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# Treating Bone Cancer

## How is bone cancer treated?

The main ways to treat bone cancer are:

- [Surgery for Bone Cancer](#)
- [Radiation Therapy for Bone Cancer](#)
- [Chemotherapy for Bone Cancer](#)
- [Targeted Therapy and Other Drugs for Bone Cancer](#)

## Common treatment approaches

Often, more than one type of treatment is used for bone cancer. Your treatment plan will depend on the type of bone cancer, which bone it started in, its stage (extent), and other factors.

- [Treating Specific Types of Bone Cancer](#)

## Who treats bone cancer?

Primary bone cancers are not common. Because of this, not a lot of doctors have extensive experience with them. Treating these cancers can be complex, so they are often best treated by a team of doctors (and often at major medical centers). Doctors on the treatment team might include:

- An **orthopedic surgeon**: a doctor who uses surgery to treat bone and joint problems. Often this is an **orthopedic oncologist**, an orthopedic surgeon who 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
- A **physiatrist**: a doctor specializing in rehabilitation and physical therapy

Many other medical specialists may be involved in your care as well, including physician assistants (PAs) nurse practitioners (NPs), nurses, psychologists, social workers, rehabilitation specialists, and other health professionals.

- [Health Professionals Associated with Cancer Care](#)

## **Making treatment decisions**

It's important to discuss all of your treatment options, including treatment 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's anything you're not sure about.

If time allows, it is often a good idea to seek a second opinion. This can give you more information and help you feel more confident about the treatment plan you choose.

- [Questions to Ask About Bone Cancer](#)
- [Seeking a Second Opinion](#)

## **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're 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.

- [Clinical Trials](#)

## **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 harmful.

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.

- [Complementary and Integrative Medicine](#)

## **Help getting through cancer treatment**

People with cancer need support and information, no matter what stage of illness they may be in. Knowing all of your options and finding the resources you need will help you make informed decisions about your care.

Whether you are thinking about treatment, getting treatment, or not being treated at all, you can still get supportive care to help with pain or other symptoms. Communicating with your cancer care team is important so you understand your diagnosis, what treatment is recommended, and ways to maintain or improve your quality of life.

Different types of programs and support services may be helpful, and can be 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, 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.

- [Palliative Care](#)
- [Programs & Services](#)

## **Choosing to stop treatment or choosing no treatment at all**

For some people, when treatments have been tried and are no longer controlling the

cancer, it could be time to weigh the benefits and risks of continuing to try new treatments. Whether or not you continue treatment, there are still things you can do to help maintain or improve your quality of life.

Some people, especially if the cancer is advanced, might not want to be treated at all. There are many reasons you might decide not to get cancer treatment, but it's important to talk to your doctors and you make that decision. Remember that even if you choose not to treat the cancer, you can still get supportive care to help with pain or other symptoms.

- [If Cancer Treatments Stop Working](#)

*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 your cancer care team any questions you may have about your treatment options.*

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## Surgery for Bone Cancer

*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.*

Surgery is an important part of treatment for most [types of bone cancer](#)<sup>4</sup>. It typically includes:

- The [biopsy](#)<sup>5</sup> to diagnose the cancer
- The surgical removal of the tumor(s)

**Whenever possible, it's very important that the biopsy and the surgery to remove the tumor be planned together, and that an experienced orthopedic surgeon does both the biopsy and the surgery.** The biopsy needs to be done in a certain way to give the best chance that less extensive surgery will be needed later on.

**The main goal of surgery is to remove all of the cancer.** If even a small amount of cancer is left behind, it might grow and make a new tumor, and might even spread to other parts of the body. To lower the risk of this happening, surgeons remove the tumor plus some of the normal tissue around it. This is known as a **wide excision**.

After surgery, a doctor called a pathologist will look at the removed tissue to see if the margins (outer edges) have cancer cells.

- If cancer cells are 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 cells are seen at the edges of the tissue, the margins are said to be **negative, clean, or clear**. A wide-excision with clean margins helps limit the risk that the cancer will come back in the place where it started.

The type of surgery done depends mainly on the location and size of the tumor. Although all operations to remove bone cancers are complex, tumors in the limbs (arms or legs) are generally not as hard to remove as those in the jaw bone, at the base of the skull, in the spine, or in the pelvic (hip) bone.

## **Surgery for bone tumors in the arms or legs**

Tumors in the arms or legs might be treated with either:

- **Limb-salvage (limb-sparing) surgery:** removing the cancer and some surrounding normal tissue but leaving the limb basically intact
- **Amputation:** removing the cancer and all or part of an arm or leg

When discussing your options with the treatment team, it's important to consider the pros and cons of either type of surgery. For example, most people prefer limb-salvage over amputation, but it's a more complex operation and can have more complications. If a limb is amputated, the patient will need to learn to live with and use a prosthetic limb.

Both types of 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. And when researchers have looked at the results of the different surgeries in terms of a person's quality of life afterward, there has been little difference between them. Still, emotional issues can be very important, and support and encouragement are needed for all patients.

No matter which type of surgery is done, physical rehabilitation will be needed afterward

(see below).

## Limb-salvage surgery

Most people with arm or leg tumors can have limb-sparing surgery, but this depends on where the tumor is, how big it is, and if it has grown into nearby structures.

The goal of limb-salvage surgery is to remove all of the cancer and still leave a working leg or arm. This type of surgery is very complex and needs to be done by 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 blood vessels to keep as much of the limb's function and appearance as possible. If the cancer has grown into these structures, they will need to be removed along with the tumor. (In such cases, amputation might sometimes be the best option.)

The section of bone that is removed along with the tumor is replaced with a **bone graft** (a piece of bone from another part of the body or from another person) or with an **endoprosthesis (internal prosthesis)**, which is a device made of metal and other materials that replaces part or all of a bone. Some newer devices combine a graft and a prosthesis.

**Complications of limb-salvage surgery** can include infections and grafts or rods that become loose or broken. Those who have limb-salvage surgery might need more surgery in the following years, and some might still eventually need an amputation.

## Amputation

For some patients, amputation of part or all of a limb is the best option. For example, if the tumor is very large or if it has grown into important nerves and/or blood vessels, it might not be possible to remove all of it and still leave behind a functional limb.

The surgeon determines how much of the arm or leg needs to be amputated based on the results of [MRI scans](#)<sup>6</sup> and examination of removed tissue by the pathologist at the time of surgery.

Surgery is usually 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 (external prosthesis). Another option might be to implant a prosthesis into the remaining bone, the end of which remains outside the skin. This can then be attached to an external prosthesis.

**Reconstructive surgery** can help some patients who lose a limb to function as well as

possible. For instance, if the leg must be amputated mid-thigh (including the knee joint), the lower leg and foot can be rotated and attached to the thigh bone, so that the ankle joint functions as a new knee joint. This surgery is called **rotationplasty**. A prosthetic limb would still be needed to replace the lower part of the leg.

If the bone tumor is in the shoulder or upper arm and amputation is needed, in some cases the area with the tumor can be removed and the lower arm reattached so that the patient has a functional, but much shorter, arm.

### **Rehabilitation after surgery on an arm or leg**

This may be the hardest part of treatment, and it cannot be described here completely. If possible, there should be a meeting with a rehab specialist before surgery so you will understand what this might entail.

Rehab after amputation typically takes less time than after limb-sparing surgery. For a tumor on a leg bone, people are often walking again 3 to 6 months after leg amputation, whereas it takes about a year, on average, for patients to learn to walk again after limb-salvage surgery. Physical rehab is also much more intense after limb-salvage surgery than it is after amputation, but it's still extremely important. If the patient doesn't actively take part in the rehabilitation program, the salvaged arm or leg might become useless, and might require amputation.

### **Surgery for bone tumors in other parts of the body**

**Tumors in the pelvic (hip) bones** can often be hard to remove completely with surgery. Some types of tumors can be treated with [chemotherapy](#) first to help shrink the cancer and make the operation easier. Pelvic bones can sometimes be reconstructed after surgery, but in some cases pelvic bones and the leg they are attached to might need to be removed.

For **tumors in the lower jaw bone**, the entire lower half of the jaw may be removed and later replaced with bone from other parts of the body. If the surgeon can't remove all of the tumor, [radiation therapy](#) may be used as well.

For **tumors in areas like the spine or the skull**, it might not be possible to remove all of the tumor safely. Cancers in these bones could require a combination of treatments such as curettage (removal by scraping - see below), [cryosurgery](#)<sup>7</sup>, and radiation.

**Joint fusion (arthrodesis):** Sometimes, after the removal of a tumor that involves a joint (an area where two bones come together), it might not be possible to reconstruct

the joint. In this case, surgery might be done to fuse the two bones together. This is most often used for tumors in the spine, but it might also be used in other parts of the body, such as a shoulder or hip. While it can help stabilize the joint, it results in loss of motion, which the person will have to learn to adjust to.

### **Curettage (intralesional excision)**

For some types of bone tumors that are less likely to spread or to come back after treatment, the surgeon might scrape out the tumor without removing a section of the bone. This is done with a sharp instrument called a curette, and it leaves a hole in the bone. After as much of the tumor is removed as possible, the surgeon might treat the nearby bone tissue with other techniques such as chemicals or extreme cold (cryosurgery) to try to kill any remaining tumor cells.

### **Bone cement**

The bone cement PMMA (polymethylmethacrylate) starts out as a liquid and hardens over time. It can be put into the hole in the bone in liquid form after curettage. As it hardens, it gives off a lot of heat, which might help kill any remaining tumor cells.

## **Surgical treatment of bone tumor metastasis**

If bone cancer has spread (metastasized) to other parts of the body, these tumors need to be removed to have a chance at curing the cancer.

When bone cancer spreads, it most often goes to the lungs. If surgery can be done to remove these metastases, it must be planned very carefully. Before the operation, the surgeon will consider the number of tumors, where they are (in one or both lungs), their size, and the person's overall health.

[Imaging tests](#)<sup>8</sup> such as a chest CT scan might not show all of the tumors, so the surgeon will have a treatment plan ready in case more tumors are found during the operation.

Some bone cancers might spread to other bones or to organs like the kidneys, liver, or brain. Whether these tumors can be removed with surgery depends on their size, location, and other factors.

Unfortunately, not all cancers that have spread can be removed with surgery. Some metastases might be too big or too close to important structures (such as large blood vessels) to be removed safely. People whose overall health isn't good (for example,



because of heart, liver, or kidney problems) might not be able to withstand the stress of anesthesia and surgery to remove the metastases. If this is the case, other treatments might be offered to try to control these tumors for as long as possible.

## Side effects of surgery

**Short-term risks and side effects:** Surgery to remove bone cancer can often be a long and complex operation. Serious short-term side effects are not common, but they can include reactions to anesthesia, excess bleeding, blood clots, and infections. Pain is common after the operation, and it might require strong pain medicines for a while after surgery as the site heals.

**Long-term side effects:** The long-term side effects of surgery depend mainly on where the tumor is and what type of operation is done. Many bone cancers occur in bones of the arms or legs, and some of the long-term issues from surgery on these tumors are described above.

Complications of limb-sparing surgery can include loose or broken bone grafts or prostheses. Infections are also a concern in people who have had amputations, especially of part of a leg, because the pressure placed on the skin at the site of the amputation can cause the skin to break down over time. It's also possible that the surgery could damage nerves in the limb, which might affect the function of the limb or cause pain (known as **neuropathic pain**).

As mentioned above, physical therapy and rehabilitation are very important after surgery for bone cancer. Following the recommended rehab program offers the best chance for good long-term limb function. Even with proper rehab, people might still have to adjust to long-term issues such as changes in how they walk or do other tasks, and changes in appearance. Physical, occupational, and other therapies can often help people adjust and cope with these challenges.

## More information about Surgery

For more general information about surgery as a treatment for cancer, see [Cancer Surgery](#)<sup>9</sup>.

To learn about some of the side effects listed here and how to manage them, see [Managing Cancer-related Side Effects](#)<sup>10</sup>.

## Hyperlinks

1. [www.cancer.org/cancer/osteosarcoma.html](http://www.cancer.org/cancer/osteosarcoma.html)
2. [www.cancer.org/cancer/ewing-tumor.html](http://www.cancer.org/cancer/ewing-tumor.html)
3. [www.cancer.org/treatment/understanding-your-diagnosis/advanced-cancer/bone-metastases.html](http://www.cancer.org/treatment/understanding-your-diagnosis/advanced-cancer/bone-metastases.html)
4. [www.cancer.org/cancer/bone-cancer/about/what-is-bone-cancer.html](http://www.cancer.org/cancer/bone-cancer/about/what-is-bone-cancer.html)
5. [www.cancer.org/cancer/bone-cancer/detection-diagnosis-staging/how-diagnosed.html](http://www.cancer.org/cancer/bone-cancer/detection-diagnosis-staging/how-diagnosed.html)
6. [www.cancer.org/cancer/osteosarcoma/detection-diagnosis-staging/how-diagnosed.html](http://www.cancer.org/cancer/osteosarcoma/detection-diagnosis-staging/how-diagnosed.html)
7. [www.cancer.org/treatment/treatments-and-side-effects/treatment-types/surgery/special-surgical-techniques.html](http://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/surgery/special-surgical-techniques.html)
8. [www.cancer.org/cancer/bone-cancer/detection-diagnosis-staging/how-diagnosed.html](http://www.cancer.org/cancer/bone-cancer/detection-diagnosis-staging/how-diagnosed.html)
9. [www.cancer.org/treatment/treatments-and-side-effects/treatment-types/surgery.html](http://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/surgery.html)
10. [www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html](http://www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html)

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National Comprehensive Cancer Network. NCCN Clinical 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 September 11, 2020.

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## Radiation Therapy for Bone Cancer

*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.*

Radiation therapy uses high-energy rays or particles to kill cancer cells.

For most types of bone cancer, the cancer cells are not easily killed by radiation, so high doses are needed. This can damage nearby healthy tissues, including key structures (like nerves and blood vessels) in the area. Because of this, radiation therapy isn't used as a main treatment for most types of bone tumors (although it's often used for [Ewing tumors](#)<sup>4</sup>).

**External beam radiation therapy** is radiation delivered from outside the body that's focused on the cancer. This is the type of radiation therapy used most often to treat bone cancer.

Before treatment starts, the radiation team takes careful measurements of the area to be treated with imaging tests such as MRI scans to determine the correct angles for aiming the radiation beams and the proper dose of radiation. This planning session is called **simulation**.

Most often, radiation is given in more than one treatment. Each treatment is much like getting an x-ray, although the dose of radiation is much higher. The treatment is not painful. For each session, you lie on a special table while a machine delivers the radiation from precise angles.

Each treatment lasts only a few minutes, although the setup time – getting you into place for treatment – usually takes longer.

### When might radiation therapy be used?

Radiation therapy might be used in different situations:

- **After surgery** if it's not clear that all of the cancer was removed (for example, if cancer cells were found in the edges (margins) of the removed tissue). This is done to try to kill any cancer cells that may have been left behind.
- **Instead of surgery** (possibly along with other treatments) for bone cancers that can't be removed (resected) completely. It might help control the growth of the tumor, and can also help control symptoms like pain and swelling.

## Types of radiation therapy

Because high doses of radiation are needed to kill bone cancer cells, doctors typically use special types of radiation therapy when treating them. These approaches allow them to control the size and strength of the radiation beams so that higher doses get to the tumor and spare the nearby tissues.

### Intensity-modulated radiation therapy (IMRT)

With IMRT, a computer program is used to shape and aim radiation beams at the tumor from several different angles, as well as to adjust the strength (intensity) of the beams. This makes it possible to reduce radiation damage to nearby normal tissues while increasing the radiation dose to the cancer.

### Stereotactic radiosurgery (SRS)

This technique lets doctors give a large dose of radiation to a small tumor area, usually in one session. Once imaging tests have been done to show the exact location of the tumor, a very thin beam of radiation is focused on the area from many different angles. This is typically done with a radiation source on the end of a computer-controlled robotic arm, which rotates around the person as they lie on a table.

Sometimes doctors give the radiation in several smaller treatments to deliver the same or slightly higher dose. This is called **stereotactic body radiotherapy (SBRT)**.

### Proton-beam radiation therapy

Proton-beam radiation therapy uses protons to kill cancer cells, instead of x-rays or other types of radiation.

Protons are parts of atoms that travel a certain distance before releasing most of their energy, but that cause little damage to the tissues they pass through. This is different from x-rays, which give off the same amount of energy as they pass through normal tissue both before and after reaching the tumor. Doctors can use this property of protons to give higher doses of radiation to the tumor while doing less damage to the normal tissue around it.

This type of treatment can be helpful in treating tumors in small, intricate areas (such as the base of the skull or the spine), where it's very important to limit the radiation that reaches nearby structures.

Proton beam radiation requires highly specialized equipment, and there are only a limited number of them in the United States at this time.

## Side effects of radiation therapy

Possible side effects of radiation therapy depend on what area of the body is being treated and how much radiation is used.

Short-term problems can include effects on skin areas that receive radiation, which can range from mild sunburn-like changes and hair loss to more severe skin reactions. Radiation to the abdomen or pelvis can cause nausea, diarrhea, and urinary problems. Talk with your doctor about the possible side effects because there may be ways to relieve some of them.

Depending on where the radiation is given, it can also damage other organs:

- Radiation to the **chest wall or lungs** can affect lung and heart function.
- Radiation to the **jaw area** might affect the salivary glands, which could lead to dry mouth and tooth problems.
- Radiation therapy to the **spine or skull** might affect the nerves in the spinal cord or brain. This could lead to nerve damage, headaches, and trouble thinking, which usually become most serious a year or two after treatment. Radiation to the spine might cause numbness or weakness in part of the body.
- Radiation to the **pelvis** can damage the bladder or intestines, which can lead to problems with urination or bowel movements. It can also damage reproductive organs, so doctors do their best to protect these organs by shielding them from the radiation or moving them out of the way whenever possible.
- Radiation that includes a **joint** (a place where two bones come together) might damage the joint, which could result in pain, scarring, and/or limited range of

motion.

Another concern with radiation therapy is that it might cause a **new cancer** to form in the part of the body that was treated. The higher the dose of radiation (and the younger a person is), the more likely this is to occur, but the overall risk is small and should not keep people who need radiation from getting it.

## More information about radiation therapy

To learn more about how radiation is used to treat cancer, see [Radiation Therapy](#)<sup>5</sup>.

To learn about some of the side effects listed here and how to manage them, see [Managing Cancer-related Side Effects](#)<sup>6</sup>.

## Hyperlinks

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4. [www.cancer.org/cancer/ewing-tumor.html](http://www.cancer.org/cancer/ewing-tumor.html)
5. [www.cancer.org/treatment/treatments-and-side-effects/treatment-types/radiation.html](http://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/radiation.html)
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## Chemotherapy for Bone Cancer

*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.*

Chemotherapy (chemo) is the use of drugs to treat cancer. These drugs are usually given into a vein (IV) and can reach and destroy cancer cells anywhere in the body, so chemo is most likely to be useful for cancers that have spread to other organs.

Chemo is often an important part of treatment for [Ewing sarcoma](#)<sup>4</sup>, [osteosarcoma](#)<sup>5</sup>, and undifferentiated pleomorphic sarcoma (UPS). But it's used less often for most other [types of bone cancers](#)<sup>6</sup>, like giant cell tumors and most types of chordomas and chondrosarcomas. These types aren't very sensitive to chemo, so [other medicines](#) might be tried first instead.

### Chemo drugs commonly used to treat bone cancer

Some of the chemo drugs that can be used to treat bone cancer include:

- Doxorubicin (Adriamycin)
- Cisplatin

- Etoposide (VP-16)
- Ifosfamide
- Cyclophosphamide
- Methotrexate
- Vincristine

In most cases, 2 or more drugs are given together.

## Side effects of chemo

Chemo kills cancer cells, but it also damages some normal cells, which can lead to side effects. These depend on the type of drugs and doses used, and the length of time they're taken.

Some common short-term side effects can include:

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

Chemo can damage the bone marrow, where new blood cells are made. This can lead to low blood cell counts, which can result in:

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

While you're getting chemo, your doctor will order [lab tests](#)<sup>7</sup> to be sure your blood cell counts are at safe levels.

Some side effects are linked to certain drugs. For example:

- **Ifosfamide** and **cyclophosphamide** can damage the lining of the bladder and cause bloody urine. The chance of this happening can be lowered by giving a drug called mesna during chemo, along with plenty of fluids.
- **Cisplatin** may cause nerve damage (called peripheral neuropathy) leading to



problems with numbness, tingling, or pain in the hands and feet. Kidney damage can also occur after treatment. Giving lots of fluid before and after the drug is infused can help prevent this. Cisplatin can sometimes affect hearing, especially of high-pitched sounds. Your doctor may have you get a hearing test (called an audiogram) before giving cisplatin.

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

It's important to note that many of the serious side effects are uncommon, but they can happen. Talk with your cancer care team so you know what to expect from the chemo you're getting.

The doctors and nurses will watch you closely for side effects. Most side effects tend to go away in time after treatment is over. Still, it's important to tell your cancer care team about any side effects you have so they can be treated. Be sure to discuss any questions you have about side effects with the cancer care team, and tell them about any side effects so that they can be controlled.

## More information about chemotherapy

For more general information about how chemotherapy is used to treat cancer, see [Chemotherapy](#)<sup>8</sup>.

To learn about some of the side effects listed here and how to manage them, see [Managing Cancer-related Side Effects](#)<sup>9</sup>.

## Hyperlinks

1. [www.cancer.org/cancer/osteosarcoma.html](http://www.cancer.org/cancer/osteosarcoma.html)
2. [www.cancer.org/cancer/ewing-tumor.html](http://www.cancer.org/cancer/ewing-tumor.html)
3. [www.cancer.org/treatment/understanding-your-diagnosis/advanced-cancer/bone-metastases.html](http://www.cancer.org/treatment/understanding-your-diagnosis/advanced-cancer/bone-metastases.html)
4. [www.cancer.org/cancer/ewing-tumor.html](http://www.cancer.org/cancer/ewing-tumor.html)
5. [www.cancer.org/cancer/osteosarcoma.html](http://www.cancer.org/cancer/osteosarcoma.html)
6. [www.cancer.org/cancer/bone-cancer/about/what-is-bone-cancer.html](http://www.cancer.org/cancer/bone-cancer/about/what-is-bone-cancer.html)
7. [www.cancer.org/treatment/understanding-your-diagnosis/tests.html](http://www.cancer.org/treatment/understanding-your-diagnosis/tests.html)
8. [www.cancer.org/treatment/treatments-and-side-effects/treatment-types/chemotherapy.html](http://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/chemotherapy.html)

9. [www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html](http://www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html)

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## Targeted Therapy and Other Drugs for Bone Cancer

*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.*

As researchers have learned more about the gene changes inside cells that can lead to bone cancer, they have developed newer drugs that specifically target some of these changes. These **targeted drugs** work differently from standard chemotherapy (chemo) drugs, and they tend to have different side effects.

Targeted drugs are especially important in treating [types of bone cancer](#)<sup>4</sup> where chemo has not been very useful, such as chordomas.

Other types of non-chemo drugs that can be used to treat some types of bone cancers include **bone-directed drugs** and **immunotherapy drugs**.

### Targeted drugs for bone cancer

The targeted drugs used to treat some types of bone cancers are known as **kinase inhibitors**. Kinases are proteins in the cell (or on its surface) that normally relay signals (such as telling the cell to grow). Blocking certain kinases can help stop or slow the growth of some tumors.

These drugs are used most often to treat chordomas that have spread or have come back after treatment. Some of these drugs might also be used to treat advanced chondrosarcomas.

Examples of kinase inhibitors include:

- Imatinib (Gleevec)

- Dasatinib (Sprycel)
- Sunitinib (Sutent)
- Erlotinib (Tarceva)
- Lapatinib (Tykerb)
- Sorafenib (Nexavar)
- Regorafenib (Stivarga)
- Pazopanib (Votrient)

These drugs are pills, typically taken once or twice a day.

The **side effects** of these drugs can vary, based on which one is being used, and can include things like diarrhea, nausea, muscle pain, and fatigue. Some of these drugs can cause itchy skin rashes or fluid build-up around the eyes, feet, or belly.

## Drugs that affect bone cells

**Denosumab (Xgeva)** is a drug known as a RANKL inhibitor. The RANKL protein normally tells cells called osteoclasts to break down bone. By binding to RANKL denosumab can block this.

This drug can be used to treat giant cell tumors of bone that have either come back after surgery or cannot be removed with surgery.

This drug is injected under the skin (sub-q or SQ). Often, the tumor can take months to shrink.

Most **side effects** are mild and can include body aches, fatigue, diarrhea, and nausea. A rare but very serious side effect of denosumab is damage to the jawbone, called **osteonecrosis** of the jaw (ONJ). This can lead to loss of teeth and/or infections of the jaw bone. ONJ can be triggered by having dental work while taking the drug. 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 check-up and have any tooth or jaw problems treated before they start taking this drug.

## Immunotherapy drugs for bone cancer

Immunotherapy drugs help the body's own immune system recognize and attack cancer cells.

## Pembrolizumab (Keytruda)

An important part of the immune system is its ability to keep itself from attacking normal cells in the body. To do this, it uses “checkpoint” proteins on immune cells, which act like switches that need to be turned on (or off) to start an immune response. Cancer cells sometimes exploit these checkpoints to avoid being attacked by the immune system.

Pembrolizumab targets the PD-1 checkpoint protein on immune system cells called T cells. This protein normally helps keep these cells from attacking other cells in the body. By blocking PD-1, this drug boosts the immune response against cancer cells. This can shrink some tumors or slow their growth.

This drug can be used in some people with advanced bone cancer if the cancer cells have certain types of gene changes.

Pembrolizumab is given as an intravenous (IV) infusion, typically once every 3 or 6 weeks.

Possible **side effects** of this drug can include feeling tired or weak, cough, nausea, itching, skin rash, loss of appetite, muscle or joint pain, shortness of breath, and constipation or diarrhea.

Other, more serious side effects occur less often:

**Infusion reactions:** This is like an allergic reaction, and can include fever, chills, flushing of the face, rash, itchy skin, feeling dizzy, wheezing, and trouble breathing. It's important to tell your doctor or nurse right away if you have any of these symptoms while getting this drug.

**Autoimmune reactions:** This drug works by basically removing one of the safeguards on the body's immune system. Sometimes the immune system starts attacking other parts of the body, which can cause serious or even life-threatening problems in the lungs, intestines, liver, hormone-making (endocrine) glands, kidneys, skin, or other organs.

## Interferon alfa-2b

Interferons are a family of substances naturally made by our immune system. Interferon alfa-2b may be used to treat giant cell tumors of the bone that have come back after treatment or that have spread.

This drug is most often given daily as an injection under the skin. It can also be injected into a muscle or vein.

Interferon can cause significant side effects. These include "flu-like" symptoms like muscle aches, bone pain, fever, headaches, fatigue, nausea, and vomiting. Patients taking this drug might have problems thinking and concentrating. Interferon can also lower blood cell counts. These effects continue as long as the drug is used, but can become easier to tolerate over time. Still, some patients find it hard to deal with these side effects every day and may need to stop treatment because of them.

For more information about drugs that help the immune system attack cancer, see [Immunotherapy](#)<sup>5</sup>.

## More information about targeted therapy

To learn more about how targeted drugs are used to treat cancer, see [Targeted Cancer Therapy](#)<sup>6</sup>.

To learn about some of the side effects listed here and how to manage them, see [Managing Cancer-related Side Effects](#)<sup>7</sup>.

## Hyperlinks

1. [www.cancer.org/cancer/osteosarcoma.html](http://www.cancer.org/cancer/osteosarcoma.html)
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3. [www.cancer.org/treatment/understanding-your-diagnosis/advanced-cancer/bone-metastases.html](http://www.cancer.org/treatment/understanding-your-diagnosis/advanced-cancer/bone-metastases.html)
4. [www.cancer.org/cancer/bone-cancer/about/what-is-bone-cancer.html](http://www.cancer.org/cancer/bone-cancer/about/what-is-bone-cancer.html)
5. [www.cancer.org/treatment/treatments-and-side-effects/treatment-types/immunotherapy.html](http://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/immunotherapy.html)
6. [www.cancer.org/treatment/treatments-and-side-effects/treatment-types/targeted-therapy.html](http://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/targeted-therapy.html)
7. [www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html](http://www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html)

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## Treating Specific Types of Bone Cancer

*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.*

The treatment of bone cancers in adults depends on the [type of bone cancer](#)<sup>4</sup>, where the cancer started, its [stage](#)<sup>5</sup> (extent), a person's overall health and preferences, and other factors.

Often, more than one type of treatment is used. Treating these cancers can be complex, so they are often best treated by a team of different types of doctors who have experience with them.

### ***Jump to a specific type of bone cancer***

- [Chondrosarcoma](#)
- [Undifferentiated pleomorphic sarcoma \(UPS\) of bone](#)
- [Fibrosarcoma of bone](#)
- [Giant cell tumor of bone](#)
- [Chordoma](#)

## Chondrosarcoma

Treatment of chondrosarcomas is based mainly on:

- The [grade](#)<sup>6</sup> of the cancer (how likely it is to grow and spread quickly, based on how it looks under a microscope). Most chondrosarcomas are lower-grade tumors.
- The type of chondrosarcoma
- The location of the cancer
- Whether the cancer has spread outside the bone where it started

Once a [biopsy](#)<sup>7</sup> of the tumor confirms the diagnosis, [surgery](#) to remove the tumor is typically the first treatment.

For **low-grade chondrosarcomas confined to an arm or leg bone**, [curettage](#) (intralesional excision) might be an option. The area where the tumor has been removed might then be treated with a chemical (such as phenol) or with extreme cold (cryotherapy) to try to kill any remaining cancer cells. The hole in the bone is then filled in with bone cement or with a bone graft. If curettage isn't an option, a wide excision (either limb-sparing surgery or amputation) will be needed.

For **low-grade chondrosarcomas in other bones** and for all **higher-grade chondrosarcomas**, more extensive surgery will likely be needed. [Limb-sparing surgery](#) might be an option for tumors in the arm or leg bones, although sometimes [amputation](#) might be a better option to completely remove the cancer.

**Chondrosarcomas in the skull** can be hard to treat. They are often hard to remove completely with surgery, which might cause serious side effects. Some low-grade tumors can be treated with curettage.

For tumors that are harder to remove completely, [radiation therapy](#) might be given before and/or after surgery. Radiation can also be used if surgery can't be done for some reason. Chondrosarcoma cells aren't killed easily by radiation, so high doses are needed. Techniques such as intensity-modulated radiation therapy (IMRT) or proton beam radiation are likely to work best for these tumors.

**Chondrosarcomas that have spread to other parts of the body** can be hard to treat.

- If there are only a few tumors, they may be removed surgically, along with the main tumor. Radiation therapy might be another option to treat tumors in other parts of the body.

- If there are many tumors, or if it's clear that not all of them can be removed, treatment is more likely to be focused on relieving symptoms from the tumors and controlling their growth for as long as possible. Treatment options might include radiation therapy, surgery, or [targeted drug treatments](#) such as dasatinib or pazopanib.

[Chemotherapy](#) (chemo) is not usually very effective against chondrosarcoma cells, so it's not often used to treat this type of cancer. Still, chemo can be used to treat some uncommon types of chondrosarcoma. For example:

- **Dedifferentiated chondrosarcoma** is often treated like [osteosarcoma](#)<sup>8</sup>, with chemo being given first, followed by surgery and then more chemo.
- **Mesenchymal chondrosarcomas** are often treated the same way as [Ewing tumors](#)<sup>9</sup> (Ewing sarcomas). Treatment typically includes chemo, surgery, and radiation therapy.

Because chondrosarcomas can often be hard to treat, taking part in a [clinical trial](#)<sup>10</sup> testing newer treatments might be an option to consider.

## Undifferentiated pleomorphic sarcoma (UPS) of bone

This cancer was previously known as **malignant fibrous histiocytoma (MFH) of bone**. It's treated basically the same way as osteosarcoma is treated.

[Chemotherapy](#) usually is given first to shrink the tumor and to try to kill any cancer cells that might have spread. Then the tumor and some surrounding normal tissue is removed with [surgery](#). The type of surgery will depend on the location of the tumor and other factors. Once the cancer has been removed, the bone may be reconstructed with a bone graft or with some type of man-made prosthesis. In some cases, chemotherapy is also given after surgery.

For more on how osteosarcoma (and therefore UPS) is treated, see [Treating Osteosarcoma](#)<sup>11</sup>.

These tumors are not common and can be hard to treat, so taking part in a [clinical trial](#)<sup>12</sup> testing newer treatments might be another option to consider.

## Fibrosarcoma of bone



[Surgery](#) is usually the main treatment for this type of bone cancer. The goal is to remove the tumor and a margin of surrounding normal bone. The type of operation will depend on the location of the tumor and other factors.

These tumors tend to come back in the same place they started, so [radiation therapy](#) may be given after surgery to try to keep this from happening. Radiation might also be given if not all of the cancer can be removed, or if the doctor suspects that some cancer might have been left behind.

Radiation can also be used if a fibrosarcoma returns after surgery.

[Chemotherapy](#) might also be part of the treatment for these cancers, as they share some features with osteosarcomas and undifferentiated pleomorphic sarcomas. However, fibrosarcomas of bone are rare tumors, so using chemo against them hasn't been studied thoroughly.

These tumors are not common and can be hard to treat, so taking part in a [clinical trial](#)<sup>13</sup> testing newer treatments might be another option to consider.

## Giant cell tumor of bone

These tumors do not usually spread to other parts of the body, but they are sometimes hard to remove completely.

Giant cell tumors are usually treated with [surgery](#). Different types of operations can be used, depending on the size and location of the tumor.

Tumors that are only in the bone where they started can often be treated with curettage (intralesional excision). The area where the tumor has been removed might then be treated with a chemical (such as phenol) or with extreme cold (cryotherapy) to try to kill any remaining cancer cells. The hole in the bone is then filled in with bone cement or with a bone graft.

If curettage isn't an option, a wide excision (either limb-sparing surgery or amputation) will likely be needed. Another option might be to try to shrink the tumor first to make it easier to remove. This can be done with [drug treatment](#) such as denosumab or interferon-alfa 2b, or with [radiation therapy](#).

It's not common for giant cell bone tumors to spread to other organs, but when they do, they usually go to the lungs first. If there are only a few tumors, it might be possible to remove them with surgery.

If surgery can't be done to remove the tumor(s) completely, other options might include drug treatments (such as denosumab or interferon alfa-2b) or radiation therapy.

One concern with using radiation therapy to treat these tumors is that if the tumor is not destroyed completely, the radiation might increase the chance that it will come back as a more aggressive tumor.

Because these tumors tend to grow slowly, chemotherapy isn't likely to be helpful in treating them.

## Chordoma

This rare type of bone tumor most often occurs in either the base of the skull or in the lower bones of the spine. It tends to grow slowly and doesn't often spread to other parts of the body, but it can be hard to remove completely, and it often comes back in the place where it started.

[Surgery](#) is usually the main treatment for these tumors. The type of surgery depends on where the tumor is.

For **tumors in the spine**, a wide excision is usually done to remove the tumor along with some nearby normal tissue. It might not be possible to remove all of the tumor in some cases, such as if the spinal cord and nearby nerves are involved.

**Tumors at the base of the skull** are often hard to remove completely because they're close to critical structures such as the brainstem and spinal cord. Curettage is often done to remove as much of the tumor as possible. This might be done through an incision in the skull, or through a small hole created in the back of the nose.

[Radiation therapy](#) might be given after surgery to lower the chance that the tumor will grow back. Doctors typically use techniques that allow them to control the radiation very precisely, such as proton beam radiation or intensity-modulated radiation therapy (IMRT).

Radiation therapy may also be used if the tumor can't be removed with surgery for some reason.

Chordomas can come back, even many years after treatment, so long-term follow-up is important. If the tumor does come back, treatment options might include surgery and/or radiation therapy. Chemotherapy isn't usually effective for chordomas, but newer [targeted drugs](#) such as imatinib, dasatinib, or sunitinib might be helpful in treating these

tumors.

## Hyperlinks

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2. [www.cancer.org/cancer/ewing-tumor.html](http://www.cancer.org/cancer/ewing-tumor.html)
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