Osteosarcoma Overview

This overview is based on the more detailed information in our document *Osteosarcoma*.

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 when they are growing, normal cells divide faster. Once 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. In most cases the cancer cells form a tumor. Cancer cells can also grow into (invade) other tissues, something that normal cells can't do. Being able to grow out of control and invade other tissues are what makes a cell a cancer cell.

Sometimes cancer cells spread to other parts of the body. There they begin to grow and form new tumors. This process is called *metastasis*.

No matter where a cancer spreads, it is named (and treated) based on the place where it started. For instance, breast cancer that has spread to the liver is still breast cancer, not liver cancer. Likewise, prostate cancer that has spread to the bones is still prostate cancer, not bone cancer.

Different types of cancer can behave very differently. They grow at different rates and respond to different treatments. This is why people with cancer need treatment that is aimed at their own kind of cancer.

Not all tumors are cancer. Tumors that aren't cancer are called *benign*. Benign tumors can cause problems – they can grow very large and press on healthy organs and tissues. But they can't 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?

The types of cancers that children and teens 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.

In most cases, childhood cancers tend to respond better to treatments like chemotherapy (chemo). But, chemo and other treatments can have long-term side effects, so children who have had 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, working 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.

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.

When a child or teen has cancer, it affects every family member and nearly every aspect of the family's life. You can read more about coping with these changes in our document *Children Diagnosed With Cancer: Dealing With Diagnosis.*

What is osteosarcoma?

Osteosarcoma is a type of cancer that starts in the bones. To understand osteosarcoma, it helps to know about the bones and what they do.

Normal bones

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

- 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 – 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. Even though this cancer starts in the cells that make bone, the cancer-filled bone is not as strong as normal bones.

Most osteosarcomas occur in children and teens, but they can occur at any age.

Osteosarcoma often starts near the ends of the long bones in the legs, especially around the knee. The arm bone near the shoulder is the next most common place. 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 better outlook for survival than others.

Osteosarcomas can be grouped as low grade, intermediate grade, or high grade.

- **Low-grade** tumors have few dividing cells and look more like normal bone. They tend to grow slowly.
- **Intermediate-grade** tumors are in between low- and high-grade tumors, although they are usually treated like low-grade tumors.
- **High-grade** tumors have many dividing cells and look very abnormal. These tumors tend to grow quickly. Most osteosarcomas in children and teens are high grade.

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 our 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 *Bone Metastasis*.

Some bone tumors are not cancer. These are called *benign* 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.

Osteosarcomas account for about 3% of childhood cancers, but they make up a much smaller portion of adult cancers.

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. 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: Risk is highest in teens and young adults, but it is also higher in people over 60.

Height: Children with osteosarcoma are usually tall for their age.

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 osteosarcoma in the same area later.

Certain bone diseases: People with certain non-cancer bone diseases have an increased risk of getting osteosarcoma:

- Paget disease of bone
- Multiple hereditary osteochondromas

Certain cancer syndromes: People with certain rare, inherited cancer syndromes have an increased risk of getting osteosarcoma:

- Li-Fraumeni syndrome
- Hereditary retinoblastoma (a rare childhood eye cancer)
- Rothmund-Thompson syndrome

- Bloom syndrome
- Werner syndrome
- Diamond-Blackfan anemia

It is important to keep in mind that for most people with osteosarcoma, 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 most of these cancers.

How is osteosarcoma found?

Most osteosarcomas 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 screen for 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. 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 bone tumor, the doctor will want to take a complete medical history. A physical exam will be done to learn more about the tumor, as well as 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
- To see if the cancer has come back after treatment

Bone x-rays: This is often the first test done if a doctor suspects a bone tumor. Doctors can often spot a bone tumor like an 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) scan: The CT scan uses x-rays to make detailed 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 or other parts of the body.

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. 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 probably won’t be needed.

Bone scan: A bone scan can help show if a cancer has spread to other bones. This test is useful because it can show the whole skeleton at once. a bone scan might not be needed if a PET scan (described below) is being done.

For a bone scan, a small amount of 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 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.

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. Any cancer cells in the body will 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 detailed like a CT or MRI scan, but it provides useful information about the whole body. PET scans can help show 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.

To learn more about these imaging tests, see our document *Imaging (Radiology) Tests.*

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. This surgeon can plan both the biopsy and surgery to treat the tumor at the same time. This can help prevent later problems and might 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 is done using a thin, hollow needle to remove a small piece of tumor.
- 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. Other lab tests might also be done on the samples. 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. Cancer cells that look somewhat like normal bone cells are described as low grade, while those that look very different from normal cells are called high grade.

Blood tests

Blood tests are not used to find osteosarcoma, but they may be helpful after it is found. 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

The stage of a cancer is a standard summary of how far it has spread. The stage 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.

Osteosarcoma can be staged in different ways.

Localized or metastatic

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

Localized: These osteosarcomas affect only the bone they started in and maybe the structures 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 visible tumor can be removed by surgery.
- **Non-resectable** (or **unresectable**) osteosarcomas cannot be fully removed by surgery.

Metastatic: These osteosarcomas have clearly spread to other parts of the body. 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 are harder to treat, 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 (based on how abnormal the cancer cells look under the microscope)
- If the main tumor has grown outside of the bone
- If 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), is based on 4 key pieces of information:

- **T** describes the size of the main **tumor** and whether it is in different areas of the bone
- **N** describes spread to nearby lymph **nodes**
- **M** tells whether the cancer has **metastasized** (spread) to other organs
- **G** stands for the **grade** of the tumor

These factors are combined to give an overall stage, using Roman numerals I to IV (1 to 4). Again, the higher the number, the more advanced the cancer.

The staging of osteosarcoma can be confusing, so be sure to ask your doctor to explain the stage of your (or your child's) cancer to you in terms you can understand.

Other things that can affect a person's outlook

The stage of the cancer is important when trying to figure out a person's outlook, but other factors are important, too. For instance, these factors have been linked with a better outlook:

- Being younger (child or young adult, as opposed to an older adult)
- Being female
- The tumor being found in an arm or leg bone (as opposed to the hip bones)
- The tumor(s) being removed completely
- 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

Once the cancer is found and staged, the doctor will talk to you about treatment options. It's important to be sure you understand your options. Ask your cancer care team questions. You can find some good questions to ask in the section "What are some questions I can ask the doctor about osteosarcoma?"

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 treat the disease and help you or your child get back to normal activities after surgery.

For children and teens, 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 (chemo)
- Radiation treatment (in certain cases)

Most often, chemo is the first treatment used. This is followed by surgery if it can be done, and then more chemo. Radiation might be used if not all of the cancer can be removed or if there is a high risk of the cancer coming back after surgery.

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 and teens, 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. For more on this, see our document *Children Diagnosed With Cancer: Understanding the Health Care System*.

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

Surgery for osteosarcoma

Surgery is an important part of treating nearly all osteosarcomas (although chemotherapy is typically given first to try to shrink the cancer and make it easier to remove).

Surgery 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 surgery be planned together, and that the same orthopedic surgeon at a cancer center does both the biopsy and the surgery to remove the tumor.

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

The type of surgery done depends on where the tumor is. 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, how big it is, and if it has grown into nearby structures.

This type of surgery is very complex and should be done by a doctor with special skill and experience. The surgeon will try 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 later on 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 the tumor is large and extends into 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.

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. You (or you and your child) should meet with a rehabilitation expert before surgery to learn what will need to be done after surgery.

If a limb is removed, the patient will need to 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 can be even more complex. Further operations might be needed in the coming years to replace the metal rod with one more suited to their growing body size.

Each of these surgeries can have pros and cons. Most people would prefer limb-sparing surgery, but it can sometimes actually lead to more problems over time, such as the need for more surgery. 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 sometimes be reconstructed after surgery, but in some cases the hip bone and leg might need to be removed.

For a tumor in the lower jaw bone, the whole bone 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.

If the cancer has spread to the lungs, surgery 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 other organs like the kidneys, liver, or brain. Whether these tumors can be removed with surgery depends on their size, place, and other factors.

Side effects of surgery

Short-term risks and side effects: Surgery for osteosarcoma is often 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 surgery, and it might require strong pain medicines for a while as the surgery 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. Most osteosarcomas 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 bone grafts or rods that might become loose or broken. The chemotherapy used before and after surgery can increase the risk of infection and affect wound healing. Infections are also a concern in people who have had amputations, especially of part of a leg.

Physical therapy and rehab is very important after surgery for osteosarcoma. It 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 how they look. Physical, occupational, and other therapies can often help people adjust and cope with these challenges.

For more on surgery as a treatment for cancer, 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.

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

Before starting chemo, the doctor might advise surgery to put a thin, soft tube called a *catheter* or *venous access device* (VAD) into a large vein in the chest. This 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. The catheter usually stays in place for several months while chemo is being given.

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)

Most of these side effects are short-term and tend to go away after treatment. Often there are ways to lessen these side effects. For example, drugs can be given to help prevent or reduce nausea and vomiting, or to help get blood counts back to normal levels. 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.

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.

Some chemo drugs can cause other side effects, such as:

- Bladder or kidney damage
- Damage to nerves, which can cause numbness, tingling, or pain in the hands and feet
- Loss of hearing
- Damage to the heart
- Increased risk of a second cancer (such as leukemia) later on
- Loss of fertility (ability to have children)

Serious side effects are rare, but they do happen. Some of these long-term effects are described in the section “Long-term effects of cancer treatment for osteosarcoma.”

To find out more about chemo, please see the “Chemotherapy” section of our website or our document *A Guide to Chemotherapy*.

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 can’t be removed completely by surgery. It can also help control symptoms like pain and swelling if the cancer has come back and surgery can’t be done.

Most often, radiation treatments are given 5 days a week for several weeks. Each treatment is a lot like getting an x-ray, although the radiation dose is much higher. The treatment is not painful. For

each session, you (or your child) will lie on a special table while the radiation is given from different angles.

Each treatment lasts only a few minutes, although the setup time – getting you (or your child) into place for treatment – usually takes longer. Young children may be given medicine to make them sleep so they will not move during the treatment.

For more on radiation therapy, see the “Radiation Therapy” section of our website or 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 osteosarcoma. 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 osteosarcoma. 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 learn more about promising new treatments or procedures.

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

If you would like to learn more about clinical trials that might be right for you (or your child), 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 studies that meet your medical needs. You can reach this service at 1-800-303-5691 or on our website 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 at 1-800-4-CANCER (1-800-422-6237) or by visiting the NCI clinical trials website 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.

For more on clinical trials, see our document *Clinical Trials: What You Need to Know*.

Complementary and alternative therapies for osteosarcoma

You are likely to hear about ways to treat your (or your child’s) cancer or relieve symptoms that your doctor hasn’t mentioned. Everyone from friends and family to social media groups and websites might 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. Delaying or interrupting medical treatments may give the cancer more time to grow and make it less likely that treatment will help.

Finding out more

It's easy to see why people with cancer (or with children who have 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 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 or see the "Complementary and Alternative Medicine" section of our website 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?

It's important to have honest, open talks with your doctor. Feel free to ask any question, no matter how small it might seem. Here are some questions you might want to ask.

- 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?

- Do we need to do other tests before we can decide on treatment?
- How much experience do you have treating this type of cancer?
- Will we need to see other doctors?
- What are our treatment choices?
- What do you suggest and why?
- How soon do we need to start treatment?
- How long will treatment last? What will it be like? Where will it be done?
- How will treatment affect our daily lives?
- What should 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 might happen later on?
- Will treatment affect my child's ability to grow and develop?
- Are there fertility issues we need to think about?
- What are the chances of the cancer coming back after treatment?
- What would we do if this happens?
- What type of follow up and rehab will be needed after treatment?
- Are there nearby support groups or other families who have been through this that we could talk to?

Along with these sample questions, be sure to write down some of your own. For instance, you might want to learn more about recovery times so you can plan work or school schedules. You may also want to ask about second opinions or about available clinical trials.

Keep in mind that doctors are not the only ones who can give you information. Other health care professionals, such as nurses and social workers, may have the answers to some of your questions. For more about communicating with your health care team, see our document *Talking With Your Doctor*.

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's 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 visits are needed to check for the cancer coming back (recurrence) or spreading, as well as to check for side effects from treatment. This is the time for you discuss any concerns or questions you might have.

Your or your child will probably need to see the doctor and get scans or other tests every few months during the first year after treatment, and less often after that if there are no issues.

Physical therapy and rehab is often a very important part of recovery after treatment, and your doctors and other health providers will follow your (child's) progress closely as time goes on.

Almost any cancer treatment can have side effects. Some may last for weeks or months, but others can last longer or might not show up until months or even years later. Be sure to 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's also very important to keep health insurance. Tests and doctor visits cost a lot, and even though no one wants to think of their cancer coming back, this could happen.

Should the cancer come back, treatment will depend on where it is, what treatments were used before, and other factors. For more on dealing with a recurrence, 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 treatments. 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 always keep copies 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 the doctor wrote when you (or your child) were 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
- Copies of all imaging tests (these can be put onto a DVD, etc.)
- The names and contact information of the doctors who treated the cancer

Impact of treatment for osteosarcoma

Social and emotional issues might come up during and after treatment. A person's age and the extent of treatment can play a role in this.

Most osteosarcomas happen during the teen or young adult years. This is a very sensitive time in a person's life. This cancer and its treatment 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, but it can be long-lasting for some people.

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.

Cancer care teams usually advise that children and teens attend school as much as they can. This helps them maintain a sense of daily routine and stay in touch with friends.

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. (For more on this, see our document *Children Diagnosed With Cancer: Returning to School*.)

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.

Parents and other family members can also be affected, both emotionally and in other ways. Some common family concerns during treatment include money issues, traveling to and staying near the cancer center, the possible loss of a job, and the need for home schooling. Social workers and other experts at cancer centers can help families sort through these issues.

During treatment, patients and their families tend to focus on the daily aspects of getting through it and beating the cancer. But once treatment is done, a number of emotional concerns can come up. Some of these might last a long time. They can include things like:

- Dealing with physical changes from the treatment
- Worrying about the cancer returning or new health problems
- Resenting having had cancer or having to go through treatment when others do not
- Worrying about being treated differently (by friends, classmates, coworkers, employers, etc.)
- Being concerned about dating, marrying, and having a family later in life

With support from family, friends, and others, many people who have survived cancer can thrive in spite of the challenges they've had to face. If needed, doctors and other members of the health care team can often recommend special support programs and services to help after cancer 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.

Late and long-term effects of treatment for osteosarcoma

More young people with osteosarcoma are now surviving this cancer. But 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 their 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 late effects of their cancer treatment. This risk depends on a number of things, such as 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)

There may be other effects from treatment as well. Your child's doctor should carefully review any possible problems with you before your child starts treatment.

Fertility issues

Fertility problems are not common after osteosarcoma treatment, but they 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 before treatment, and ask if there are options for saving fertility, such as sperm banking. To find out more, see our documents *Fertility and Women With Cancer* or *Fertility and Men With Cancer*.

Getting a second cancer

Rarely, some types of chemotherapy can 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. For more on second cancers, see our document *Second Cancers Caused by Cancer Treatment*.

Long-term follow-up care for children and teens

To help increase awareness of late effects and improve the long-term care of children who have had cancer, 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's 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 view them for free at the COG website: 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 discuss them with a doctor.

For more about some of the possible long-term effects of treatment, see our 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 learning more about what makes osteosarcoma cells different from normal bone cells. This might help researchers design new and better treatments.

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 (called *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

Immunotherapy drugs: 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.

Targeted drugs: Doctors are also looking at new medicines that are aimed at certain molecules on the cancer cells. Some of these are man-made versions of immune system proteins called *monoclonal antibodies*.

Drugs that affect the bones: 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 website, www.cancer.org.

Osteosarcoma Detailed Guide

Children with cancer

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

Pediatric Cancer Centers (also in Spanish)

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

Children Diagnosed With Cancer: Financial and Insurance Issues

Children Diagnosed With Cancer: Returning to School

Children Diagnosed With Cancer: Late Effects of Cancer Treatment

Health Professionals Associated With Cancer Care

Talking With Your Doctor (also in Spanish)

Coping with cancer

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

Family and Medical Leave Act (FMLA) (also in Spanish)

Nutrition for Children With Cancer (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 (booklet)

Cancer treatment information

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

A Guide to Chemotherapy (also in Spanish)

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

Clinical Trials: What You Need to Know (also in Spanish)

Cancer treatment side effects

Caring for the Patient With Cancer at Home: A Guide for Patients and Families (also in Spanish)

Nausea and Vomiting

Guide to Controlling Cancer Pain (also in Spanish)

Anemia in People With Cancer

Fatigue in People With Cancer

Fertility and Women With Cancer

Fertility and Men With Cancer

Second Cancers Caused by Cancer Treatment

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 websites*

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
Website: www.acco.org

Offers information for children and teens with cancer, their siblings, and adults dealing with children with cancer. Also offers books and a special kit for children newly diagnosed with cancer, as well as some local support groups.

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

Offers resources for specific groups with amputations, including parents and youth (see their "Limb Loss Resource Center" online); also lists some local support groups across the country.

Children's Oncology Group (COG)
Website: www.childrensoncologygroup.org

Provides key information from the world's largest organization devoted to childhood cancer research to help support children and their families from the time of diagnosis, through treatment, and beyond. Also has a searchable database to find the COG center closest to you.

CureSearch for Children's Cancer
Toll-free number: 1-800-458-6223
Website: www.curesearch.org

Provides up-to-date information about childhood cancer from pediatric cancer experts. Has sections on the website for patients, families, and friends to help guide them on how to support the child with cancer.

National Cancer Institute
Toll-free number: 1-800-422-6237 (1-800-4-CANCER)
Website: www.cancer.gov

Provides accurate, up-to-date information about cancer for patients and their families, including clinical trials information. Offers a special booklet for teen siblings of a child with cancer at: www.cancer.gov/cancertopics/when-your-sibling-has-cancer.

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

Services include an online support network for parents of children with cancer, educational materials, and financial assistance for treatment-related expenses.

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

Provides information about disabilities and disability-related issues for families, educators, and other professionals.

Websites for teens and children

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

> Website has animated stories and interactive programs to teach kids about chemo and procedures that are done in the hospital; also has videos specifically for teens and provides a safe, monitored online support group for teens with cancer.

Teens Living with Cancer
Website: www.teenslivingwithcancer.org

> An online-only resource dedicated to teens coping with a cancer diagnosis and treatment. It focuses on teen issues and provides resources to support teens, their families, and friends.

Group Loop (a subsite of the **Cancer Support Community** just for teens)
Toll-free number: 1-888-793-9355
Website: www.grouploop.org

> An online place for teens with cancer or teens who know someone with cancer to connect with other teens away from the pressures of classes, responsibilities, and treatment schedules. Has online support groups, chat rooms, information, and more.

SuperSibs! powered by Alex's Lemonade Stand
Toll-free number: 1-866-333-1213
Website: www.supersibs.org

> Supports, honors, and recognizes brothers and sisters of children diagnosed with cancer so they may face the future with strength, courage, and hope. Alex's Lemonade Stand is restarting SuperSibs in 2014 so there may be some delays with resuming support services.

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

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.

Last Medical Review: 6/13/2014
Last Revised: 6/13/2014

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