



Osteosarcoma Early Detection, Diagnosis, and Staging

Detection and Diagnosis

Catching cancer early often allows for more treatment options. Some early cancers may have signs and symptoms that can be noticed, but that is not always the case.

- [Can Osteosarcoma Be Found Early?](#)
- [Signs and Symptoms of Osteosarcoma](#)
- [How Is Osteosarcoma Diagnosed?](#)

Stages of Osteosarcoma

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

- [How Is Osteosarcoma Staged?](#)

Outlook (Prognosis)

Doctors often use survival rates as a standard way of discussing someone's outlook (prognosis). Some people want to know about survival statistics, while others might not find the numbers helpful, or might even not want to know them.

- [What Are the Survival Rates for Osteosarcoma?](#)

Questions to Ask About Osteosarcoma

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

- [What Should You Ask the Doctor About Osteosarcoma?](#)

Can Osteosarcoma Be Found Early?

At this time, there are no widely recommended screening tests for this cancer. (Screening is testing for cancer in people without any symptoms.)

Still, most osteosarcomas are found at an early stage, before they have clearly spread to other parts of the body. Symptoms such as bone pain or swelling often prompt a visit to a doctor. (For more on this, see the section [Signs and Symptoms of Osteosarcoma](#).)

People with certain bone diseases or in families known to carry inherited conditions that raise the risk of this cancer (listed in [What Are the Risk Factors for Osteosarcoma?](#)) should talk with their doctors about the possible need for increased monitoring for this disease. This type of cancer usually does not run in families, but looking out for the early signs of cancer is important if it is to be treated successfully.

- [References](#)

[See all references for Osteosarcoma](#)

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Signs and Symptoms of Osteosarcoma

Osteosarcomas are usually found because of the symptoms they cause.

Pain and swelling

Pain in the affected bone (usually around the knee or in the upper arm) is the most common symptom of osteosarcoma. At first, the pain might not be constant and may be worse at night. The pain often increases with activity and may result in a limp if the tumor is in a leg bone.

Swelling in the area is another common symptom, although it may not occur until

several weeks after the pain starts. Depending on where the tumor is, it may be possible to feel a lump or mass.

Limb pain and/or 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 do not 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, the bones often do not break. Telangiectatic osteosarcomas, which are rare, tend to weaken bones more than other forms of osteosarcoma and are more likely to cause a fracture at the tumor site.

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](#)

[See all references for Osteosarcoma](#)

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How Is Osteosarcoma Diagnosed?

Osteosarcomas are usually found when a person goes to the doctor because of [signs or symptoms](#) they are having. If a bone tumor is suspected, tests will be needed to find out for sure.

Medical history and physical exam

If a person has signs or symptoms that suggest a tumor in or around a bone, the doctor will want to take a complete medical history to find out more about the symptoms. A physical exam can provide information about a possible tumor, as well as other health problems. For example, the doctor may be able to see or feel an abnormal mass.

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

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 may 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 may 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 may have come back

Patients who have or may have osteosarcoma will have one or more of these tests.

Bone x-ray

This is often the first test done if a doctor suspects a bone tumor. Doctors can often recognize a bone tumor such as osteosarcoma based on plain x-rays 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 will still be needed to confirm that it is cancer rather than some other problem, such as an infection.

Magnetic resonance imaging (MRI) scan

MRI scans provide detailed images of soft tissues in the body. These scans make detailed images using radio waves and strong magnets instead of x-rays, so no

radiation is involved. A contrast material called *gadolinium* may be injected into a vein before the scan to better see details.

Often, an MRI scan is done to get a more detailed look at a bone mass seen on an x-ray. MRI scans can usually show if the mass is likely to be a tumor, an infection, or some type of bone damage from other causes. MRI scans can also help show the exact extent of a tumor, as they provide a detailed view of the marrow inside bones and the soft tissues around the tumor. Sometimes, the MRI can help find 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](#). An MRI scan usually gives better details than a CT scan (described below).

An MRI scan can take up to an hour. You (or your child) may have to lie on a table that slides inside a narrow tube, which is confining and can be distressing. Newer, more open MRI machines can help with these feelings, but the test still requires staying still for long periods of time. The machines also make buzzing and clicking noises that may be disturbing. Sometimes, younger children are given medicine to help keep them calm or even asleep during the test.

Computed tomography (CT) scan

The CT scan uses x-rays 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.

Instead of taking one picture, like a regular x-ray, a CT scanner takes many pictures as it rotates around a person lying on a table. A computer then combines these pictures into detailed images of slices of the part of the body being studied.

Before the test, you (or your child) may be asked to drink a contrast solution and/or get an intravenous (IV) injection of a contrast dye that helps better outline abnormal areas in the body. If the contrast dye is to be injected, you (or your child) may need an IV line. The contrast may cause some flushing (a feeling of warmth, especially in the face). Some people are allergic and get hives. Rarely, more serious reactions like trouble breathing or low blood pressure can occur. Be sure to tell the doctor if you (or your child) have any allergies or have ever had a reaction to any contrast material used for x-rays.

A CT scanner has been described as a large donut, with a narrow table in the middle

opening. During the test, the table slides in and out of the scanner. You (or your child) will need to lie still on the table while the scan is being done. CT scans take longer than regular x-rays, and you might feel a bit confined by the ring while the pictures are being taken. In some cases, children may need to be sedated before the test to stay still and help make sure the pictures come out well.

Chest x-ray

This test is sometimes done to see if cancer has spread to the lungs. 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 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 a vein (intravenously, or IV). (The amount of radioactivity used is very low and will pass out of the body within a day or so.) The substance settles in areas of damaged bone throughout the entire skeleton over the course of a couple of hours. You (or your child) then lie on a table for about 30 minutes while a special camera detects the radioactivity and creates a picture of the skeleton. Younger children may be given medicine to help keep them calm or even asleep during the test.

Areas of active bone changes appear as “hot spots” on the skeleton because they attract the radioactivity. 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, a form of radioactive sugar (known as *FDG*) is injected into the blood. The amount of radioactivity used is very low and will pass out of the body within a day or so. Because cancer cells in the body are growing quickly, they absorb large amounts of the sugar. After about an hour, you (or your child) will lie on a table in the PET scanner for about 30 minutes while a special camera creates 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, and can also help in following the response to treatment.

Some newer 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 our document [Imaging \(Radiology\) Tests](#).

Biopsy

The results of imaging tests might strongly suggest that a person has some 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. A biopsy is also the best way to tell osteosarcoma from other types of bone cancer.

If the tumor is in a bone, it is very important that a surgeon experienced in treating bone tumors does the biopsy. Whenever possible, the biopsy and surgical treatment should be planned together, and the same orthopedic surgeon should do both the biopsy and the surgery. Proper planning of the biopsy can help prevent later complications and might reduce the amount of surgery needed later on.

There are 2 main types of biopsies.

Needle biopsy

For these biopsies, the doctor uses a hollow needle to remove a small sample of 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 is near the surface of the body. If the tumor can't be felt because it is too deep, the doctor can guide the needle into the tumor while viewing a CT scan. This is called a *CT guided needle biopsy*.

Core needle biopsy: In a core needle biopsy, the doctor uses a large, hollow needle to

remove a small cylinder of tissue from the tumor.

Fine needle aspiration (FNA) biopsy: For an FNA biopsy, the doctor uses a very thin needle attached to a syringe to withdraw (aspirate) a small amount of fluid and some cells from the tumor. This type of biopsy is rarely used for bone tumors.

Surgical (open) biopsy

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

This type of biopsy must be 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, it's possible the chance for saving the limb may be lost. If possible, the incision in the skin used in 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 lessens the amount of tissue that needs to be removed later on.

Lab tests

Testing the biopsy samples

All samples removed by biopsy are sent to a pathologist (a doctor specializing in lab tests) to be looked at under a microscope. Tests looking for chromosome or gene changes in the tumor cells may 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 therapy.

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 it looks under a microscope. Cancers that look somewhat like normal bone tissue are described as low grade, while those that look very abnormal are called high grade. For more on grading, see the section [How Is Osteosarcoma Staged?](#)

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 than it appears.

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.

- [References](#)

[See all references for Osteosarcoma](#)

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How Is Osteosarcoma Staged?

The stage of a cancer is a standard summary of how far a cancer has spread. The [treatment](#) and prognosis (outlook) for osteosarcoma depend, to a large extent, on the stage of the cancer when it is first diagnosed.

The stage of an osteosarcoma is based on the results of physical exams, imaging tests, and any biopsies that have been done, which were described in the section [How Is Osteosarcoma Diagnosed?](#)

A staging system is a standard way for the cancer care team to sum up the extent of the cancer. When trying to figure out the best course of treatment, doctors often use a simple system that divides osteosarcomas into 2 groups – localized and metastatic. Doctors can also use more formal staging systems, described below, to describe the extent of an osteosarcoma in more detail.

Staging can be confusing. If you have any questions about the stage of the cancer, ask your (child's) doctor to explain it to you in a way you understand.

Localized versus metastatic osteosarcoma

Localized osteosarcoma

A localized osteosarcoma is seen only in the bone it started in and possibly the tissues next to the bone, such as muscle, tendon, or fat.

About 4 out of 5 osteosarcomas are thought to be localized when they are first found. But even when imaging tests don't show that the cancer has spread to distant areas, most patients are likely to have very small areas of cancer spread that can't be detected with tests. This is why [chemotherapy](#) is an important part of treatment for most osteosarcomas. If it isn't given, the cancer is more likely to come back after [surgery](#).

Doctors further divide localized osteosarcomas into 2 groups:

- **Resectable** cancers are those in which all of the visible tumor can be removed by surgery.
- **Non-resectable** (or **unresectable**) osteosarcomas can't be removed completely by surgery.

Metastatic osteosarcoma

A metastatic osteosarcoma has clearly spread to other parts of the body. Most often it spreads to the lungs, but it can also spread to other bones, the brain, or other organs.

About 1 out of 5 osteosarcoma patients has metastatic spread at the time of diagnosis. These patients are harder to treat, but some can be cured if the metastases can be removed by surgery. The cure rate for these patients improves markedly if chemotherapy is also given.

Musculoskeletal Tumor Society (MSTS) Staging System

One system commonly used to stage osteosarcoma is the MSTS system, also known as the *Enneking system*. It is based on 3 key pieces of information:

- The **grade** of the tumor (G)
- The extent of the main (primary) **tumor** (T)
- If the tumor has **metastasized** (spread) to nearby lymph nodes (bean-sized collections of immune system cells) or other organs (M)

The grade of a tumor is a measure of how likely it is to grow and spread, based on how

it looks under the microscope. Tumors are either low grade (G1) or high grade (G2). Low-grade tumor cells look more like normal cells and are less likely to grow and spread quickly, while high-grade tumor cells look more abnormal.

The extent of the primary tumor is classified as either intracompartmental (T1), meaning it has basically remained within the bone, or extracompartmental (T2), meaning it has extended beyond the bone into other nearby structures.

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 further 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 staging system

Another system sometimes used to stage bone cancers is the American Joint Commission on Cancer (AJCC) system. The AJCC uses one system to describe all bone cancers, including osteosarcomas. The AJCC staging system for bone cancers is based on 4 key pieces of information:

- **T** describes the size of the main (primary) **tumor** and whether it appears in different areas of the bone.
- **N** describes the extent of spread to nearby (regional) lymph **nodes** (small bean-sized collections of immune system cells). Bone tumors rarely spread to the lymph nodes.

- **M** indicates whether the cancer has **metastasized** (spread) to other organs of the body. (The most common sites of spread are to the lungs or other bones.)
- **G** stands for the **grade** of the tumor, which describes how the cells look under a microscope. Low-grade tumor cells look more like normal cells and are less likely to grow and spread quickly, while high-grade tumor cells look more abnormal.

Numbers after T, N, M, and G provide more details about each of these factors.

T categories of bone cancer

T0: There is no evidence of a main (primary) tumor.

T1: The tumor is 8 cm (around 3 inches) across or less.

T2: The tumor is larger than 8 cm across.

T3: The tumor has “skipped” to another site or sites within the same bone.

N categories of bone cancer

N0: The cancer has not spread to regional (nearby) lymph nodes.

N1: The cancer has spread to nearby lymph nodes.

M categories of bone cancer

M0: There is no spread (metastasis) to distant organs.

M1a: The cancer has spread only to the lung.

M1b: The cancer has spread to other distant sites in the body.

Grades of bone cancer

Note: The grades used for the AJCC system are different from those in the MSTS system. There are other differences between the systems as well. To avoid confusion, it may help to ask your (child’s) doctor which staging system he or she uses.

GX: Grade can’t be assessed

G1, G2: Low grade

G3, G4: High grade

Stage grouping

Once the T, N, and M categories and the grade of the bone cancer have been determined, the information is combined into an overall stage. The process of assigning a stage number is called *stage grouping*. The stages are described in Roman numerals from I to IV (1 to 4), and are sometimes divided further.

Stage IA

T1, N0, M0, G1 or G2 (or GX): The tumor is 8 cm across or less and is low grade (or the grade can't be assessed). It has not spread to nearby lymph nodes or to distant parts of the body.

Stage IB

T2-T3, N0, M0, G1 or G2 (or GX): The tumor is larger than 8 cm across or has "skipped" to other sites in the same bone. It is low grade (or the grade can't be assessed). It has not spread to nearby lymph nodes or to distant parts of the body.

Stage IIA

T1, N0, M0, G3 or G4: The tumor is 8 cm across or less and is high grade. It has not spread to nearby lymph nodes or to distant parts of the body.

Stage IIB

T2, N0, M0, G3 or G4: The tumor is larger than 8 cm across and is high grade. It has not spread to nearby lymph nodes or to distant parts of the body.

Stage III

T3, N0, M0, G3 or G4: The tumor has "skipped" to other sites in the same bone. It is high grade. It has not spread to nearby lymph nodes or to distant parts of the body.

Stage IVA

Any T, N0, M1a, any G: The tumor has spread only to the lungs. It has not spread to

the lymph nodes or to other distant sites. (It can be any size or grade.)

Stage IVB (if either of these applies)

Any T, N1, any M, any G: The tumor has spread to lymph nodes. It can be any size or grade, and might or might not have spread to other distant sites.

Any T, any N, M1b, any G: The tumor has spread to distant sites other than the lung. It can be any size or grade.

- [References](#)

[See all references for Osteosarcoma](#)

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What Are the Survival Rates for Osteosarcoma?

Survival rates are often used by doctors as a standard way of discussing the prognosis (outlook) of a person with a certain type and [stage](#) of cancer. Some patients or parents of children with cancer may want to know the survival statistics for people in similar situations, while others may not find the numbers helpful, or may even not want to know them. If you do not want to read about the survival statistics for osteosarcoma given in the next few paragraphs, skip to the [next section](#).

The 5-year survival rate refers to the percentage of patients who live at least 5 years after their cancer is diagnosed. Of course, many people live much longer than 5 years (and many are cured).

In order to get 5-year survival rates, doctors have to look at people who were treated at least 5 years ago. Advances in treatment since then may mean a more favorable outlook for people now being diagnosed with osteosarcoma.

Survival rates are often based on previous outcomes of large numbers of people who

had the disease, but they can't predict what will happen in any particular person's case. Many other factors can affect a person's outlook, such as the subtype and location of the osteosarcoma and how well the cancer responds to [treatment](#). Your (child's) doctor can tell you if the numbers below may apply, as he or she is familiar with the aspects of your (child's) situation.

Localized tumors

With current treatment, the 5-year survival rate for people with localized osteosarcoma is in the range of 60% to 80%. These cancers are more likely to be cured if they are resectable; that is, if all of the visible tumor can be removed (resected) by [surgery](#). (For high-grade osteosarcomas that can be resected completely, [chemotherapy](#) is still an essential part of treatment. Without it, the cancer is still very likely to come back.)

Metastatic tumors

If the osteosarcoma has already spread when it is first found, the 5-year survival rate is about 15% to 30%. The survival rate is closer to 40% if the cancer has spread only to the lungs (as opposed to having reached other organs), or if all of the tumors (including metastases) can be removed with surgery.

Other factors that may affect prognosis

As noted above, factors other than the stage of the cancer can also affect survival rates. For example, factors that have been linked with a better prognosis include:

- Being younger (child or young adult, as opposed to older adult)
- Being female
- The tumor being on an arm or leg (as opposed to the hip bones)
- The tumor(s) being completely resectable
- Normal blood alkaline phosphatase and LDH levels
- The tumor having a good response to chemotherapy
- [References](#)

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What Should You Ask the Doctor About Osteosarcoma?

It's important to have frank, open discussions with your cancer care team. They want to answer all of your questions no matter how minor they might seem. For instance, consider these questions:

- What [kind of osteosarcoma](#) do I (does my child) have? Will this affect treatment?
- Has the cancer spread beyond the bone it started in?
- What is the [stage](#) of the cancer and what does that mean?
- Do we need to do other tests before we can decide on treatment?
- How much experience do you have treating this type of cancer?
- Will we need to see other doctors?
- What are our [treatment options](#)?
- What do you recommend and why?
- How soon do we need to start treatment?
- How long will treatment last? What will it be like? Where will it be done?
- How will treatment affect our daily lives?
- What should I (we) do to be ready for treatment?
- 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?
- What are the chances of the cancer coming back with these treatment plans? What will we do if this happens?
- What type of [follow up](#) and rehab will be needed after treatment?
- Are there nearby support groups or other families who have been through this that we could talk to?

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. You may also want to ask about second opinions or about available clinical trials.

- [References](#)

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