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Osteosarcoma Early Detection, Diagnosis, and Staging

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

Detection and Diagnosis

Catching cancer early often allows for more treatment options. Some cancers may cause signs and symptoms early in the course of the disease, but that's not always the case.

Can Osteosarcoma Be Found Early?

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.

Gorlick R, Janeway K, Marina N. Chapter 34: Osteosarcoma. In: Pizzo PA, Poplack DG, eds. *Principles and Practice of Pediatric Oncology*. 7th ed. Philadelphia Pa: Lippincott Williams & Wilkins; 2016.

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Signs and Symptoms of Osteosarcoma

- [Bone pain and swelling](#)
- [Bone fractures \(breaks\)](#)

Osteosarcomas are usually found because of the symptoms they are causing.

Bone pain and swelling

Pain at the site of the tumor in the bone is the most common symptom of osteosarcoma. The most common sites for these tumors in younger people are around the knee or in the upper arm, but they can occur in other bones as well. At first, the pain might not be constant and might be worse at night. The pain often increases with activity and might result in a limp if the tumor is in a leg bone.

Swelling in the area is another common symptom, although it might not occur until later. Depending on where the tumor is, it might be possible to feel a lump or mass.

Limb pain and swelling are very common in normal, active children and teens. They are much more likely to be caused by normal bumps and bruises, so they might not prompt a doctor visit right away. This can delay a diagnosis. If your child has these symptoms and they don't go away within a few weeks (or they get worse), see a doctor so that the cause can be found and treated, if needed.

These symptoms are less common in adults, so they should be a sign to see a doctor even sooner.

Bone fractures (breaks)

Although osteosarcoma might weaken the bone it develops in, fractures (breaks) are not common. Exceptions are rare telangiectatic osteosarcomas, which tend to weaken bones more than other forms of osteosarcoma and are more likely to cause breaks where the tumor is.

People with a fracture next to or through an osteosarcoma often describe a limb that was sore for a few months and suddenly became very painful when the fracture occurred.

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.

Gorlick R, Janeway K, Marina N. Chapter 34: Osteosarcoma. In: Pizzo PA, Poplack DG, eds. *Principles and Practice of Pediatric Oncology*. 7th ed. Philadelphia Pa: Lippincott Williams & Wilkins; 2016.

Wang LL, Gebhardt MC, Rainusso N. Osteosarcoma: Epidemiology, pathogenesis, clinical presentation, diagnosis, and histology. UpToDate. Accessed at www.uptodate.com/contents/osteosarcoma-epidemiology-pathogenesis-clinical-presentation-diagnosis-and-histology on July 27, 2020.

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Tests for Osteosarcoma

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

Osteosarcomas are usually found because a person is having [signs or symptoms](#), which prompt a visit to a doctor. If a bone tumor is suspected, exams and tests will be needed to find out for sure.

If an osteosarcoma is found, other tests will then be done to learn more about it.

Medical history and physical exam

If a person has signs or symptoms that suggest they might have a tumor in or around a bone, the doctor will take a complete **medical history** to find out more about the symptoms.

A **physical exam** can often provide information about a possible tumor. For example, the doctor may be able to see or feel an abnormal lump or mass.

The doctor may also look for problems in other parts of the body. When people (especially adults) have cancer in the bones, it's often the result of cancer that started somewhere else and then [spread to the bones](#)¹.

If the doctor suspects a person could have osteosarcoma (or another type of bone tumor), more tests will be done. These might include imaging tests, biopsies, and/or lab tests.

Imaging tests

Imaging tests use x-rays, magnetic fields, or radioactive substances to create pictures of the inside of the body. Imaging tests might be done for a number of reasons, including:

- To help find out if a suspicious area might be cancer
- To help determine if a cancer might have started in another part of the body
- To learn how far cancer has spread
- To help determine if treatment is working
- To look for signs that the cancer might have come back

People who have or might have osteosarcoma will have one or more of these tests.

Bone x-ray

This is often the first test done if a bone tumor is suspected. Doctors can often recognize a bone tumor such as an osteosarcoma based on plain [x-rays](#)² of the bone. But other imaging tests might be needed as well.

Even if results of an x-ray strongly suggest a person has osteosarcoma, a biopsy (described below) will still be needed to confirm that it is cancer rather than some other problem, such as an infection.

Magnetic resonance imaging (MRI) scan

[MRIs](#)³ create detailed images of soft tissues in 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 a bone mass seen on an x-ray. MRIs can usually show if the mass is likely to be a tumor, an infection, or some type of bone damage from another cause.

MRIs can also 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 small bone tumors several inches away from the main tumor (called **skip metastases**). Knowing the extent of an osteosarcoma is very important when planning [surgery](#)⁴.

An MRI scan usually shows better details than a CT scan (described below).

Computed tomography (CT) scan

A [CT scan](#)⁵ combines many x-ray pictures to make detailed cross-sectional images of parts of the body. If a bone x-ray shows a tumor, CT scans are sometimes used to see if the tumor has grown into nearby muscle, fat, or tendons, although MRI is often better for this.

A CT scan of the chest is often done to look for spread of the cancer to the lungs. CT scans may also be done to look for the spread of the cancer to other parts of the body.

Chest x-ray

This test is sometimes done to see if an osteosarcoma has [spread to the lungs](#)⁶. It can find larger tumors, but it is not as good as a CT scan for spotting smaller tumors. If a CT scan of the chest is done, a chest x-ray probably won't be needed.

Bone scan

A [bone scan](#)⁷ can help show if a cancer has spread to other bones, and is often part of the workup for people with osteosarcoma. This test is useful because it can show the entire skeleton at once. (A positron emission tomography [PET] scan, described below, can often provide similar information, so a bone scan might not be needed if a PET scan is done.)

For this test, a small amount of low-level radioactive material is injected into the blood and travels to the bones. A special camera that can detect the radioactivity then creates a picture of the skeleton.

Areas of active bone changes attract the radioactivity and appear as “hot spots” on the skeleton. Hot spots may suggest areas of cancer, but other bone diseases can also cause the same pattern. To make an accurate diagnosis, other tests such as plain x-rays, MRI scans, or even a bone biopsy might be needed.

Positron emission tomography (PET) scan

For a [PET scan](#)⁸, a form of radioactive sugar (known as **FDG**) is injected into the blood. Because cancer cells in the body are growing quickly, they absorb large amounts of the sugar. A special camera can then create a picture of areas of radioactivity in the body. The picture is not detailed like a CT or MRI scan, but it provides useful information about the whole body.

PET scans can help show the spread of osteosarcomas to the lungs, other bones, or other parts of the body. They can also be used to see how well the cancer is responding to treatment.

Many machines can do a PET and CT scan at the same time (PET/CT scan). This lets the doctor compare areas of higher radioactivity on the PET scan with the more detailed appearance of that area on the CT scan.

To learn more about this and other imaging tests, see [Imaging \(Radiology\) Tests](#)⁹.

Biopsy

The results of imaging tests might strongly suggest that a person has osteosarcoma (or some other type of bone cancer), but a biopsy (removing some of the tumor for viewing under a microscope and other lab testing) is the only way to be certain.

If the tumor is in a bone, it is 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 doctors should do both. Proper planning of the biopsy can help prevent later complications and might reduce the amount of surgery needed later on.

Two main types of biopsies can be used for bone tumors.

Core 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, sedation or general anesthesia (where the patient is asleep) may be needed.

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 a CT scan. This **CT-guided needle biopsy** is typically done by a doctor who is an **interventional radiologist**.

Surgical (open) biopsy

In an open biopsy, a doctor (typically an **orthopedic surgeon**) cuts through the skin, exposes the tumor, and then cuts out a piece of it. These biopsies are usually done in an operating room with the patient under general anesthesia (in a deep sleep). They can also be done using a nerve block, which numbs a large area of the body.

Again, it's important that the biopsy is done by an expert in bone tumors, or it could result in problems later on. For example, if the tumor is on the arm or leg and the biopsy isn't done properly, it might lower the chances of saving the limb. If possible, the incision for the biopsy should be lengthwise along the arm or leg because this is the way the incision will be made during the operation to remove the cancer. The entire scar of the original biopsy will also have to be removed, so making the biopsy incision this way
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tests) to be looked at with a microscope. Tests looking for chromosome or gene changes in the tumor cells might also be done. These tests can help tell osteosarcoma from other cancers that look like it under the microscope, and they can sometimes help predict whether the osteosarcoma is likely to respond to treatment.

If osteosarcoma is diagnosed, the pathologist will assign it a **grade**, which is a measure of how quickly the cancer is likely to grow and spread, based on how the tumor cells look. Cancers that look somewhat like normal bone tissue are described as low grade (and tend to grow more slowly), while those that look very abnormal are called high grade. For more on grading, see [Osteosarcoma Stages](#).

Blood tests

Blood tests are not needed to diagnose osteosarcoma, but they may be helpful once a diagnosis is made. For example, high levels of chemicals in the blood such as **alkaline phosphatase** and **lactate dehydrogenase (LDH)** can suggest that the osteosarcoma 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 are also used to monitor a person's health while they are getting chemotherapy.

Finding out that you or a loved one has cancer can be overwhelming. [Coping with Cancer](#)¹⁰ discusses the emotions and concerns you might face and things you can do to help work through them.

Hyperlinks

1. www.cancer.org/cancer/managing-cancer/advanced-cancer/bone-metastases.html
2. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/x-rays-and-other-radiographic-tests.html
3. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/mri-for-cancer.html
4. www.cancer.org/cancer/types/osteosarcoma/treating/surgery.html
5. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/ct-scan-for-cancer.html
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7. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/nuclear-medicine-

- [scans-for-cancer.html](#)
8. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/nuclear-medicine-scans-for-cancer.html
 9. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/imaging-radiology-tests-for-cancer.html
 10. www.cancer.org/cancer/survivorship/coping.html

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- 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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Osteosarcoma Stages

- Localized versus metastatic
- Musculoskeletal Tumor Society (MSTS) staging system
- The TNM staging system

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

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.

The TNM staging system

Another system sometimes used to stage bone cancers (including osteosarcomas) is the American Joint Commission on Cancer (AJCC) TNM system. This system is based on 4 key pieces of information:

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Hyperlinks

1. www.cancer.org/cancer/types/osteosarcoma/treating.html
2. www.cancer.org/cancer/types/osteosarcoma/treating/chemotherapy.html
3. www.cancer.org/cancer/types/osteosarcoma/treating/surgery.html
4. www.cancer.org/cancer/managing-cancer/advanced-cancer.html
5. www.cancer.org/cancer/types/bone-cancer/detection-diagnosis-staging/staging.html

References

American Joint Committee on Cancer. Bone. In: *AJCC Cancer Staging Manual*. 8th ed. New York, NY: Springer; 2017: 471-486.

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Survival Rates for Osteosarcoma

started.

- **Regional:** The cancer has spread outside the bone and into nearby 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 osteosarcoma

These numbers are based on people diagnosed with osteosarcoma between 2012 and 2018.

SEER* stage	5-year relative survival rate
Localized	76%
Regional	64%
Distant	24%
All SEER stages combined	59%

*SEER = Surveillance, Epidemiology, and End Results

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 how far the cancer has spread. But other factors, such as those listed below, can also affect a person's outlook.

factors that have been linked with a better prognosis include:

- Being younger (child or teen, as opposed to an adult)
- Being female
- The tumor being on an arm or leg (as opposed to the hip or other bones)
- The tumor(s) being completely **resectable** (removable with surgery)
- Normal blood **alkaline phosphatase and LDH** levels
- The tumor responding well to **chemotherapy**¹

Hyperlinks

1. www.cancer.org/cancer/types/osteosarcoma/treating/chemotherapy.html

References

Gorlick R, Janeway K, Marina N. Chapter 34: Osteosarcoma. In: Pizzo PA, Poplack DG, eds. *Principles and Practice of Pediatric Oncology*. 7th ed. Philadelphia Pa: Lippincott Williams & Wilkins; 2016.

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Questions to Ask About Osteosarcoma

- Before getting a bone biopsy
- If osteosarcoma has been diagnosed
When deciding on a treatment plan

- Should we get a [second opinion](#)⁴? How do we do that? Can you recommend a doctor or cancer center?
- How soon do we need to start treatment?
- What should I (we) do to be ready for treatment?
- How long will treatment last? What will it be like? Where will it be done?
- How will treatment affect our daily lives?
- What are the possible risks and side effects of the suggested treatments?
- Which side effects start shortly after treatment and which ones might develop later on?
- Will treatment affect my child's ability to grow and develop?
- Are there fertility issues we need to consider?

During and after treatment

Once treatment begins, you'll need to know what to expect and what to look for. Not all of these questions may apply to you, but getting answers to the ones that do may be helpful.

- How will we know if the treatment is working?
- Is there anything we can do to help manage side effects?
- What symptoms or side effects should we tell you about right away?
- How can we reach you or someone on your team on nights, weekends, or holidays?
- Who can we talk to if we have questions about costs, insurance coverage, or social support?
- What are the chances of the cancer [coming back](#)⁵ after treatment? What will we do if this happens?
- What type of [follow up](#)⁶ and rehab will be needed after treatment?
- Do you know of any local or online support groups where we can talk to other families who have been through this?

Along with these sample questions, be sure to write down some of your own. For instance, you might want more information about recovery times so you can plan work or school schedules.

Keep in mind that doctors aren't the only ones who can give you information. Other health care professionals, such as nurses and social workers, can answer some of your

questions. To learn more about speaking with your health care team, see [The Doctor-Patient Relationship](#)⁷.

Hyperlinks

1. www.cancer.org/cancer/types/osteosarcoma/about/what-is-osteosarcoma.html