, it *increases* the number of false positives.

[caption:] The CAD program used on these images marks suspicious areas with circles and crosses.

### **You try it.**

Do you see anything suspicious on these mammograms? Lift the flap to find out how a radiologist interpreted them.

[flip label #1]

Patient A's mammogram

Nothing on this mammogram looked suspicious enough for the radiologist to order more additional tests, but it was discovered later that there was a cancerous tumor in the circled area.

This type of error is called a *false negative*.

[flip label #2]

Patient B's mammogram

The radiologist thought the circled area looked suspicious. The patient was called back for additional testing, which found no cancer.

This type of error is called a *false positive*.



# Image-Guided Procedures

## Why would you have an image-guided procedure?

- You might have an *image-guided needle biopsy* to take a tissue sample from an area that looked suspicious on your mammogram or other breast image.
- You might have an *image-guided wire localization* prior to breast surgery, to mark the target area for the surgeon.

## How does an image-guided procedure work?

Image-guided procedures can be done using mammography, ultrasound, or MRI. This adds up to a large number and wide variety of procedures. Two examples are described here.

### *Ultrasound-Guided Needle Biopsy*

If the tissue to be biopsied can be seen using ultrasound, then doctors will probably use ultrasound for any image-guided procedures. Ultrasound does not expose the patient to X-rays like mammography does, and it is less expensive than mammography or MRI.

[image 1] Typically, the patient lies on her back. The ultrasound transducer is placed against the breast. Looking at the image displayed on a monitor, the doctor inserts the needle into the area to be biopsied.

[image 2] By moving the ultrasound transducer to look at the needle from different angles, the doctor can check that the tip of the needle is in the right location. A sample of tissue is then collected through the needle.

### *Mammographic Wire Localization*

Unlike ultrasound images, mammographic images can not be viewed in real time. So to be sure the right place is being targeted, two images are taken, each from a slightly different angle.

[image 4a] An image of the breast is taken with the breast in a compression grid, so the radiologist can identify the coordinates where a needle will be placed.

[image 4b] After placement of the needle, two images are take: one from above to confirm that the needle is over the right place, and one from the side to see if the needle has been inserted to the correct depth.

[image 4c] A wire with a hook at the end is inserted through the needle, and the needle is removed. Another image is taken, to confirm that the hooked end of the wire is in the right place.

Typically, the wire is taped to the patient's chest to keep it from moving, and the patient goes to the operating room.

[image 4d] After the surgery, the radiologist takes an image of the tissue that was removed. If not all of the tumor has been removed, the radiologist informs the surgeon so that additional tissue can be taken.