Osteosarcoma Overview

The information that follows is an overview of this type of cancer. It is based on the more detailed information in our document, *Osteosarcoma*. This document and other information can be obtained by calling 1-800-227-2345 or visiting our Web site at www.cancer.org.

What is cancer?

The body is made up of trillions of living cells. Normal body cells grow, divide into new cells, and die in an orderly way. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out, damaged, or dying cells.

Cancer begins when cells in a part of the body start to grow out of control. There are many kinds of cancer, but they all start because of this out-of-control growth of abnormal cells.

Cancer cell growth is different from normal cell growth. Instead of dying, cancer cells keep on growing and form new cancer cells. These cancer cells can grow into (invade) other tissues, something that normal cells cannot do. Being able to grow out of control and invade other tissues are what makes a cell a cancer cell.

In most cases the cancer cells form a tumor. But some cancers, like leukemia, rarely form tumors. Instead, these cancer cells are in the blood and bone marrow.

When cancer cells get into the bloodstream or lymph vessels, they can travel to other parts of the body. There they begin to grow and form new tumors that replace normal tissue. This process is called *metastasis* (muh-**tas**-tuh-sis).

No matter where a cancer may spread, it is always named for the place where it started. For instance, breast cancer that has spread to the liver is still called breast cancer, not liver cancer. Likewise, prostate cancer that has spread to the bone is still prostate cancer, not bone cancer.

Different types of cancer can behave very differently. For example, lung cancer and breast cancer are very different diseases. They grow at different rates and respond to different treatments. That is why people with cancer need treatment that is aimed at their own kind of cancer.

Not all tumors are cancerous. Tumors that aren't cancer are called *benign* (be-**nine**). Benign tumors can cause problems – they can grow very large and press on healthy organs and tissues. But they cannot grow into other tissues. Because of this, they also can't spread to other parts of the body (metastasize). These tumors are almost never life threatening.

What are the differences between cancers in adults and children?

As a rule, the types of cancers that children get are often different from the types found in adults. Childhood cancers are often the result of changes in cells that take place very early in life, sometimes even before birth. Unlike many cancers in adults, childhood cancers are not strongly linked to lifestyle (like diet or exercise) or to environmental risk factors.

Although there are exceptions, childhood cancers tend to respond better to treatments like chemotherapy (chemo). But, chemo and radiation can have some long-term side effects, so children who survive their cancer will need to be followed closely for the rest of their lives.

Children (and teens) with cancer and their families have special needs that are best met by children's cancer centers that work closely with the child's main doctor. These centers have teams of experts with experience in treating children. They know the special needs of children with cancer. Besides doctors and nurses, the team can include psychologists, social workers, child life specialists, nutritionists, educators, and others.

Since the 1960s most children with cancer have been treated at these special centers. In the United States, most children with cancer are treated at a center that is a member of the Children's Oncology Group (COG). All of these centers are part of a university or a children's hospital. As we have learned more about treating childhood cancer, it has become even more important that treatment be given by experts with this kind of experience.

What is osteosarcoma?

Osteosarcoma is a type of cancer that starts in the bones. To understand osteosarcoma, it helps to know something about the normal structure of bones.

Normal bones

Many people think of bones as just being part of the skeleton, like the steel girders that support a building. But bones have a number of different functions.

- Some bones help support and protect our vital organs. Examples include the skull bones, breast bone (sternum), and ribs. These types of bones are often referred to as *flat bones*.
- Other bones, like those in the arms and legs, make a framework for our muscles that helps us move. These are called *long bones*.
- Bones also make new blood cells. This is done in the soft, inner part of some bones called the *bone marrow*.
- Bones also provide the body with a place to store minerals such as calcium.

Because bones are very hard and don't change shape (at least in adults) we may think of bones as not being alive. But bones are really living tissue made up of living cells.

There are 2 main types of cells in our bones:

- *Osteoblasts* help build up bones by forming the matrix of the bones, that is, the connective tissue and minerals that give the bones strength.
- *Osteoclasts* break down bone matrix to keep it from building up. These cells help bones keep their shape. They also help control the amount of minerals in the blood.

Osteosarcoma

Osteosarcoma is the most common type of cancer that starts in the bone. While this cancer starts in the cells that make bone, the cancer-filled bone is not as strong as normal bones.

Osteosarcoma often starts near the ends of the long bones in the legs, especially in the part of the thigh bone next to the knee, and the part of the lower leg bone next to the knee. The arm bone near the shoulder is the second most common place for this cancer to start. But it can start in other bones, too, like the hip bone (pelvis), shoulder, or jaw.

Subtypes of osteosarcoma

There are several subtypes of osteosarcoma. The subtype is based on how the cancer looks on x-rays and under the microscope. Some subtypes have a much better outlook for survival than others.

Osteosarcomas can be grouped as low grade, intermediate grade, or high grade. If the tumor has few dividing cells and looks more like normal bone, it is called a low-grade osteosarcoma. If it has many dividing cells and is growing quickly, it is high grade. Most osteosarcomas in children and teens are high grade.

The grade is important because it tells the doctor how likely the cancer is to grow and spread to other parts of the body. Low-grade tumors grow slowly, while high-grade tumors grow quickly. The grade helps the doctor figure out the stage of the tumor and the best type of treatment to use. For more on staging, see the section, “Staging of osteosarcoma.”

Other types of bone tumors

Ewing tumors are the second most common kind of bone cancer in children. They are described in the American Cancer Society document, *Ewing Family of Tumors*. Most other types of bone cancers are usually found in adults and are rare in children. For more information on other bone cancers, see our document, *Bone Cancer*.

Many types of cancer that start in other places can spread to the bones, but they are not true bone cancers. They are sometimes called *metastatic bone cancers*. For instance, prostate cancer that spreads to the bones is still prostate cancer and is treated like prostate cancer. For more information, see our document called *Bone Metastasis*.

Many bone tumors are not cancer. These are called *benign* (be-**nine**) bone tumors. Benign bone tumors do not spread to other parts of the body. Most of the time they are not a threat to life and can be cured by surgery.

The rest of this document refers only to osteosarcoma.

How many people get osteosarcoma?

Osteosarcoma is not common. There are about 800 new cases of osteosarcoma in the United States each year. About 400 of these are in children and teens. Osteosarcoma is most common in teens, but it can occur at any age.

What are the risk factors for osteosarcoma?

The exact cause of most osteosarcomas is not known. But we do know that certain risk factors are linked to this disease. A risk factor is something that affects a person's chance of getting a disease. Some risk factors, like smoking, can be controlled. Others, like a person's age or race, can't be changed. Different cancers have different risk factors.

So far, lifestyle-related factors (like bad diets, lack of exercise, or obesity) have not been linked to osteosarcoma in children or in adults.

Risk factors for osteosarcoma

Age and height: The risk of osteosarcoma is highest during the teenage growth spurts. Children with osteosarcoma are usually tall for their age. There may be a link between rapid bone growth and the risk of tumors forming. Osteosarcoma in older adults is often linked to a different cause, such as a long-standing bone disease.

Gender: Osteosarcoma is more common in males than in females.

Race/ethnicity: Osteosarcoma is slightly more common in African Americans than in whites.

Radiation to bones: Young people who were treated with radiation for an earlier cancer have a higher risk of getting osteosarcoma in the same area later. It is not clear if tests that such as x-rays, CT scans, and bone scans, raise the risk of osteosarcoma. The amount of radiation used for these tests is many times lower than that used for cancer treatment. If there is any increased risk it is likely to be very small, but doctors try to limit the use of these types of tests in children when they can, just in case.

Certain bone diseases: People with certain non-cancer bone diseases have an increased risk of getting osteosarcoma. Some of these diseases include *Paget disease of bone* and *multiple hereditary osteochondromas*.

Certain cancer syndromes: Some people inherit gene changes from their parents that put them at increased risk for some types of cancer. People with certain rare, inherited cancer syndromes have an increased risk of getting osteosarcoma. One of these syndromes is Li-Fraumeni syndrome. When children with the inherited form of retinoblastoma (a rare eye cancer) are treated with radiation it raises the chance of osteosarcoma in the bones of the skull. There are several other rare syndromes that increase the risk of osteosarcoma in children.

It is important to keep in mind that most people with osteosarcoma do not have any known risk factors. For most patients, the cause of their cancer is not clear.

Can osteosarcoma be prevented?

Most of the known risk factors for osteosarcoma cannot be changed, so at this time there is no way to protect against this cancer.

How is osteosarcoma found?

Most cases of osteosarcoma are found at an early stage, before they have clearly spread to other parts of the body. Symptoms like bone pain or swelling often prompt a visit to a doctor. The sooner it is found, the better the chance of a cure.

At this time there are no special tests to find osteosarcoma in people without symptoms or strong risk factors. The best thing to do is to watch for any symptoms of this disease and see a doctor right away.

Signs and symptoms of osteosarcoma

Pain and swelling

Pain in a bone is the most common symptom of osteosarcoma. At first, the pain may come and go. It might be worse at night. The pain gets worse with activity and may cause a limp if the tumor is in a leg.

Swelling in the area of the pain may not happen until weeks later. Depending on where the tumor is, you may be able to feel a lump.

Limb pain or swelling is fairly common in normal, active children and teens, so it’s easy to see why this cancer might not be found right away. These symptoms are less common in adults and should be a sign to see a doctor.

Bone fractures (breaks)

Although osteosarcoma may weaken the bone it develops in, the bones often do not break. 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.

Medical history and exam

If there are signs or symptoms that suggest a tumor, the doctor will want to take a complete medical history. A physical exam will be done to learn more about the tumor and other health problems. If the doctor thinks it may be osteosarcoma or another type of bone tumor, more tests will be done, such as those listed below.

Imaging tests

Imaging tests are done to get pictures of the inside of the body to look for problems. These tests can be done to find the cancer, to figure out how far it has spread, to see how well treatment is working, or to see if the cancer has come back after treatment.

Bone x-rays: Doctors can often spot osteosarcoma on a regular x-ray, but only a biopsy (see below) can show if cancer is really there.

MRI (magnetic resonance imaging): MRI scans use radio waves and strong magnets instead of x-rays to make very detailed pictures. An MRI can help show if a bone tumor has grown into nearby areas. Sometimes the MRI can help find small tumors several inches away from the main tumor. Knowing how far the tumor has grown is important for planning the best type of surgery.

An MRI scan could take up to an hour. You (or your child) have to lie on a table that slides inside a narrow tube, which can be upsetting. Newer, more open MRI machines can help with these feelings, but the test still means staying still for a long time. The machine also makes a thumping noise that may be disturbing. Some places will give you headphones with music to block out the noise. Sometimes, younger children are given medicine to help keep them calm or even asleep during the test.

CT (computed tomography) scans: In this test many x-rays of the body are taken from different angles. These images are combined by a computer to make cross-sectional pictures of your insides. A CT scan of the bone can show if the tumor has spread into nearby tissues like muscle or fat, although MRI is often better for this. A chest CT scan can show whether the cancer has spread to the lungs.

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

Before the scan, you (or your child) may be asked to drink a liquid or have a contrast dye put into your vein. This helps better outline places in the body. The dye may cause some a feeling of warmth, especially in the face. Some people are allergic and get hives. Rarely, problems 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 problem with any contrast dye used for x-rays.

Chest x-ray: An x-ray is sometimes done to see if the cancer has spread to the lungs. A chest x-ray 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 may not be needed.

Bone scan: A bone scan can help show if a cancer has spread to other bones. This test is useful because it gives a picture of the whole skeleton at once. For a bone scan, a radioactive tracer is put into a vein and travels through the blood. Areas of damaged bone, such as tumors, absorb this tracer. You (or your child) then lie on a table for about 30 minutes while a special camera makes pictures of the bones that show the radioactive spots. Younger children may be given medicine to help keep them calm or even asleep during the test.

A computer puts the pictures together showing the whole skeleton. Osteosarcoma will usually look like a darker spot in the bone (called a "hot spot"), showing where there is more radioactivity. Hot spots may suggest cancer, but other bone diseases can also cause the same pattern.

PET scan: For a PET scan, a form of radioactive sugar is put into the blood. The amount of radioactivity used is very low. Because cancer cells in the body are growing quickly, they take in a lot of the sugar. A special camera can then make a picture of places of radioactivity in the body. The picture is not as detailed as a CT or MRI scan, but it provides useful information about the

whole body. PET scans can be helpful in showing the spread of the cancer to the lungs, other bones, or other parts of the body. Some newer machines can do a PET and CT scan at the same time.

Biopsy

A biopsy involves taking a sample of the tumor to be looked at under a microscope. It is the only way to be sure if a tumor is an osteosarcoma or another type of bone cancer.

If the tumor is in a bone, it is very important that a surgeon with experience in treating bone tumors does the biopsy. When the biopsy is done right, it can prevent later problems and reduce the amount of surgery needed later on.

The biopsy may be done after the area around the tumor is numbed or with the patient in a deep sleep (under general anesthesia).

There are 2 different types of biopsies, the *needle biopsy* and the *open (surgical) biopsy*.

A needle biopsy can be done using a thick or a thin (fine) hollow needle to remove a small piece of tumor. With the thick needle biopsy, the surgeon takes out a round core of tissue. The fine needle biopsy, which is not used much for bone tumors, removes very small pieces of tissue.

In an open biopsy, the doctor cuts through the skin, exposes the tumor, and then cuts out a piece of it. This type of biopsy must be done by an expert in bone tumors, or else it could result in problems later on.

Lab tests

Testing the biopsy samples

All biopsy samples are sent to a doctor with special training in lab tests (a pathologist) to be looked at under a microscope. Tests to find 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.

If an osteosarcoma is found, the doctor will give it a grade, which is a measure of how quickly the cancer is likely to grow and spread. Cancers that look somewhat like normal bone tissue are described as low grade, while those that look very different from normal cells are called high grade. For more on grading, see the section, “Staging of osteosarcoma.”

Blood tests

Blood tests are not used to find osteosarcoma, but they may be helpful later. For instance, high levels of certain chemicals in the blood can suggest that the osteosarcoma might be more advanced than it looks.

Other tests (like blood cell counts) are done before surgery and other treatments to get a sense of a person’s overall health. These tests are also important to keep track of a person’s health while they are getting chemotherapy.

Staging of osteosarcoma

Staging is the process the doctor uses to find out how far the cancer has spread. The stage of the cancer 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 found?” The treatment and outlook for survival depend mostly on the stage of the cancer.

Localized or metastatic

Doctors divide osteosarcomas into 2 groups when deciding on the best course of treatment – *localized* or *metastatic*.

A *localized* osteosarcoma affects only the bone it started in and maybe the tissues next to the bone, such as muscles and tendons. But even when tests do not show that the cancer has spread to distant places, most patients are likely to have very small areas of cancer spread that can’t be found with tests. This is why chemotherapy (chemo) is an important part of treatment for most patients.

Doctors further divide these osteosarcomas into 2 groups. *Resectable* cancers are those in which all of the tumor than can be seen is able to be removed by surgery. Osteosarcomas that cannot be fully removed by surgery are called *non-resectable* (or *unresectable*).

A *metastatic* osteosarcoma has clearly spread to other parts of the body not directly connected to the bone the tumor started in. Most often the spread is to the lungs, but it can also spread to other bones, the brain, or other organs.

Patients with metastases (“mets”) at the time the cancer is found have a worse outlook, although some can be cured if the mets can be removed by surgery. The cure rate for these patients is much better if chemo is also given.

Musculoskeletal Tumor Society (MSTS) staging system

This system is a more detailed way to stage osteosarcoma. It is also known as the Enneking system. It takes into account the grade of the tumor, if the tumor has grown outside of the bone, and whether the cancer has spread to nearby lymph nodes or other organs. The grade is found by looking at the cancer cells under a microscope and is used to predict how likely the cancer is to grow and spread.

These factors are combined to give an overall stage, expressed in Roman numerals from I to III (1 to 3). Some of these stages are further divided into A or B. As a rule, the higher the number, the more serious the cancer.

AJCC staging system

Another staging system, the AJCC system (American Joint Commission on Cancer), divides osteosarcoma into 4 stages using Roman numerals I to IV (1 to 4). Again, the higher the number, the more advanced the cancer.

Ask your doctor to explain the stage of your (or your child’s) cancer to you in terms you can understand.

Survival rates for osteosarcoma

Survival rates are often used by doctors as a standard way of talking about 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 rates, 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 found. Of course, many people live much longer than 5 years – and many are cured. 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 better outlook for people now being treated for osteosarcoma.

With modern treatment, the 5-year survival rate for patients with localized osteosarcoma is in the range of 60% to 80%.

The 5-year survival rate for patients whose cancer has already spread (metastasized) at the time it is found is about 15% to 30%. The survival rate is closer to 40% if the cancer has spread only to the lungs or if all of the tumors can be removed with surgery.

Other things that may affect survival

Factors other than the stage of the cancer can also affect survival rates. For instance, these factors have been linked with a better outlook:

- Being younger (child or young adult, as opposed to older adult)
- Being female
- The tumor being found in an arm or leg bone (as opposed to the hip bones)
- The tumor(s) being completely removed
- Normal results on certain blood tests
- The tumor having a good response to chemotherapy

How is osteosarcoma treated?

This information represents the views of the doctors and nurses serving on the American Cancer Society's Cancer Information Database Editorial Board. These views are based on their interpretation of studies published in medical journals, as well as their own professional experience.

The treatment information in this document is not official policy of the 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.

About treatment

There has been great progress in the treatment of osteosarcoma during the past few decades. In the 1960s the only treatment was surgery to remove the limb with the tumor (amputation). At that time, only a small number of patients lived for 2 or more years after their cancer was found. Since then, doctors have found that chemotherapy (chemo) given before and after surgery will cure many people with this cancer. It may also allow some people to avoid having an arm or leg removed.

Once the cancer is found and staged, the doctor will talk to you about treatment options. This is an important decision and it is a good idea to take time and think about all the choices. Because osteosarcoma is rare, few doctors except those in major cancer centers have much experience in treating this disease. The best approach involves a team of people that includes several doctors, as well as other experts, who work together to find and treat the disease and help you or your child get back to normal activities after surgery.

For children, the best team approach includes the child's doctor as well as other experts like pediatric oncologists and orthopedic surgeons. Treatment is best done at a children's cancer center.

The types of treatment used for osteosarcomas include:

- Surgery
- Chemotherapy
- Radiation treatment (in certain cases)

In most cases, both chemo and surgery are needed.

All of these treatments can have side effects, but there is help for many of them. Your medical team will help you take care of the side effects and will work closely with other experts to help you understand and deal with the problems, stress, and other issues related to the treatment.

Because many of these issues can be more complex for cancer in children, many people will be involved in your child's overall care. As a parent, taking care of a child with cancer can be a very big job. It is important to remember that you will have a lot of help.

The next few sections describe the types of treatment used for osteosarcomas.

Surgery for osteosarcoma

Surgery for this type of cancer includes both the biopsy to confirm the cancer and the surgery to take out the tumor(s).

When possible, it is very important that the biopsy and surgical treatment be planned together, and that the same orthopedic surgeon at a cancer center does both the biopsy and the surgical treatment.

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 make a new tumor. To try to be sure that this doesn't happen, surgeons remove the tumor plus some of the normal tissue around it. This is known as *wide excision*. Taking out some normal-looking tissue raises the chance that all of the cancer has been removed.

The type of surgery done depends on the place of the tumor. Some tumors are much harder to treat. These include tumors at the base of the skull, or in the spine or hip bone (pelvis).

Tumors in the arms or legs

Surgery can be either the kind that saves the arm or leg (limb-sparing) or removes the cancer and all or part of an arm or leg (amputation).

Limb-sparing surgery (limb-salvage surgery): Most patients with tumors in the arms or legs can have limb-sparing surgery, but this depends on where the tumor is and how big it is. This type of surgery is very complex and should be done by a doctor with special skill and experience. The challenge for the surgeon is to remove all of the tumor while saving the nearby tendons, nerves, and blood vessels. But if the cancer has grown into these structures, they will need to be removed along with the tumor. In such cases, amputation may sometimes be the best option.

The part of the bone that is removed is replaced with a bone graft (piece of bone from a different part of the body or from another person), or with a device made of metal or other materials. Some metal rods are designed to grow with the child and can be made longer without any extra surgery. They have tiny devices in them that can lengthen the “bone” whenever needed to make room for a child’s growth. But even these may need to be replaced with something stronger once the child’s body stops growing.

More surgery may be needed during the years after the first operation, and some patients might still need an amputation later on. There can be a danger of infection, and grafts or rods can become loose or break. It takes about a year, on average, for patients to learn to walk again after this surgery on a leg. If the person does not keep up with rehabilitation, the arm or leg may become useless.

Amputation: If there is a large tumor that involves the nerves or the blood vessels, an amputation might be the best choice. Surgery is planned so that muscles and the skin will form a cuff around the end of the remaining arm or leg bone. This cuff will fit into an artificial limb (prosthesis). With physical therapy, the patient is often walking within 3-6 months after a leg amputation.

Reconstructive surgery: Sometimes, if the bone has to be removed in the middle of the thigh, the lower leg and foot is turned and attached to the thigh bone. The ankle now functions as a knee joint. This surgery is called *rotationplasty*. Of course, the person will need an artificial leg to make the leg long enough.

If the cancer is in the upper arm, the tumor may be removed and the lower arm reattached. Then the person will have a working, but shorter, arm.

Rehabilitation after surgery: This might turn out to be the hardest part of treatment. Patients (and the parents, if the patient is a child) should meet with a rehabilitation expert before surgery to learn what needs to be done.

If a limb is removed, the patient must learn how to use an artificial limb. This can be hard for growing children when the artificial limb needs to be changed to keep up with their growth.

If limb-sparing surgery is done, the situation is even more complex. Further operations might be needed to replace the metal rod with one more suited to their growing body size.

Each of these surgeries has problems as well as benefits. Most people would prefer limb-sparing surgery, but it can actually lead to more problems over time, such as the need for more surgery. People who have had a limb removed can often be more active, as the artificial limb may be able to take more stress than one with a bone graft or metal rod. It turns out that there is little difference in terms of people's quality of life. Often the biggest problem is for teens who fear the social effects of their operation. These feelings and concerns are very important, and support and encouragement are needed for all patients. (Please see the section "Impact of treatment for osteosarcoma").

Tumors that start in other places

Pelvic tumors can often be hard to remove with surgery. But if the tumor responds well to chemotherapy first, then surgery (sometimes followed by radiation treatment) may get rid of all of the cancer. Pelvic bones can often be reconstructed after surgery.

For a tumor in the lower jaw bone, the whole lower half of the jaw may be removed and later replaced with bones from other parts of the body. If the surgeon can't remove all of the tumor, radiation treatment may be used as well.

For tumors in areas like the spine or the skull, it may not be possible to remove all of the tumor safely. Cancers in these bones may need a combination of treatments like chemotherapy, surgery, and radiation.

Surgery for metastases

If the osteosarcoma has spread to other parts of the body, these tumors need to be removed for there to be a chance of curing the cancer

Surgery to remove cancer that has spread to the lungs must be planned very carefully. The doctor must have a plan in case there are more tumors than the CT scan showed. There could be some areas of spread that cannot be removed because they are too big or are too close to major structures in the chest, such as large blood vessels. Also, some patients may not be healthy enough to go through such surgery.

A small number of osteosarcomas spread to other bones or to the kidneys, liver, or brain. Whether or not these tumors can be removed with surgery depends on their size, place, and other factors.

For more information on surgery as a treatment for cancer, please see our document *Understanding Cancer Surgery: A Guide for Patients and Families.*

Chemotherapy for osteosarcoma

Chemotherapy (chemo) is the use of drugs to kill cancer cells. Most often the drugs are given into a vein. Once the drugs enter the bloodstream, they go throughout the body. This makes it a useful treatment for osteosarcoma, which has often spread to the lungs or other organs, or is likely to do so, even if tumors can't be seen on imaging tests.

Doctors give chemo in cycles, with each round of treatment followed by a rest to allow the body time to recover. Each chemo cycle lasts for a few weeks.

Chemo is part of the treatment for most osteosarcomas, although some patients with low-grade osteosarcoma may not need it. Often, chemo is given both before (for about 10 weeks) and after surgery for up to a year. Most of the time 2 or 3 drugs are given together.

Before starting chemo, the doctor might advise surgery to put a venous access device into a large vein in the chest. The device is a hollow tube that lets the health care team give chemo and other drugs and to draw blood samples without having to stick needles into the veins each time.

Side effects of chemo

Chemo kills cancer cells, but it also harms some normal cells. Side effects from chemo will depend on the type of drugs given, the amount taken, and how long treatment lasts. Side effects could include:

- Nausea and vomiting
- Loss of appetite
- Hair loss (the hair grows back after treatment ends)
- Mouth sores
- Diarrhea
- Increased chance of infection (caused by a shortage of white blood cells)
- Bleeding or bruising after small cut or injuries (from a shortage of platelets)
- Tiredness or shortness of breath (from a shortage of red blood cells)

Children seem to do better than adults when it comes to chemo. They tend to have less severe side effects and to get over side effects faster. Because of this, doctors can give them higher doses of chemo to try to kill the cancer.

Rarely, chemo may cause a second type of cancer (such as leukemia) years after the osteosarcoma is cured. But the need for chemo in treating osteosarcoma far outweighs this risk. Some other side effects, such as damage to the heart and not being able to have children (infertility), can happen with certain drugs. Serious side effects are rare, but they do happen. Side effects can often be prevented or controlled. Anyone who has problems with side effects should talk with their doctor or nurse about them. Some of these long-term effects are described in the section, “Long-term effects of cancer treatment for osteosarcoma.”

Tests to check for side effects of chemo: Before each treatment, the doctor will check your (or your child’s) lab results to be sure the liver, kidneys, and bone marrow (which makes blood cells) are working well.

The *complete blood count (CBC)* includes counts of white blood cells, red blood cells, and blood platelets. White blood cells fight infections, so it is important to know the white blood cell count before chemo starts. Platelets are small cells that plug up holes in blood vessels and stop bleeding. Red blood cells carry oxygen from the lungs to the rest of the body.

B*lood chemistry panels* measure certain blood chemicals that tell doctors how well the liver and the kidneys are working.

A test may be done to check the patient's hearing, which can be harmed by certain chemo drugs. Tests to check other body organs, such as the heart, may be done as well.

To find out more about chemo, please see our document, *Understanding Chemotherapy: A Guide for Patients and Families*.

Radiation treatment for osteosarcoma

Radiation therapy is treatment with high-energy rays to kill cancer cells. For the most part, radiation is not often used to treat osteosarcoma. Sometimes, though, it may be useful when the tumor cannot be completely removed by surgery. It can also help control symptoms like pain and swelling if the cancer has come back and surgery cannot be done.

To learn more about radiation treatment, please see our document, *Understanding Radiation Therapy: A Guide for Patients and Families.*

Clinical trials for osteosarcoma

You may have had to make a lot of decisions since you've been told you (or your child) has cancer. One of the most important decisions you will make is deciding which treatment is best for you. You may have heard about clinical trials being done for your type of cancer. Or maybe someone on your health care team has mentioned a clinical trial to you.

Clinical trials are carefully controlled research studies that are done with patients who volunteer for them. They are done to get a closer look at promising new treatments or procedures.

If you (or your child) would like to take part in a clinical trial, you should start by asking your doctor if your clinic or hospital conducts clinical trials. You can also call our clinical trials matching service for a list of clinical trials that meet your medical needs. You can reach this service at 1-800-303-5691 or on our Web site at www.cancer.org/clinicaltrials. You can also get a list of current clinical trials by calling the National Cancer Institute's Cancer Information Service toll-free at 1-800-4-CANCER (1-800-422-6237) or by visiting the NCI clinical trials Web site at www.cancer.gov/clinicaltrials.

There are requirements that must be met to take part in any clinical trial. If you (or your child) do qualify for a clinical trial, it is up to you whether or not to enter (enroll in) it. Older children, who can understand more, usually must also agree to take part in the clinical trial before the parents' consent is accepted.

Clinical trials are one way to get state-of-the art cancer treatment. Sometimes they may be the only way to get access to some newer treatments. They are also the only way for doctors to learn better methods to treat cancer. Still, they are not right for everyone.

You can get a lot more information on clinical trials, in our document called *Clinical Trials: What You Need to Know*. You can read it on our Web site or call our toll-free number and have it sent to you.

Complementary and alternative therapies for osteosarcoma

You are likely to hear about ways to treat your cancer or relieve symptoms that your doctor hasn't mentioned. Everyone from friends and family to Internet groups and Web sites may offer ideas for

what might help. These methods can include vitamins, herbs, and special diets, or other methods such as acupuncture or massage, to name a few.

What are complementary and alternative therapies?

It can be confusing because not everyone uses these terms the same way, and they are used to refer to many different methods. We use *complementary* to refer to treatments that are used *along with* regular medical care. *Alternative* treatments are used *instead of* a doctor's medical treatment.

Complementary methods: Most complementary treatment methods are not offered as cures for cancer. Mainly, they are used to help a person feel better. Some examples of methods that are used along with regular treatment are: art therapy or play therapy to reduce stress, acupuncture to help relieve pain, or peppermint tea to relieve nausea. Some complementary methods are known to help, while others have not been tested. Some have been proven not to be helpful, and a few are even harmful.

Alternative treatments: Alternative treatments may be offered as cancer cures. These treatments have not been proven safe and effective in clinical trials. Some of these methods may be harmful, or have life-threatening side effects. But the biggest danger in most cases is that you (or your child) may lose the chance to be helped by standard medical treatment. Delays or interruptions in medical treatments may give the cancer more time to grow and make it less likely that treatment will help.

Finding out more

It is easy to see why people with cancer think about alternative methods. You want to do all you can to fight the cancer, and the idea of a treatment with few or no side effects sounds great. Sometimes medical treatments like chemo can be hard to take, or they may no longer be working. But the truth is that most of these alternative methods have not been tested and proven to work in treating cancer.

As you think about your options, here are 3 important steps you can take:

- Look for "red flags" that suggest fraud. Does the method promise to cure all or most cancers? Are you told not to have regular medical treatments? Is the treatment a "secret" that requires you to visit certain providers or travel to another country?
- Talk to your (or your child's) doctor or nurse about any method you are thinking of using.
- Contact us at 1-800-227-2345 to learn more about complementary and alternative methods in general and to find out about the specific methods you are looking at.

You always have a say in how you or your child are treated. If you want to use a non-standard treatment, learn all you can about the method and talk to the doctor about it. With good information and the support of your health care team, you (or your child) may be able to safely use the methods that can help while avoiding those that could be harmful.

What are some questions I can ask the doctor about osteosarcoma?

As you cope with your (or your child's) cancer and cancer treatment, we encourage you to have honest, open talks with the doctor. Feel free to ask any question that's on your mind, no matter how small it might seem. Here are some questions you might want to ask. Be sure to add your own questions as you think of them. Nurses, social workers, and other members of the treatment team may also be able to answer many of your questions.

- Would you please write down the exact kind of cancer this is?
- Has the cancer spread beyond the bone where it started?
- What is the stage of the cancer and what does that mean?
- Are there other tests that need to be done before we can decide on treatment?
- How much experience do you have treating this type of cancer?
- What other doctors will we need to see?
- What treatment choices are there?
- What do you suggest and why?
- How long will treatment last? What will it involve? Where will it be done?
- How will treatment affect our daily lives?
- What is the goal of this treatment?
- What should we do to get 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 may happen later on?
- How might treatment affect my child's ability to grow and develop?
- Are there fertility issues we need to think about?
- What risks or side effects are there to the treatment you suggest?
- What are the chances of the cancer coming back after treatment?
- What would we do if this happens?
- What type of follow up and rehabilitation will be needed after treatment?

Add your own questions below:

Moving on after treatment for osteosarcoma

After treatment for osteosarcoma, the main concerns for most people are the side effects of the cancer and its treatment (both right away and long-term), and concerns about the cancer coming back.

It's normal to want to put the tumor and its treatment behind you and to get back to a life that doesn't revolve around cancer, but it's important to keep in mind that follow-up care is a central part of this process. It offers you (or your child) the best chance for recovery and long-term survival.

Follow-up care

After treatment is over, it is very important to go to all follow-up visits. During these, doctors will ask about symptoms, do physical exams, and may order blood tests or tests like CT scans or x-rays. Follow-up is needed to check for the cancer coming back (recurrence) or spread, as well as to check for side effects of certain treatments. This is the time for you discuss any concerns or questions you might have.

Your or your child will probably see the oncologist and the orthopedic surgeon every few months during the first year after treatment. Physical exams, tests like chest x-rays or CT scans, and x-rays of the bone that had cancer are recommended every 3 to 4 months for 3 years, every 6 months in years 4 and 5, and once a year after that.

Some chemotherapy drugs can cause problems with hearing or damage to the heart. People who get these drugs may have exams to check these things.

Almost any cancer treatment can have side effects. Some may last for a few weeks or months, but others can be permanent. Please tell the cancer care team about any symptoms or side effects that bother you (or your child) so they can help you manage them.

It is also important to keep health insurance. While you hope your cancer (or your child's cancer) won't come back, it could happen. If it does, you don't want to have to worry about paying for treatment. Should the cancer come back, our document *When Your Cancer Comes Back: Cancer Recurrence* can help you manage and cope with this phase of treatment.

Keeping good medical records for osteosarcoma

As much as you may want to put the cancer behind you once treatment is over, it is very important to keep good records of all on-going medical care. This can be very helpful for you or for your child later on as an adult. Gathering these details soon after treatment may be easier than trying to get them at some point in the future. Be sure the doctors have the following information and keep copies of all medical records for yourself:

- A copy of the pathology report from any biopsies or surgeries
- If surgery was done, a copy of the operative report
- If you (or your child) stayed in the hospital, copies of the discharge summaries that doctors prepare when patients are sent home

- If chemo was given, a list of the drugs, drug doses, and when they were given
- If radiation was given, a summary of the type and dose of radiation and when and where it was given

Impact of treatment for osteosarcoma

Most cases of osteosarcoma happen during the teen or young adult years. This is a very sensitive time in a person's life. Having this disease can affect how a person looks and how they do some everyday tasks. This can have an impact on their school, work, and other daily activities. The impact is often greatest during the first year of treatment.

The treatment center should help address these issues as soon as possible. Some common concerns include costs, getting to the cancer center, and being able to go to work or school. If possible, children should attend school as much as they can. This helps them stay in touch with friends and gives them a chance to tell others what is going on.

While friends can be a great source of support, some people have wrong ideas or fears about cancer. Some cancer centers have programs that can help by sending health educators to the school to talk to students and teachers about cancer and its treatment.

There may also be programs that help new patients meet others who have already finished treatment. These are often called support groups and they can be a big help for the person starting treatment.

Adults with osteosarcoma can face many of the same challenges. They, as well as children and teens, can and should use their cancer center's extra support services.

Long-term effects of cancer treatment for osteosarcoma

Because there are now much better treatments, more children who have had cancer are living longer lives. Their health as adults has come more into focus in recent years. Just as the treatment of cancer in young people calls for a very special approach, so does the care and follow-up after treatment. The earlier any problems can be spotted, the more likely it is they can be treated effectively.

Young people who survive cancer are at some risk for several possible late effects of their cancer treatment. This risk depends on a number of things, such as their type of cancer, the cancer treatments they had, and their age when they had treatment. For example, the effects of surgery for osteosarcoma can range from small scars to the loss of a limb.

Some other late effects of treatment could include:

- Heart or lung problems (due to certain treatments)
- Loss of hearing (due to certain drugs)
- Slowed or decreased growth and development (in the bones or overall)
- Changes in sexual development and ability to have children (see below)
- Learning problems in younger children

- Development of second cancers (see below)

Infertility

Not being able to have children (infertility) is not a common side effect of the treatment for osteosarcoma, but it can happen. Older girls and women may have changes in their periods, but normal monthly cycles usually return after chemotherapy ends. Boys and men may not be able to make sperm. This usually returns, but the sperm count may remain low.

Talk to your (child's) cancer care team about the risks of infertility with treatment, and ask if there are options for saving fertility, such as sperm banking. To find out more, see our document, *Fertility and Women With Cancer* or *Fertility and Men With Cancer*.

Getting a second cancer

Rarely, some types of chemotherapy may cause a second type of cancer (such as leukemia), years after the osteosarcoma is cured. Radiation treatment can also raise the risk of a new cancer at the site of the treatment. But the need to treat the osteosarcoma far outweighs this risk.

Long-term follow-up care for children and teens

To help increase awareness of late effects and improve follow-up care of children who have had cancer throughout their lives, the Children's Oncology Group (COG) has long-term follow-up guidelines for survivors of childhood cancers. These guidelines can help you learn what to watch for, what type of screening tests should be done to look for problems, and how late effects are treated.

It is very important to discuss possible long-term problems with your child's health care team, and to make sure there is a plan in place to watch for these problems and treat them, if needed. To learn more, ask your child's doctors about the COG survivor guidelines. You can also download them for free at the COG Web site: www.survivorshipguidelines.org. The guidelines are written for health care professionals. Patient versions of some of the guidelines are available (as "Health Links") on the site as well, but we urge you to review them with a doctor.

For more about some of the possible long-term effects of treatment, see the document, *Children Diagnosed With Cancer: Late Effects of Cancer Treatment.*

What's new in osteosarcoma research?

Research on the causes and treatment of this cancer is now being done at many medical centers around the world.

Researchers are making progress in learning about the causes of osteosarcoma and the DNA changes that cause this cancer. This knowledge could lead to treatments to correct these changes.

Treatment

Great progress has been made in treating osteosarcoma in the past few decades. Still, more research is needed to learn how best to manage hard-to-treat osteosarcomas, such as those that have already spread when they are found.

Surgery

Doctors now know much more about the growth and spread of osteosarcomas than they did in the past. This, along with newer imaging tests, allows them to plan surgeries that remove the cancer while leaving as much normal tissue as they can.

Some newer, man-made devices used to replace pieces of bone (internal prostheses) can now be made longer without the need for further surgery. This is especially important for children, who in the past often needed several operations to replace the prosthesis with a larger one as they grew.

Radiation treatment

Osteosarcoma cells are not killed easily by radiation, so high doses are needed to have an effect. This has limited the use of radiation, because such high doses can often cause bad side effects. Newer forms of radiation let doctors focus the radiation more right on the tumor. This limits the doses received by nearby healthy tissues and may allow higher doses to be used on the tumor itself.

Chemotherapy

Clinical trials are being done to figure out the best combinations of chemo drugs, as well as the best time to give them. Newer chemo drugs are being studied, too.

The lungs are the most common place for osteosarcoma to spread. Inhaled forms of some chemo drugs are being studied for patients whose cancer has spread to their lungs. Early results have shown promise.

Other new forms of treatment

Clinical trials are looking into ways to help the patient's own immune system recognize and attack the osteosarcoma cells. A new drug called *muramyl tripeptide* (MTP) has been shown to help some patients when added to chemotherapy.

Doctors are also looking at new medicines that are aimed at certain molecules on the cancer cells. These are known as *targeted therapies*. Some of these are man-made versions of immune system proteins called *monoclonal antibodies*.

Other drugs that target the bone cells called osteoclasts may also be useful against osteosarcoma. Bisphosphonates are a group of drugs that are already used to treat bone thinning and certain cancers that have spread to the bone. Some of these drugs, as well as others that affect the bones, are now being studied for use in patients with osteosarcoma.

More information about osteosarcoma

From your American Cancer Society

Here is more information you might find helpful. You also can order free copies of our documents from our toll-free number, 1-800-227-2345, or read them on our Web site, www.cancer.org.

Osteosarcoma Detailed Guide

After Diagnosis: A Guide for Patients and Families (also in Spanish)

Children Diagnosed With Cancer: Dealing With Diagnosis (also in Spanish)

Children Diagnosed With Cancer: Financial and Insurance Issues

Children Diagnosed With Cancer: Late Effects of Cancer Treatment

Children Diagnosed With Cancer: Returning to School

Children Diagnosed With Cancer: Understanding the Health Care System (also in Spanish)

Clinical Trials: What You Need to Know

Family and Medical Leave Act (FMLA)

Fertility and Women With Cancer

Fertility and Men With Cancer

Health Professionals Associated With Cancer Care

Nutrition for Children with Cancer (also in Spanish)

Pediatric Cancer Centers (also in Spanish)

Second Cancers Caused by Cancer Treatment

Understanding Cancer Surgery: A Guide for Patients and Families

Understanding Chemotherapy: A Guide for Patients and Families (also in Spanish)

Understanding Radiation Therapy: A Guide for Patients and Families (also in Spanish)

What Happened to You, Happened to Me (children’s booklet)

When Your Brother or Sister Has Cancer (children’s booklet)

When Your Child’s Treatment Ends: A Guide for Families

Your American Cancer Society also has books that you might find helpful. Call us at 1-800-227-2345 or visit our bookstore online at cancer.org/bookstore to find out about costs or to place an order.

National organizations and Web sites*

Along with the American Cancer Society, other sources of information and support include:

American Childhood Cancer Organization (formerly Candlelighters)
Toll-free number: 1-855-858-2226
Web site: www.acco.org

Amputee Coalition of America
Toll-free number: 1-888-AMP-KNOW (1-800-267-5669)
Web site: www.amputee-coalition.org

CureSearch (National Childhood Cancer Foundation and Children's Oncology Group)
Toll-free number: 1-800-458-6223
Web site: www.curesearch.org

National Cancer Institute, Cancer Information Service
Toll-free number: 1-800-422-6237 (1-800-4-CANCER)
Web site: www.cancer.gov

National Children's Cancer Society, Inc.
Toll-free number: 1-800-532-6459 (1-800-5-FAMILY)
Web site: www.children-cancer.org

National Dissemination Center for Children with Disabilities (NICHCY)
Toll-free number: 1-800-695-0285 (also for TTY)
Web site: www.nichcy.org

Starlight Children's Foundation
Toll-free number: 1-800-315-2580
Web site: www.starlight.org

Teens Living with Cancer
Web site: www.teenslivingwithcancer.org

**Inclusion on this list does not imply endorsement by the American Cancer Society*

Other publications*

For adults

100 Questions & Answers About Your Child's Cancer, by William L. Carroll and Jessica Reisman. Jones and Bartlett Publishers, 2004.

Cancer & Self-Help: Bridging the Troubled Waters of Childhood Illness, by Mark A. Chester and Barbara K. Chesney. University of Wisconsin Press, 1995.

Care for Children and Adolescents with Cancer: Questions and Answers. National Cancer Institute. 2008. Available at: www.cancer.gov/cancertopics/factsheet/NCI/children-adolescents or call 1-800-332-8615.

Childhood Cancer: A Parent's Guide to Solid Tumor Cancers, by Honna Janes-Hodder and Nancy Keene. O'Reilly and Associates, 1999.

Childhood Cancer: A Handbook from St Jude Children's Research Hospital, by Grant Steen and Joseph Mirro (editors). Perseus Publishing, 2000.

Childhood Cancer Survivors: A Practical Guide to Your Future, by Nancy Keene, Wendy Hobbie, and Kathy Ruccione. O'Reilly and Associates, 2000.

Children with Cancer: A Comprehensive Reference Guide for Parents (2nd edition), by Jeanne Munn Bracken and Pruden Pruden. Oxford University Press, 2005.

Educating the Child with Cancer: A Guide for Parents and Teachers, edited by Nancy Keene. Candlelighters Childhood Cancer Foundation, 2003.

Living with Childhood Cancer: A Practical Guide to Help Families Cope, by Leigh A. Woznick and Carol D. Goodheart. American Psychological Association, 2002.

Surviving Childhood Cancer: A Guide for Families, by Margo Joan Fromer. New Harbinger Publications, 1998.

When Bad Things Happen to Good People, by Harold Kushner. G.K. Hall, 1982.

When Someone You Love Is Being Treated for Cancer. National Cancer Institute, 2012. Available at: www.cancer.gov/cancertopics/coping/when-someone-you-love-is-treated, or call 1-800-332-8615.

Young People with Cancer: A Handbook for Parents. National Cancer Institute, 2003. Available at: www.cancer.gov/cancertopics/coping/youngpeople, or call 1-800-332-8615.

Your Child in the Hospital: A Practical Guide for Parents (2nd edition), by Nancy Keene. O'Reilly & Associates. 1999. (Also available in Spanish.)

Books for teens and children

Although these books are intended for children, younger kids are helped more when an adult reads with and helps the child reflect about what different parts of the book mean to the child.

The Amazing Hannah, Look at Everything I Can Do! by Amy Klett. Candlelighters Childhood Cancer Foundation, 2002. For ages 1 to 6. (Also available in Spanish.)

Chemo, Craziness and Comfort: My Book about Childhood Cancer by Nancy Keene. Candlelighters Childhood Cancer Foundation, 2002. Can be ordered from www.candlelighters.org. For ages 6 to 12.

Childhood Cancer Survivors: A Practical Guide to Your Future (2nd edition), by Kathy Ruccione, Nancy Keene, and Wendy Hobbie. Patient Centered Guides, 2006. For older teens.

Going to the Hospital, by Fred Rogers. Paperstar Book, 1997. For children ages 4 to 8.

Life Isn't Always a Day at the Beach: A Book for All Children Whose Lives Are Affected by Cancer, by Pam Ganz. High-Five Publishing, 1996. Workbook for ages 6 to 10.

Little Tree: A Story for Children with Serious Medical Problems, by Joyce C. Mills. Magination Press, 2003. For ages 4 to 8.

Living Well With My Serious Illness, by Marge Heegaard. Fairview Press, 2003. For ages 8 to 12.

Me and My Marrow, by Karen Crowe. Published by Fujsawa Healthcare, 1999. For teens.

My Book for Kids with Cansur [sic], by Jason Gaes. Viking Penguin, 1998. For ages 4 to 8.

Oncology, Stupology…I Want to Go Home! by Marilyn K. Hershey. Butterfly Press, 1999. For ages 8 to 12. (Also in Spanish.)

What About Me? When Brothers and Sisters Get Sick, by Allan Peterkin and Frances Middendorf. Magination Press, 1992. For brothers and sisters (ages 4 to 8) of a child with cancer.

When Someone Has a Very Serious Illness: Children Can Learn to Cope with Loss and Change, by Marge Heegaard. Woodland Press, 1991. For ages 6 to 12.

Why, Charlie Brown, Why? A Story About What Happens When a Friend Is Very Ill, by Charles M. Schultz. Ballantine Publishing Group, 1990. For ages 6 to 12.

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No matter who you are, we can help. Contact us anytime, day or night, for cancer-related information and support. Call us at 1-800-227-2345 or visit www.cancer.org.

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