



Treating Bone Cancer

General treatment information

Depending on the [type](#) and [stage](#) of your cancer, you may need more than one type of treatment. Doctors on your cancer treatment team may include:

- An orthopedic surgeon: a doctor who uses surgery to treat bone and joint problems
- An orthopedic oncologist: an orthopedic surgeon that specializes in treating cancer of the bones and joints
- A radiation oncologist: a doctor who uses radiation to treat cancer
- A medical oncologist: a doctor who uses chemotherapy and other medicines to treat cancer

Many other specialists may be involved in your care as well, including nurse practitioners, nurses, psychologists, social workers, rehabilitation specialists, and other health professionals.

The main types of treatment for bone cancer are:

- [Surgery](#)
- [Radiation](#)
- [Chemotherapy](#)
- [Targeted therapy](#)

Often, more than one type of treatment is used. For information about some of the most common approaches used based on the extent of the disease, see the section “[Treating specific bone cancers.](#)”

It is important to discuss all of your treatment options, including their goals and possible side effects, with your doctors to help make the decision that best fits your needs. It's also very important to ask questions if there is anything you're not sure about. You can find some good questions to ask in the section, “[What should you ask your doctor](#)

[about bone cancer?](#)”

Thinking about taking part in a clinical trial

Clinical trials are carefully controlled research studies that are done to get a closer look at promising new treatments or procedures. Clinical trials are one way to get state-of-the-art cancer treatment. In some cases they may be the only way to get access to newer treatments. They are also the best way for doctors to learn better methods to treat cancer. Still, they are not right for everyone.

If you would like to learn more about clinical trials that might be right for you, start by asking your doctor if your clinic or hospital conducts clinical trials. You can also call our clinical trials matching service at 1-800-303-5691 for a list of studies that meet your medical needs, or see [“Clinical Trials”](#) to learn more.

Considering complementary and alternative methods

You may hear about alternative or complementary methods that your doctor hasn't mentioned to treat your cancer or relieve symptoms. These methods can include vitamins, herbs, and special diets, or other methods such as acupuncture or massage, to name a few.

Complementary methods refer to treatments that are used along with your regular medical care. Alternative treatments are used instead of a doctor's medical treatment. Although some of these methods might be helpful in relieving symptoms or helping you feel better, many have not been proven to work. Some might even be dangerous.

Be sure to talk to your cancer care team about any method you are thinking about using. They can help you learn what is known (or not known) about the method, which can help you make an informed decision. See [Complementary and Alternative Medicine](#) to learn more.

Help getting through cancer treatment

Your cancer care team will be your first source of information and support, but there are other resources for help when you need it. Hospital- or clinic-based support services are an important part of your care. These might include nursing or social work services, financial aid, nutritional advice, rehab, or spiritual help.

The American Cancer Society also [has programs and services](#) – including rides to

treatment, lodging, support groups, and more – to help you get through treatment. Call our National Cancer Information Center at 1-800-227-2345 and speak with one of our trained specialists on call 24 hours a day, every day.

The treatment information given here is not official policy of the American Cancer Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor. Your doctor may have reasons for suggesting a treatment plan different from these general treatment options. Don't hesitate to ask him or her questions about your treatment options.

Surgery for Bone Cancer

Surgery is the primary (main) treatment for most bone cancers. Surgery may also be needed to obtain a biopsy of the cancer. The biopsy and the surgical treatment are separate operations, but it is very important that the doctor plans both together. Ideally, the same surgeon should do both the biopsy and the main surgery. A biopsy taken from the wrong place can lead to problems when the surgeon does the operation to remove the cancer. Sometimes a poorly placed biopsy can even make it impossible to remove the cancer without cutting off the limb.

The main goal of surgery is to remove all of the cancer. If even a few cancer cells are left behind, they can grow and multiply to make a new tumor. To try to be sure that this doesn't happen, surgeons remove the tumor plus some of the normal-appearing tissue that surrounds it. This is known as *wide-excision*. Removing some normal-looking tissue helps ensure that all of the cancer is removed. After surgery, a pathologist will look at the tissue that was removed under the microscope to see if the margins (outer edges) have cancer cells. If cancer cells were seen at the edges of the tissue, the margins are called *positive*. Positive margins can mean that some cancer was left behind. When no cancer is seen at the edges of the tissue, the margins are said to be *negative*, *clean*, or *clear*. A wide-excision with clean margins minimizes the risk that the cancer will grow back where it started.

Tumors in the arms or legs

Sometimes the entire limb needs to be removed in order to do a good wide-excision (and remove all of the cancer). This operation is known as an *amputation*. But most of the time the surgeon can remove the cancer without amputation. This is called *limb-salvage* or *limb-sparing surgery*. In going over treatment options, it is important to realize that there are advantages and disadvantages with either type of surgery. For example, although for many people limb-salvage seems more acceptable than

amputation, it is more complex and so can have more complications. Both operations have the same overall survival rates when done by expert surgeons. Studies looking at quality of life have shown little difference in how people react to the final result of the different procedures. Perhaps the biggest concern was seen in teenagers who worry about the social effects of their operation. Emotional issues can be very important and support and encouragement are needed for all patients.

No matter which type of surgery is done, rehabilitation will be needed afterward. This can be the hardest part of treatment. If possible, the patient should meet with a specialist in rehabilitation before surgery to understand what will be involved.

Amputation: Amputation is surgery to remove part or all of a limb (an arm or leg). When used to treat cancer, amputation removes the limb part with the tumor, some healthy tissue above it, and everything below it. In the past, amputation was the main way to treat bone cancers found in the arms or legs. Now, this operation is only chosen if there is a reason not to do limb-salvage surgery. For example, an amputation may be needed if removing all of the cancer requires removing essential nerves, arteries, or muscles that would leave the limb without good function.

MRI scans and examination of the tissue by the pathologist at the time of surgery can help the surgeon decide how much of the arm or leg needs to be removed. Surgery is planned so that muscles and the skin will form a cuff around the amputated bone. This cuff fits into the end of an artificial limb (or prosthesis). After surgery, a person must learn how to use the prosthesis in rehabilitation. With proper physical therapy they are often walking again 3 to 6 months after leg amputation.

Limb-salvage surgery: The goal of limb-salvage surgery is to remove all of the cancer and still leave a working leg (or arm). Over 90% of patients with bone cancer in a limb are able to have their limb spared. This type of surgery is very complex and requires surgeons with special skills and experience. The challenge for the surgeon is to remove the entire tumor while still saving the nearby tendons, nerves, and vessels. This is not always possible. If a cancer has grown into these structures, they will need to be removed along with the tumor. This can sometimes result in a limb that is painful or can't be used. In that case, amputation may be the best option.

In this type of surgery, a wide-excision is done to remove the tumor. A bone graft or an *endoprosthesis* (**en-doe-pros-THEE-sis**, meaning internal prosthesis) is used to replace the bone that is lost. Endoprostheses are made of metal and other materials and can be very sophisticated. Because they may be used in growing children, some can be made longer without any extra surgery as the child grows.

Further surgery could be needed if the bone graft or endoprosthesis becomes infected,

loose, or broken. Limb-salvage surgery patients may need more surgery during the following 5 years, and some may eventually need an amputation.

Rehab is much more intense after limb-salvage surgery than it is after amputation. It takes an average time of a year for patients to learn to walk again after limb-salvage of a leg. If the patient does not take part in the rehabilitation program, the salvaged arm or leg may become useless.

Reconstructive surgery: If the leg must be amputated mid-thigh, the lower leg and foot can be rotated and attached to the thigh bone. The old ankle joint becomes the new knee joint. This surgery is called *rotationplasty* (roh-TAY-shun-PLAS-tee). A prosthesis is used to make the new leg the same length as the other (healthy) leg.

If the bone tumor is located in the upper arm, the tumor may be removed and then the lower arm attached again. This leaves the patient with an arm that works but is much shorter.

Tumors in other areas

Bone cancer in the pelvis is treated with a wide-excision when possible. If needed, bone grafts can be used to rebuild the pelvic bones.

For a tumor in the lower jaw bone, the entire lower half of the jaw may be removed and later replaced with bones from other parts of the body.

For tumors in areas like the spine or the skull, it may not be possible to safely do a wide-excision. Cancers in these bones may require a combination of treatments such as curettage, cryosurgery, and radiation.

Curettage (kur-uh-TAHZH): In this procedure, the doctor scoops out the tumor from the bone without removing a section of the bone. This leaves a hole in the bone. In some cases, after most of the tumor has been removed, the surgeon will treat the nearby bone tissue to kill any remaining tumor cells. This can be done with cryosurgery or by using bone cement.

Cryosurgery: For this treatment, liquid nitrogen is poured into the hole that is left in the bone after the tumor was removed. This extremely cold material kills tumor cells by freezing them. This treatment is also called *cryotherapy*. After cryosurgery, the hole in the bone can be filled by bone grafts or by bone cement.

Bone cement: The bone cement PMMA (polymethylmethacrylate) starts out as a

liquid and hardens over time. It can be put into a hole in the bone in liquid form. As PMMA hardens, it gives off a lot of heat. The heat helps kill any remaining tumor cells. This allows PMMA to be used without cryosurgery for some types of bone tumors.

Surgical treatment of metastasis

To be able to cure a bone cancer, it and any existing metastases must be removed completely with surgery. The lungs are the most common site of distant spread for bone cancer. Surgery to remove bone cancer metastases to the lungs must be planned very carefully. Before the operation, the surgeon will consider the number of tumors, their location (one lung or both lungs), their size, and the person's general condition.

The chest [CT scan](#) may not show all the tumors that truly exist. The surgeon will have a treatment plan in case more tumors are found during the operation than can be seen in the chest CT scan.

Removing all the lung metastases is probably the only chance for a cure. However, not all lung metastases can be removed. Some tumors are too big or are too close to important structures in the chest (such as large blood vessels) to be removed safely. People whose general condition is not good (due to poor nutritional status or problems with the heart, liver, or kidneys) may not be able to withstand the stress of anesthesia and surgery to remove metastases.

For more information about surgery, see [Cancer Surgery](#).

- [References](#)

[See all references for Bone Cancer](#)

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Radiation Therapy for Bone Cancer

Radiation therapy uses high-energy rays or particles to kill cancer cells. *External beam radiation therapy* uses radiation delivered from outside the body that is focused on the cancer. This is the type of radiation therapy that has been tried as a treatment for bone cancer.

Most bone cancers are not easily killed by radiation, and high doses are needed. These

high doses can damage healthy structures like nerves in the nearby area. This is why radiation therapy is not used as a major treatment for most types of bone tumors, (except for [Ewing tumors](#), and these are discussed in a separate document). Often radiation is used to treat bone cancers that are *unresectable* (they cannot be completely removed by surgery). Radiation may also be used after surgery if cancer cells were present in the edges of the removed tissue. Another term for this is *positive margins* (this is discussed in the section about [surgery](#)). In this case, radiation may be given to kill any cancer that may have been left behind. If the cancer comes back after treatment, radiation can help control symptoms like pain and swelling.

Intensity-modulated radiation therapy

Intensity-modulated radiation therapy (IMRT) is an advanced form of external beam radiation therapy. With this technique, a computer matches the radiation beams to the shape of the tumor and can adjust the intensity (strength) of the beams. The radiation is delivered to the tumor from several directions to reduce the amount of radiation that goes through any one area of normal tissue. Altogether, this makes it possible to reduce radiation damage to normal tissues while increasing the radiation dose to the cancer.

Proton-beam radiation

Proton-beam radiation is a special form of radiation that uses protons instead of regular x-rays to kill cancer cells. Protons are positively charged particles that are found inside all atoms. They cause little damage to the tissues they pass through but are very good at killing cells at the end of their path. This allows a high dose of radiation to be given to the tumor without hurting the normal tissue around it. Proton-beam radiation therapy requires highly specialized equipment and is not available in all medical centers. This form of radiation is very helpful in treating skull base chondrosarcomas and chordomas.

Side effects

Side effects of radiation therapy depend on what area of the body is being treated and how much radiation is used. Common [side effects](#) include:

- Fatigue (tiredness)
- Loss of appetite
- Skin changes in the area being treated, ranging from redness and hair loss to blistering and peeling
- Low blood counts
- Nausea, vomiting, and diarrhea (these are more common if radiation is given to the

belly)

More information on radiation therapy can be found in the [Radiation section](#) of our website.

- [References](#)

[See all references for Bone Cancer](#)

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Chemotherapy for Bone Cancer

Chemotherapy (chemo) is the use of drugs to treat cancer. Chemo is *systemic* therapy. This means that the drug enters the bloodstream and circulates to reach and destroy cancer cells throughout the body.

Chemo is often a part of treatment for [Ewing sarcoma](#) and [osteosarcoma](#), but it isn't often used for other bone cancers, like chordomas and chondrosarcomas, because they aren't very sensitive to chemo and so it often doesn't work well. It can be useful for some special types of chondrosarcoma, like *dedifferentiated* and *mesenchymal*.

Chemo is sometimes used for bone cancer that has spread through the bloodstream to the lungs and/or other organs. The drugs mainly used to treat bone cancer include:

- Doxorubicin (Adriamycin[®])
- Cisplatin
- Carboplatin
- Etoposide (VP-16)
- Ifosfamide (Ifex[®])
- Cyclophosphamide (Cytosan[®])
- Methotrexate
- Vincristine (Oncovin[®])

Usually, several drugs (2 or 3) are given together. For example, a very common combination is cisplatin and doxorubicin. Other combinations are ifosfamide and etoposide or ifosfamide and doxorubicin

Side effects of chemotherapy

Chemo kills cancer cells, but it will also damage some normal cells. Careful attention is given to avoid or minimize side effects. The [side effects](#) of chemo depend on the type of drugs, the amount taken, and the length of time they are taken.

Some common temporary side effects can include:

- Nausea and vomiting
- Loss of appetite
- Hair loss
- Mouth sores

It is important to tell your cancer care team about any side effects you have so that they can be prevented or controlled.

Chemotherapy can damage the blood-producing cells of the bone marrow and lymph nodes, so patients may have low blood cell counts. Low blood cell counts can result in:

- Increased chance of infection (too few white blood cells)
- Bleeding or bruising after minor cuts or injuries (too few platelets)
- Fatigue or shortness of breath (too few red blood cells)

Some side effects are specific to particular drugs. It's important to note that many of the serious side effects are rare, but possible. Discuss these with your cancer care team if you have concerns before treatment.

Ifosfamide and cyclophosphamide can damage the lining of the bladder and cause bloody urine. This is called *hemorrhagic cystitis*. This problem can be prevented by giving a drug called *mesna* along with the chemo.

Cisplatin may cause nerve damage (called *neuropathy*) leading to problems with numbness, tingling, and even pain in the hands and feet. Kidney damage (called *nephropathy*) can also occur after treatment with cisplatin. Giving lots of fluid before and after the drug is infused can help prevent this side effect. Cisplatin can sometimes cause problems with hearing (known as *ototoxicity*). Most often patients with this problem notice problems hearing high-pitched sounds.

Over time, doxorubicin can damage the heart. The risk of this goes up as the total amount of the drug given goes up. Before giving doxorubicin, your doctor may test your heart function to make sure that it is safe to give you this drug.

The doctors and nurses will watch closely for side effects. There are treatments for most side effects, but preventing significant side effects is more important. Most, if not all, of these side effects will eventually stop after the treatment is over. Do not hesitate to ask

your cancer care team any questions about side effects.

While you are being treated, your doctor will order [lab tests](#) to be sure your liver, kidney, and bone marrow (which produces the cells in the blood) are functioning well.

- The **complete blood count (CBC)** includes levels of white blood cells, red blood cells, and platelets.
- **Chemistry panels** measure certain blood chemicals that tell doctors how well the liver and the kidneys are working. Some drugs used in chemotherapy can damage the kidneys and liver.

If a drug can damage hearing, the doctor may order a hearing test (called an *audiogram*) before giving it.

For more information about chemotherapy, see the [Chemotherapy section](#) of our website.

- [References](#)

[See all references for Bone Cancer](#)

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Targeted Therapy for Bone Cancer

As researchers have learned more about the molecular and genetic changes in cells that cause cancer, they have been able to develop newer drugs that specifically target some of these changes. These drugs, often called targeted therapy drugs, work differently from standard chemotherapy (chemo) drugs and have different side effects. Targeted drugs are especially important in diseases such as chordomas and other bone cancers, where chemo has not been very useful.

Imatinib

Some chordomas have [gene defects](#) (mutations) that make proteins that signal the cells to grow. These genes are called *c-kit*, *PDGFRA*, and *PDGFRB*. The drug imatinib (Gleevec[®]) is a targeted therapy drug that can block the signals from these genes. This can make some tumors stop growing or even shrink a little. Imatinib is used to treat chordomas that have spread or have come back after treatment. Imatinib has been

used to treat chordomas for several years, but it isn't approved by the Food and Drug Administration to treat this type of cancer. It is approved to treat more common cancers.

This drug is given as a pill, taken with food once a day. Common side effects are mild and can include **diarrhea, nausea, muscle pain, and fatigue**. These are generally mild. Some people taking the drug have itchy skin rashes. Fluid buildup around the eyes, feet, or abdomen can also be a problem.

Denosumab

Denosumab (Xgeva[®]) is a monoclonal antibody (a man-made version of an immune system protein) that binds to a protein called RANK ligand. RANK ligand normally tells cells called *osteoclasts* to break down bone, but when denosumab binds to it, that action is blocked. In patients with giant cell tumors of bone that have either come back after surgery or cannot be removed with surgery, denosumab can help shrink tumors for a while.

To treat giant cell tumors, this drug is injected under the skin (sub-q or SQ), weekly for 4 weeks, and then every 4 weeks. Often, it can take months to see tumor shrinkage.

Most side effects are mild and can include **body aches, headache, and nausea**. A rare but very distressing side effect of denosumab is damage to the jawbone called **osteonecrosis of the jaw (ONJ)**. ONJ often appears as an open sore in the jaw that won't heal. It can lead to loss of teeth or infections of the jaw bone. Doctors don't know why this happens, but it can be triggered by having a tooth removed while taking the drug. The best treatment is also unclear, other than to stop denosumab. Maintaining good oral hygiene by flossing, brushing, making sure that dentures fit properly, and having regular dental check-ups may help prevent this. Most doctors recommend that patients have a dental checkup and have any tooth or jaw problems treated before they start taking this drug.

For more general information about targeted therapy drugs, see the [Targeted Cancer Therapy](#) section of our website.

- [References](#)

[See all references for Bone Cancer](#)

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Treating Specific Bone Cancers

For specific information on treating [Ewing sarcoma](#) and [osteosarcoma](#), please see the American Cancer Society information on those cancers.

Chondrosarcomas

After a biopsy confirms the diagnosis, [surgery](#) is done to remove the tumor. Again, it is important that the biopsy be done by the same surgeon who will remove the tumor. For a low-grade chondrosarcoma in an arm or leg, curettage with cryotherapy is an option. If the tumor is high-grade, limb-sparing surgery will be done if possible. Sometimes amputation is needed to completely remove the cancer. If the chondrosarcoma has spread to the lung and there are only a few metastases, they may be removed surgically.

Chondrosarcomas in the skull are hard to treat. Complete surgical removal is difficult, and may cause serious side effects. Some low-grade tumors are treated with curettage and cryosurgery.

Sometimes the patient is treated with [radiation therapy](#). Since chondrosarcomas are resistant to radiation, high doses are required. Proton-beam radiation works well for these tumors.

Chemotherapy (chemo) is not often used to treat chondrosarcoma, because most types of chondrosarcoma are resistant to chemo. Chemo can be used to treat some special types of chondrosarcoma. For example, dedifferentiated chondrosarcoma may be treated like [osteosarcoma](#), with chemo followed by surgery and then more chemo. Patients with mesenchymal chondrosarcomas also get chemo before surgery. These tumors are treated the same as [Ewing tumors](#) or [soft tissue sarcomas](#).

Malignant fibrous histiocytomas (MFH)

MFH is treated the same way osteosarcoma is treated. (See [Osteosarcoma](#) for more detailed information.) Often the patient is first treated with [chemotherapy](#) to shrink the tumor. Then the tumor and some surrounding normal tissue is removed (wide-excision). After resection, the bone may be reconstructed with a bone graft or a prosthesis (metallic rod). Amputation is rarely needed. In some cases, chemotherapy is also given after [surgery](#).

Fibrosarcomas

Surgery is the main treatment for this kind of cancer, with the goal of removing the tumor and a margin of surrounding normal bone. Radiation is sometimes given after surgery if the doctor suspects that some cancer has been left behind. Radiation therapy is sometimes used instead of surgery if the tumor cannot be removed completely. Radiation is also used if a fibrosarcoma returns after surgery.

Giant cell tumors of bone

These are treated mainly with [surgery](#). Different surgeries are used, depending on the size and location of the tumor. One option is wide-excision. This often means removing the part of the bone containing the tumor, and replacing it with a bone graft or prosthesis (such as a metal rod). If this operation can be done without seriously affecting the movement of the limb or without causing serious damage to nearby tissues, this approach provides a good likelihood of success.

Another option is curettage followed by cryosurgery. The defect (hole) in the bone can then be filled in with bone cement or a bone graft.

Radiation therapy may sometimes be used for giant cell tumors in bones where surgery may be difficult to perform without damaging nearby sensitive tissues such as the skull and the spine. Radiation is not often used to treat giant cell tumors because if the tumor is not killed completely it may increase the chance that it comes back in the malignant form.

Amputation is rarely needed to treat a giant cell tumor.

If a giant cell bone tumor spreads to other organs, the lungs are most commonly affected. If there are only a few metastatic tumors in the lungs, it may be possible to remove them surgically. Metastases that can't be removed can be treated with radiation or with the drug denosumab (Xgeva).

Chordomas

This primary tumor of bone most often occurs in the base of the skull or the bones of the spine. The best treatment is a [wide excision](#) to remove the tumor completely with some nearby normal tissue. This is not always possible because the spinal cord and nerves nearby may be involved. Still, as much of the tumor as possible will be removed.

[Radiation](#) is often given after surgery to lower the chance that the tumor will grow back.

Proton-beam radiation, either alone or with intensity-modulated radiation therapy, is often used.

Imatinib (Gleevec) is often used for a chordoma that has spread widely. It may rarely shrink the tumors, but often can stop them from growing for a while. Studies are looking at adding other drugs to imatinib when it stops working (this is discussed in the section, “[What’s new in bone cancer research and treatment?](#)”). Chemo may be tried as well, but so far it hasn’t worked well by itself. Chordomas can come back, even 10 or more years after treatment, so long-term follow-up is important.

- [References](#)

[See all references for Bone Cancer](#)

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1-800-227-2345 or www.cancer.org