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# Bone Cancer Early Detection, Diagnosis, and Staging

Learn about the signs and symptoms of bone cancer. Find out how bone cancer is tested for, diagnosed, and staged.

## Detection and Diagnosis

Finding cancer early -- while it's small and before it has spread -- often allows for more treatment options. Some early cancers may have signs and symptoms that can be noticed, but that's not always the case.

- [Can Bone Cancer Be Found Early?](#)
- [Signs and Symptoms of Bone Cancer](#)
- [Tests for Bone Cancer](#)

## Stages and Outlook (Prognosis)

After a cancer diagnosis, staging provides important information about the extent of cancer in the body and anticipated response to treatment.

- [Bone Cancer Stages](#)
- [Survival Rates for Bone Cancer](#)

## Questions to Ask About Bone Cancer

Here are some questions you can ask your cancer care team to help you better understand your cancer diagnosis and treatment options.

- [Questions to Ask About Bone Cancer](#)

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## Can Bone Cancer Be Found Early?

There are no widely recommended screening tests for bone cancer, but many bone cancers can be found early because of the signs or symptoms they cause.

- [For people at average risk](#)
- [For people at higher risk](#)

*The information here focuses on primary bone cancers (cancers that start in bones) that most often are seen in adults. Information on [Osteosarcoma](#)<sup>1</sup>, [Ewing Tumors](#)<sup>2</sup> (Ewing sarcomas), and [Bone Metastasis](#)<sup>3</sup> is covered separately.*

3. [www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html](http://www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html)
4. [www.cancer.org/cancer/types/bone-cancer/causes-risks-prevention/risk-factors.html](http://www.cancer.org/cancer/types/bone-cancer/causes-risks-prevention/risk-factors.html)

## References

Anderson ME, Dubois SG, Gebhart MC. Chapter 89: Sarcomas of bone. In: Niederhuber JE, Armitage JO, Doroshow JH, Kastan MB, Tepper JE, eds. *Abeloff's Clinical Oncology*. 6th ed. Philadelphia, Pa: Elsevier; 2020.

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# Signs and Symptoms of Bone Cancer

There are different [types of primary bone cancer](#)<sup>1</sup>. Signs and symptoms depend mainly on the type, location, and extent of the cancer.

- [Pain](#)
- [Lump or swelling](#)
- [Fractures](#)
- [Other symptoms](#)

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## Pain

Pain in the area of the tumor is the most common sign of bone cancer. At first, the pain might not be there all the time. It may get worse at night or when the bone is used, such as when walking for a tumor in a leg bone. Over time, the pain can become more constant, and it might get worse with activity.

Sometimes a tumor can weaken a bone to the point where it breaks (fractures), which can cause a sudden onset of intense pain (see Fractures below).

## Lump or swelling

Some bone tumors cause a lump or swelling in the area, although this might not happen until sometime after the area becomes painful.

Cancers in the bones of the neck can sometimes cause a lump in the back of the throat that can lead to trouble swallowing or breathing.

## Fractures

Bone cancer can weaken the bone, but most often the bones do not fracture (break). People with a fracture next to or through a bone tumor usually describe sudden severe pain in a bone that had been sore for a few months.

## Other symptoms

Cancer in the bones of the spine can press on the nerves coming out of the spinal cord. This can cause numbness and tingling or even weakness in different parts of the body, depending on where the tumor is.

Bone cancer, like many other types of cancer, can sometimes cause weight loss and fatigue.

If the cancer spreads to other organs, it can also cause other symptoms. For instance, if the cancer spreads to the lungs, it might result in a cough or trouble breathing.

**Bone cancer isn't common, and the symptoms it can cause are more likely to be due to other conditions, such as injuries or arthritis. Still, if you have symptoms that go on for a long time or get worse, it's important to see a doctor so the cause can be found and treated, if needed.**

## Hyperlinks

1. [www.cancer.org/cancer/types/bone-cancer/about/what-is-bone-cancer.html](http://www.cancer.org/cancer/types/bone-cancer/about/what-is-bone-cancer.html)

2. [www.cancer.org/cancer/types/osteosarcoma.html](http://www.cancer.org/cancer/types/osteosarcoma.html)
3. [www.cancer.org/cancer/types/ewing-tumor.html](http://www.cancer.org/cancer/types/ewing-tumor.html)
4. [www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html](http://www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html)

## References

Anderson ME, Dubois SG, Gebhart MC. Chapter 89: Sarcomas of bone. In: Niederhuber JE, Armitage JO, Doroshow JH, Kastan MB, Tepper JE, eds. *Abeloff's Clinical Oncology*. 6th ed. Philadelphia, Pa: Elsevier; 2020.

Hornicek FJ, McCarville B, Agaram N. Bone tumors: Diagnosis and biopsy techniques. UpToDate. 2020. Accessed at <https://www.uptodate.com/contents/bone-tumors-diagnosis-and-biopsy-techniques> on August 28, 2020.

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# Tests for Bone Cancer

Primary bone cancers are usually found when [signs or symptoms](#) a person is having prompt them to visit a doctor.

- [Medical history and physical exam](#)
- [Imaging tests](#)
- [Biopsy](#)
- [Lab tests](#)

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Symptoms and the results of physical exams and imaging tests might suggest that a person has bone cancer. But in most cases, doctors need to confirm this by taking and testing a tissue or cell sample (a procedure known as a [biopsy](#)<sup>4</sup>).

It's important for doctors to distinguish primary bone cancers from cancers that have spread to the bones from other parts of the body ([bone metastasis](#)<sup>5</sup>), as well as from

People who have or might have bone cancer will have one or more of these tests. For more information on these tests, see [Imaging \(Radiology\) Tests for Cancer](#)<sup>6</sup>.

## X-rays

An [x-ray](#)<sup>7</sup> **of the bone** is often the first test done if some type of bone tumor is suspected. Tumors might look “ragged” instead of solid on an x-ray, or they might look like a hole in the bone. Sometimes doctors can see a tumor that might extend into nearby tissues (such as muscle or fat).

Doctors might strongly suspect an abnormal area is a bone cancer by the way it appears on an x-ray, but usually a biopsy (described below) is needed to tell for sure.

Adults with bone tumors might have a **chest x-ray** done to see if the cancer has spread to the lungs. But this test isn't needed if a chest CT scan (discussed below) has been done.

## Magnetic resonance imaging (MRI)

[MRI scans](#)<sup>8</sup> create detailed images of the inside of the body using radio waves and strong magnets instead of x-rays, so no radiation is involved. A contrast material called **gadolinium** is often injected into a vein before the scan to better see details.

An MRI is often done to get a more detailed look at an abnormal area of bone seen on an x-ray. MRIs can usually show if it's likely to be a tumor, an infection, or some type of bone damage from another cause.

MRIs can help determine the exact extent of a tumor, as they can show the marrow inside bones and the soft tissues around the tumor, including nearby blood vessels and nerves. MRIs can also show any small bone tumors several inches away from the main tumor (called **skip metastases**). Knowing the extent of tumor is very important when planning surgery.

## Computed tomography (CT) scan

A [CT scan](#)<sup>9</sup> combines many x-ray pictures to make detailed cross-sectional images of parts of the body.

CT scans aren't usually as helpful as MRIs in showing the detail in and around bone tumors. But they are often done to look for possible cancer spread in other parts of the body, such as the lungs, liver, or other organs.

CT scans can also be used to guide a biopsy needle into a tumor (a **CT-guided needle biopsy**). For this test, you stay on the CT scanning table while the doctor moves a biopsy needle toward the tumor. CT scans are repeated until the tip of the needle is within the mass. (See Needle biopsy below.)



a [biopsy](#)<sup>12</sup> (removing some of the abnormal area and checking it under a microscope and with other lab testing) is usually the only way to be certain.

**If the tumor is most likely a primary bone cancer, it's very important that the biopsy is done by doctors experienced in treating bone tumors.** Whenever possible, the biopsy and surgical treatment should be planned together, and the same doctor should do both. Proper planning of the biopsy can help prevent later complications and might reduce the amount of surgery needed later on.

Sometimes the wrong kind of biopsy can make it hard for the surgeon to later remove all of the cancer, which might then require more extensive surgery. It might also increase the risk of the cancer spreading.

The type of biopsy done is based on whether the tumor looks benign (not cancer) or malignant (cancer) and exactly what type of tumor it most likely is (based on imaging tests, the patient's age, and where the tumor is). Some kinds of bone tumors can be diagnosed from needle biopsy samples, but larger samples (from a surgical biopsy) are often needed to diagnose other types. Plans to remove the entire tumor during the biopsy will also impact the type of biopsy done.

## Needle biopsy

For these biopsies, the doctor uses a hollow needle to remove a small cylinder of tissue from the tumor. The biopsy is usually done with local anesthesia, where numbing medicine is injected into the skin and other tissues over the biopsy site. In some cases, the patient might need sedation or general anesthesia (where the patient is asleep).

Often, the doctor can aim the needle by feeling the suspicious area if it's near the surface of the body. If the tumor can't be felt because it's too deep, the doctor can guide the needle into the tumor using an imaging test such as an ultrasound or CT scan. These types of image-guided biopsies are usually done by a doctor who is an **interventional radiologist**.

There are 2 types of needle biopsies:

- A **core needle biopsy** uses a large needle to remove a cylinder of tissue. This is the most common type of needle biopsy used for bone tumors.
- A **fine needle aspiration (FNA)** biopsy uses a very thin needle on the end of a syringe to suck out a small amount of fluid and some cells from the tumor. This type of biopsy is less likely to be helpful for bone tumors, as the smaller needle might not be able to get through the bone. And even if it can be done, it might not remove



**phosphatase** and **lactate dehydrogenase (LDH)** can suggest that the cancer may be more advanced.

Other tests such as **blood cell counts** and **blood chemistry tests** are done before surgery and other treatments to get a sense of a person's overall health. These tests can also be used to monitor the person's health while they are getting treatments such as chemotherapy.

## Hyperlinks

1. [www.cancer.org/cancer/types/osteosarcoma.html](http://www.cancer.org/cancer/types/osteosarcoma.html)
  2. [www.cancer.org/cancer/types/ewing-tumor.html](http://www.cancer.org/cancer/types/ewing-tumor.html)
  3. [www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html](http://www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html)
  4. [www.cancer.org/cancer/diagnosis-staging/tests/biopsy-and-cytology-tests.html](http://www.cancer.org/cancer/diagnosis-staging/tests/biopsy-and-cytology-tests.html)
  5. [www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html](http://www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html)
  6. [www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/imaging-radiology-tests-for-cancer.html](http://www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/imaging-radiology-tests-for-cancer.html)  
[www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/x-rays-and-other-](http://www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/x-rays-and-other-)
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National Comprehensive Cancer Network (NCCN). Practice Guidelines in Oncology: Bone Cancer. Version 1.2020. Accessed at [www.nccn.org/professionals/physician\\_gls/pdf/bone.pdf](http://www.nccn.org/professionals/physician_gls/pdf/bone.pdf) on July 28, 2020.

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## Bone Cancer Stages

After someone is diagnosed with bone cancer, doctors will try to figure out if it has spread, and if so, how far. This process is called **staging**. The stage of a cancer describes how much cancer is in the body. It helps determine how serious the cancer is

either low grade (G1) or high grade (G2). Low-grade cancer cells look more like normal cells and are less likely to grow and spread quickly, while high-grade cancer cells look more abnormal.

- The **extent of the primary tumor (T)**, which is classified as either **intracompartmental (T1)**, meaning it has basically remained within the bone, or **extracompartmental (T2)**, meaning it has grown beyond the bone into other nearby structures.
- If the tumor has **metastasized (M)**, which means it has spread to other areas, either to nearby lymph nodes (bean-sized collections of immune system cells) or other organs. Tumors that have not spread to the lymph nodes or other organs are considered M0, while those that have spread are M1.

These factors are combined to give an overall stage, using Roman numerals from I to III. Stages I and II are divided into A for intracompartmental tumors or B for extracompartmental tumors.

Stage	Grade	Tumor	Metastasis
IA	G1	T1	M0
IB	G1	T2	M0
IIA	G2	T1	M0
IIB	G2	T2	M0
III	G1 or G2	T1 or T2	M1

In summary:

- Low-grade, localized tumors are stage I.
- High-grade, localized tumors are stage II.
- Metastatic tumors (regardless of grade) are stage III.

## AJCC TNM staging system

The other staging system sometimes used for bone cancer is the American Joint Committee on Cancer (AJCC) **TNM** system. This system is based on 4 key pieces of information:

- The extent (size) of the main (primary) **tumor (T)**: How large is the tumor and/or has it reached nearby bones? Is it in more than one spot in the bone?
- The spread to nearby lymph **nodes (N)**: Has the cancer spread to nearby lymph nodes?
- The spread (**metastasis**) to distant sites (**M**): Has the cancer spread to distant parts of the body, such as the lungs, other bones, or the liver?
- The **grade** of the cancer (**G**): How abnormal do the cells look under a microscope?

Numbers or letters after T, N, M, and G provide more details about each of these factors. Higher numbers generally mean the cancer has more concerning features.

For example, the scale used for grading bone cancer in this system ranges from 1 to 3. Low-grade cancers (G1) tend to grow and spread more slowly than high-grade (G2 or G3) cancers.

- Grade 1 (G1) means the cancer looks much like normal bone tissue.
- Grade 2 (G2) means the cancer looks more abnormal.
- Grade 3 (G3) means the cancer looks very abnormal.

Once a person's T, N, M, and G categories have been determined, this information is combined in a process called **stage grouping** to assign an overall stage. These stages (which are different from those of the MSTS system) are described by Roman numerals from I to IV. Tshat04)M, and areso(meimiesdiovided urothes.)Tj 0 g ET BT 1 0 0 1 72 30.23 Tm /F2 12

Sometimes, the clinical and pathological stages can be different (for example, if surgery finds that the cancer has spread farther than could be seen on imaging tests). The table below describes the pathological stage of the cancer.

<b>AJCC stage</b>	<b>Stage grouping</b>	<b>Stage description*</b> <b>(8 centimeters = about 3 inches)</b>
<b>IA</b>	<b>T1</b> <b>N0</b> <b>M0</b> <b>G1 or GX</b>	The main tumor is no more than 8 centimeters across (T1). The cancer has not spread to nearby lymph nodes (N0) or to distant parts of the body (M0). The cancer is low grade (G1), or the grade cannot be determined (GX).
	<b>T2</b> <b>N0</b> <b>M0</b> <b>G1 or GX</b>	The main tumor is more than 8 centimeters across (T2). The cancer has not spread to nearby lymph nodes (N0) or to distant parts of the body (M0). The cancer is low grade (G1), or the grade cannot be determined (GX).
<b>IB</b>	OR	
	<b>T3</b> <b>N0</b> <b>M0</b> <b>G1 or GX</b>	There is more than one tumor in the same bone (T3). The cancer has not spread to nearby lymph nodes (N0) or to distant parts of the body (M0). The cancer is low grade (G1), or the grade cannot be determined (GX).
<b>IIA</b>	<b>T1</b> <b>N0</b> <b>M0</b> <b>G2 or G3</b>	The main tumor is no more than 8 centimeters across (T1). The cancer has not spread to nearby lymph nodes (N0) or to distant parts of the body (M0). The cancer is high grade (G2 or G3).
<b>IIB</b>	<b>T2</b> <b>N0</b>	The main tumor is more than 8 centimeters across (T2). The cancer has not spread to nearby lymph nodes (N0) or to distant parts of the body (M0). The cancer is high grade (G2 or G3).

	<p><b>M0</b></p> <p><b>G2 or G3</b></p>	
<p><b>III</b></p>	<p><b>T3</b></p> <p><b>N0</b></p> <p><b>M0</b></p> <p><b>G2 or G3</b></p>	<p>There is more than one tumor in the same bone (T3). The cancer MOMO</p>





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**Keep in mind that survival rates are estimates and are often based on previous outcomes of large numbers of people who had a specific cancer, but they can't predict what will happen in any particular person's case. These statistics can be confusing and might raise more questions for you. Ask your doctor how these numbers might apply to you.**

## What is a 5-year relative survival rate?

A **relative survival rate** compares people with the same type (and often stage) of cancer to people in the overall population. For example, if the **5-year relative survival rate** for a specific type and stage of bone cancer is 80%, it means that people who have that cancer are, on average, about 80% as likely as people who don't have that cancer to live for at least 5 years after being diagnosed.

## Where do these numbers come from?

The American Cancer Society relies on information from the Surveillance, Epidemiology, and End Results (SEER) database, maintained by the National Cancer Institute (NCI), to provide survival statistics for different types of cancer.

The SEER database tracks 5-year relative survival rates for different types of bone cancer in the United States, based on how far the cancer has spread. The SEER database, however, does not group cancers by [MSTS or TNM stages](#) (stage 1, stage 2, stage 3, etc.). Instead, it groups cancers into localized, regional, and distant stages:

- **Localized:** There is no sign that the cancer has spread outside of the bone where it started.
- **Regional:** The cancer has grown outside the bone and into nearby bones or other structures, or it has reached nearby lymph nodes.
- **Distant:** The cancer has spread to distant parts of the body, such as to the lungs or to bones in other parts of the body.

## 5-year relative survival rates for certain bone cancers

These numbers are based on people diagnosed with certain types of bone cancer between 2012 and 2018. For rates for some of the other more common types of bone cancer, see [Survival Rates for Osteosarcoma](#)<sup>4</sup> or [Survival Rates for Ewing Tumors](#)<sup>5</sup>.

### Chondrosarcoma

SEER* stage	5-year relative survival rate
Localized	91%
Regional	76%
Distant	17%
All SEER stages combined	79%

### Chordoma

SEER stage	5-year relative survival rate
Localized	87%
Regional	84%
Distant	69%
All SEER stages combined	84%

### Giant cell tumor of bone

SEER stage	5-year relative survival rate
Localized	90%
Regional	77%
Distant	36%
All SEER stages combined	78%

\*SEER=Surveillance, Epidemiology, and End Results

If you have a type of bone cancer not listed here and you'd like to know more about your prognosis (outlook), talk to your health care team to learn more.

## Understanding the numbers

- **These numbers apply only to the stage of the cancer when it is first diagnosed.** They do not apply later on if the cancer grows, spreads, or comes back after treatment.
- **These numbers don't take everything into account.** Survival rates are grouped based on the type of bone cancer and how far the cancer has spread. But other factors, such as your age and overall health, which bone the cancer started in, and how well the cancer responds to treatment, can also affect your outlook.
- **People now being diagnosed with bone cancer may have a better outlook than these numbers show.** Treatments improve over time, and these numbers are based on people who were diagnosed and treated at least 5 years earlier.

## Hyperlinks

1. [www.cancer.org/cancer/types/osteosarcoma.html](http://www.cancer.org/cancer/types/osteosarcoma.html)
2. [www.cancer.org/cancer/types/ewing-tumor.html](http://www.cancer.org/cancer/types/ewing-tumor.html)
3. [www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html](http://www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html)
4. [www.cancer.org/cancer/types/osteosarcoma/detection-diagnosis-staging/survival-rates.html](http://www.cancer.org/cancer/types/osteosarcoma/detection-diagnosis-staging/survival-rates.html)
5. [www.cancer.org/cancer/types/ewing-tumor/detection-diagnosis-staging/survival-rates.html](http://www.cancer.org/cancer/types/ewing-tumor/detection-diagnosis-staging/survival-rates.html)

## References

SEER\*Explorer: An interactive website for SEER cancer statistics [Internet]. Surveillance Research Program, National Cancer Institute. Accessed at <https://seer.cancer.gov/explorer/> on February 23, 2023.

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# Questions to Ask About Bone Cancer

It's important to have honest, open discussions with your health care team. Ask any question, no matter how small it might seem. For instance, consider these questions:

- [Before getting a bone biopsy](#)
- [If bone cancer has been diagnosed](#)
- [When deciding on a treatment plan](#)
- [During and after treatment](#)

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## If bone cancer has been diagnosed

### Before getting a bone biopsy

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- What do you recommend and why?
- (For tumors on an arm or leg) Which is the better surgical option: limb-sparing surgery or amputation? Why?
- Are there any [clinical trials](#)<sup>6</sup> we should consider? How can I find out more about them?
- What's the goal of treatment?  
Should I get a [second opinion](#)<sup>7</sup>



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