

# Rivaroxaban Learning System

## Orthopedic Surgery

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# Rivaroxaban Learning System

## Orthopedic Surgery

### Module Introduction

This module provides an overview of hip and knee replacement surgery, and includes the following chapters:

### Welcome

Welcome to the **Orthopedic Surgery** training module in the Rivaroxaban Learning System.

- o Overview of Orthopedic Surgery
- o Hip Replacement Surgery
- o Knee Replacement Surgery
- o Prevention of Venous Thromboembolism After Orthopedic Surgery

### Important Notes

- o Rivaroxaban is pending approval for the prophylaxis of venous thromboembolism following hip and knee replacement surgery.
- o Promotion of rivaroxaban for this indication or any other disease state described in this module is strictly prohibited prior to FDA approval for condition described in this module.



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## Orthopedic Surgery

### What to Expect

Pain and altered function of the hip and knee due to conditions such as arthritis affect patients' quality of life and are the basis for considerable healthcare use and costs.

After trying conservative treatment without relief, patients may consider hip or knee replacement—elective surgeries that can relieve pain, improve function, and have been shown to be cost effective.

Rivaroxaban is pending approval for the prophylactic treatment of **venous thromboembolism (VTE)** following hip replacement and knee replacement surgery.

Promotion of rivaroxaban for this indication or any other disease state described in training is strictly prohibited prior to FDA approval.

**A solid understanding of orthopedic surgery of the hip and knee—including patient types, surgical procedure, and potential complications—will prepare you to speak knowledgeably with physicians.**



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## Orthopedic Surgery

### Overview of Orthopedic Surgery

#### Chapter Overview

- o The goals of orthopedic surgery are to relieve pain, increase mobility, and improve function.
- o In this chapter, you will learn more about the patient population for orthopedic surgery, preoperative assessment, and potential complications.



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## Orthopedic Surgery

### Chapter Learning Objectives

After completing this chapter, you should be able to:

1. Describe the patient population for orthopedic surgery, specifically joint replacement candidates
2. Understand the components of a preoperative patient assessment in orthopedic surgery
3. List potential complications of orthopedic surgery



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## Orthopedic Surgery

### Patient Population

- o Elderly people are the primary recipients of joint replacements.
- o However, disorders requiring joint surgery occur in patients of all ages.
- o For example, hip disorders may occur in newborns and infants, who may have **congenital** or developmental dislocation of the hip.

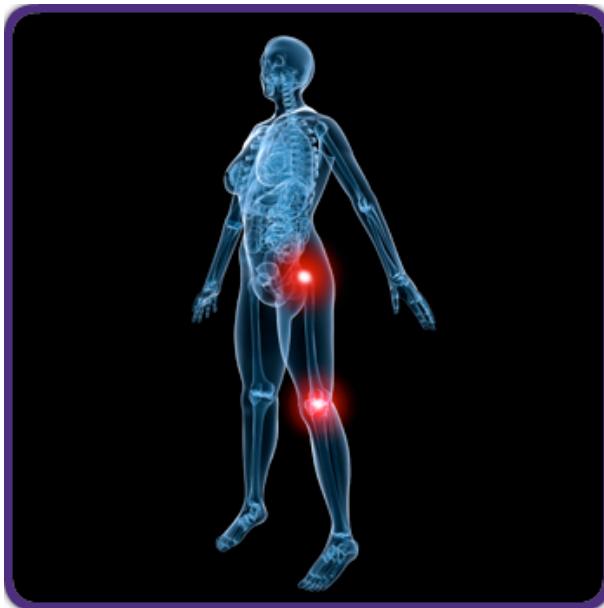


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## Orthopedic Surgery

### Need for Total Joint Replacement

- o End-stage degenerative joint disease secondary to **osteoarthritis** and **rheumatoid arthritis** is the major indication for total joint replacement.
- o Several conditions are associated with a need for joint replacement, including:
  - Osteoarthritis
  - Rheumatoid arthritis
  - Trauma (such as fractures and dislocations)
  - Bone **necrosis**



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## Orthopedic Surgery

### Preoperative Patient Assessment

#### Overview

- o To prevent potential complications that may result in death or amputation, the medical evaluation prior to orthopedic surgery must be detailed and comprehensive.
- o A critical part of the evaluation is determining whether total joint replacement is clearly indicated and that a major elective operation is warranted.



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## Orthopedic Surgery

### Imaging

**Radiographs** of the respective bones should be reviewed to evaluate the structural integrity, to estimate the size of the implant required and how much shaping would be necessary, and to determine whether bone grafting would be necessary. Preoperative radiographs should include:

- o **Hip:** a front and back view of the **pelvis** showing the **proximal femur** and a side view of the hip and proximal femur when evaluating for hip replacement
- o **Knee:** a standing front and back view of the knee, a side view of the knee, and a **skyline view** of the **patella** when evaluating for knee replacement



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## Orthopedic Surgery

### History

- o **Comorbid** diseases should be taken into account since most patients who undergo total joint replacement are elderly.
- o Patients with multiple risk factors have been shown to require longer hospital stays.
- o Smokers, in particular, tend to have longer operative times and increased hospital **charges** after undergoing joint replacement.
- o If the patient has a history of purulent drainage or other indications of infection, relevant lab values, scans, culture, and sensitivity tests are recommended before surgery.



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## Orthopedic Surgery

### Medications

- o Aspirin and other **anti-inflammatory** and **antiplatelet** medications should be discontinued 7 to 10 days before surgery.
- o Oral **anticoagulants** should be discontinued in sufficient time for the bleeding and **clotting times** to return to normal.



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## Orthopedic Surgery

### Anesthesia

- o Selection of **anesthesia** (general vs regional) is a complicated matter, and a patient's comorbid conditions should be taken into consideration.
- o General inhalation anesthesia, a continuous **epidural block**, or a **spinal** anesthetic can be used for surgery.
- o The choice usually depends on the preference of the anesthesiologist in collaboration with the surgeon and may be based on hospital protocols or specific patient needs.



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## Orthopedic Surgery

### Potential Complications

As in any surgical procedure, total joint replacement is associated with potential complications. Although complications are uncommon, they still do occur and can be serious. Careful preoperative assessment and planning are important to ensure that complications are kept to a minimum.

Potential complications include the following:

- o Hip dislocation after surgery
- o Deep infection: the most serious complication (other than **pulmonary embolism [PE]**); occurs in less than 1% of cases
- o Neurovascular injury
- o Cardiorespiratory and central nervous system disease
- o Without **thromboprophylaxis**, the incidence of hospital-acquired **DVT** is approximately 40%-60% following major orthopedic surgery.



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## Orthopedic Surgery

### Chapter 1 Summary

- o Total joint replacement is an elective surgical option that can provide significant pain relief and improved function with proven cost effectiveness.
- o Elderly people are the primary recipients of joint replacements; however, the need is not restricted to this population.
- o End-stage degenerative joint disease secondary to osteoarthritis and rheumatoid arthritis is the major indication for total joint replacement.
- o The medical evaluation prior to orthopedic surgery helps prevent potential complications and includes imaging, history, review of medications, and anesthesia assessment.
- o Total joint replacement is associated with potential complications. Without thromboprophylaxis, the incidence of hospital-acquired DVT is approximately 40%-60% following major orthopedic surgery.

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## Orthopedic Surgery

### Hip Replacement Surgery

#### Chapter Overview

In this chapter, you will learn about the epidemiology and surgical procedure of hip replacement surgery.

Hip replacement surgery is one of the most important surgical advances of the last century. Since the first hip replacement surgery, performed in 1960, improvements in surgical techniques and technology have greatly increased the effectiveness of **total hip replacement (THR)**.

Hip replacement surgery can relieve pain, increase motion, and help patients return to everyday activities by replacing a diseased joint with an artificial joint.



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## Orthopedic Surgery

### Chapter Learning Objectives

After completing this chapter, you should be able to:

1. Understand the preoperative assessment and templating in hip replacement surgery
2. Be familiar with the steps of a hip replacement procedure
3. Discuss postoperative care in hip replacement patients

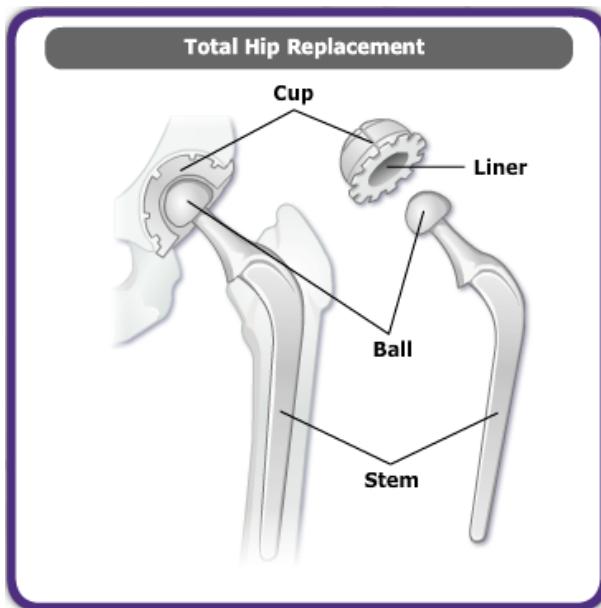


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## Orthopedic Surgery

### Surgical Overview

- o In hip replacement surgery, a hip **prosthesis** is surgically implanted to replace damaged bone within the hip joint.
- o The hip, one of the body's largest weight-bearing joints, consists of 2 main parts:
  - A ball (femoral head) at the top of the thigh bone (**femur**)
  - A rounded hip socket (**acetabulum**) of the pelvis, into which the femoral head fits
- o A total hip prosthesis consists of 4 parts:
  - A cup that replaces the hip socket, usually metal
  - A liner that fits inside the socket and allows the hip to move smoothly; usually made of plastic but may be made of other materials such as ceramic or metal
  - A metal or ceramic ball that replaces the head of the thigh bone
  - A metal stem that is attached to the shaft of the bone to add stability



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## Orthopedic Surgery

### Important Precautions

- o When using power instruments to prepare the femur to accept the metal stem, care must be taken to prevent fracture or perforation.
- o The acetabular cup and the femoral stem must also be correctly oriented. This is critical to the stability of the replacement, because incorrect orientation of the components is one of the most common causes of postoperative dislocation of the hip.

### Surgical Procedure

The basic steps in a hip replacement procedure are illustrated here.



**1**

**Step 1:** First, an incision is made over the hip and along the thigh, revealing the hip socket.

**2**

**Step 2:** The surgical team pulls the top of the thigh bone, or femur, out of the hip socket.

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## Orthopedic Surgery

**3**

**Step 3:** Using a surgical saw, the ball of the thigh bone, or femoral head, is removed.

**4**

**Step 4:** The thigh bone is then hollowed using power instruments.

**5**

**Step 5:** The femoral component, the metal stem, is inserted into the hollowed canal of the thigh bone.

**6**

**Step 6:** The inner surface of the hip socket is carefully machined to fit a hemi-spherical cup. Once the hip socket has been prepared, the cup is secured in place with or without cement.

**7**

**Step 7:** Finally, the artificial ball joint is fixed into the hip socket. Care must be taken to ensure correct orientation of the ball joint and hip socket, allowing the full range of normal motion.

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## Orthopedic Surgery

### Preoperative Patient Assessment

#### Welcome to Virtual Surgery Hospital



I'm Dr. Glad, the chief of orthopedic surgery, and you will be observing me in a hip replacement procedure today.

Before we scrub into the OR, let's take a look at the patient's chart. A preoperative assessment is important to make sure the surgery is appropriate, and to minimize potential complications.

#### Patient Chart

**Name:** Christine Summers

**Age:** 65

**Gender:** Female

**Height:** 5' 6"

**Weight:** 150 lbs

#### History:

- o Patient was diagnosed with arthritis of the right hip at the age of 52.
- o Reported pain in the right hip has been progressively worsening over the past 2 years, and is not responding to conservative treatments.
- o Patient reports pain all of the time, which interferes with sleep.

#### Medications:

- o Anti-inflammatory prescriptions, including ibuprofen and naproxen, and steroid injections.

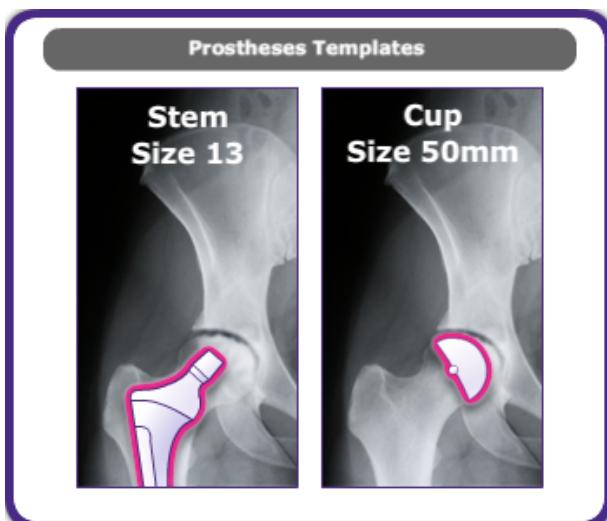
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## Orthopedic Surgery

### About Templating

#### Overview

- o Before the **prosthetic** components of the hip are surgically implanted, templates are used to select the size and shape of the prostheses and to determine the fitting of corresponding bone surfaces.
- o Templating is indicated for both straightforward and complicated cases of primary **THR**.



#### Methods

- o Historically, templating has been used with traditional **radiographic** films and printed templates (acetates).
- o Today, digital templating has become possible with the introduction of digital radiography and computers in clinical practice.
- o It is important that the patient is positioned properly when templating, to avoid misleading information.

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## Orthopedic Surgery

### Benefits

Benefits of templating include:

- o Identification of difficult or problematic cases
- o Prediction of sizes of prosthetic implants
- o Prevention of complications such as leg length inequality
- o Planning for leg length equalization
- o Restoration of the normal hip center

## Operating Room

### About Minimally Invasive Approaches

#### Increased Interest

While implant design and biomaterials have varied over the years, approaches to hip surgery have remained largely unchanged. Recently, however, orthopedic surgeons have revealed increased interest in less invasive approaches.



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## Orthopedic Surgery

### Challenges for Minimally Invasive Hip Replacement

Minimally invasive hip replacement has been an issue of much debate and attention. It should be stressed that long-term outcomes with this surgical technique are still unclear, and the short-term outcomes have been inconsistent. Challenges include:

- o Prolonged learning curve for surgeons
- o Increased cost of equipment and disposable instruments
- o Longer operating times
- o Concern about accuracy of implant positioning
- o Challenge of performing surgery within a smaller workspace and without the usual landmarks

### Goals of Minimally Invasive Surgery

- o Improved patient outcomes
- o Long-term cost reduction

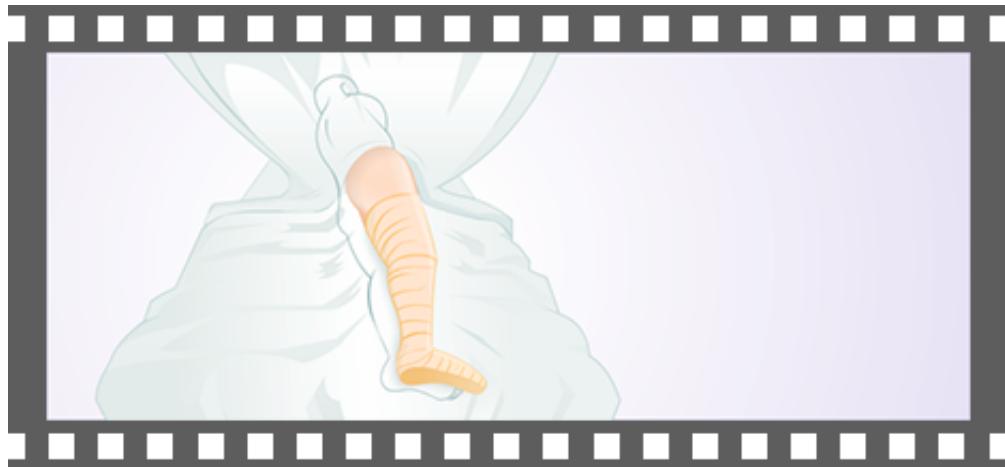
### Incision Length

- o Defining the term "minimally invasive surgery" is controversial, but the "mini-incision" used for these techniques is typically a length of 10 cm or less.
- o In any type of surgery, the incision length should not be standardized, as several factors can determine the length needed to correctly perform the surgery.
- o Factors that determine incision length include: the skill of the surgeon, patient weight, local subcutaneous tissue, muscle mass, and the individual joint and anatomy.

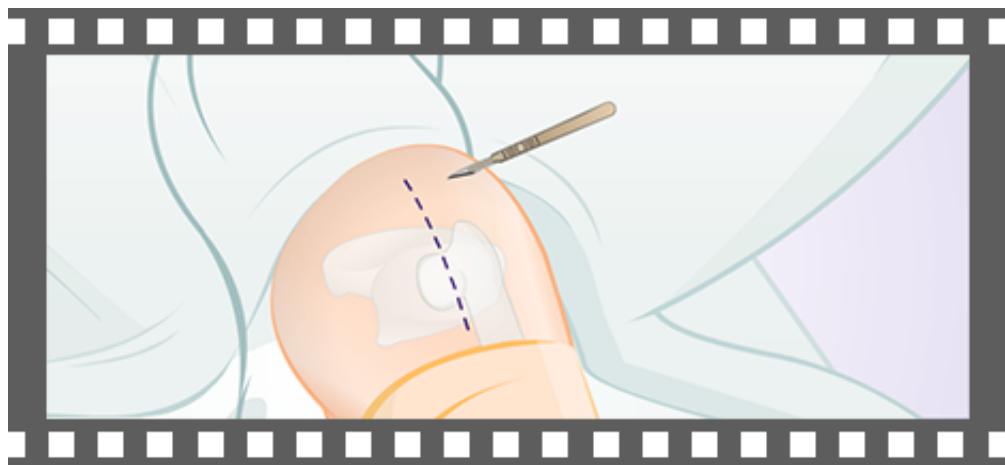
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### Preparing for Incision



The patient has been anesthetized, prepped and draped by the OR team. Note that the patient is lying on her left side, and the right hip and right thigh bone will be accessible.

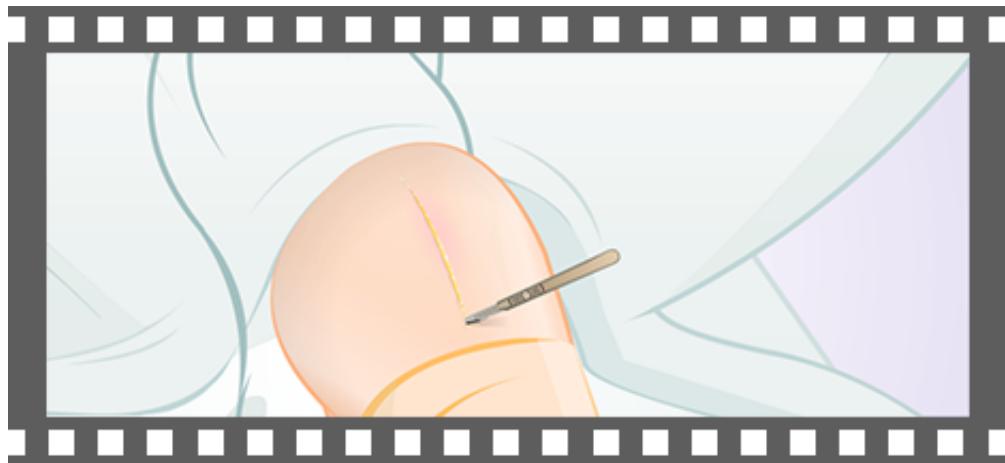


We're now ready to make the first incision.

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## Orthopedic Surgery

### The Incision



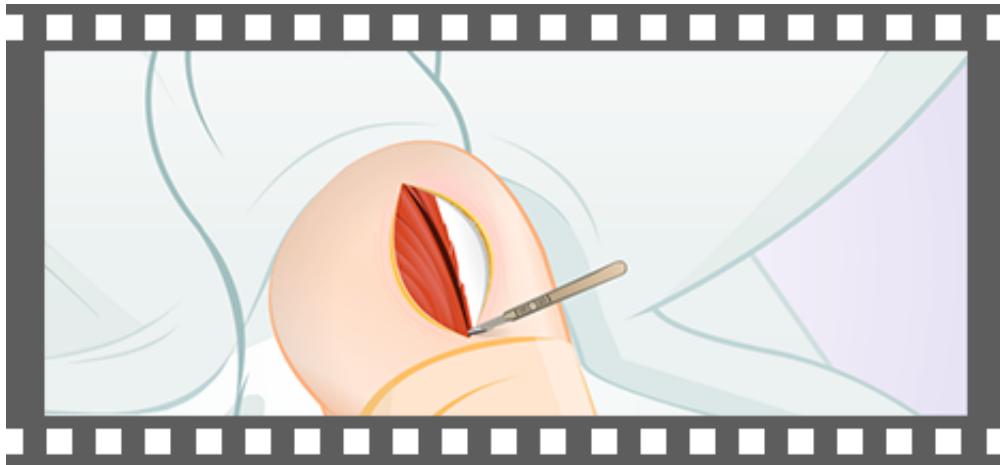
We carefully cut through the skin and subcutaneous tissue over the head of the femur, or thigh bone.



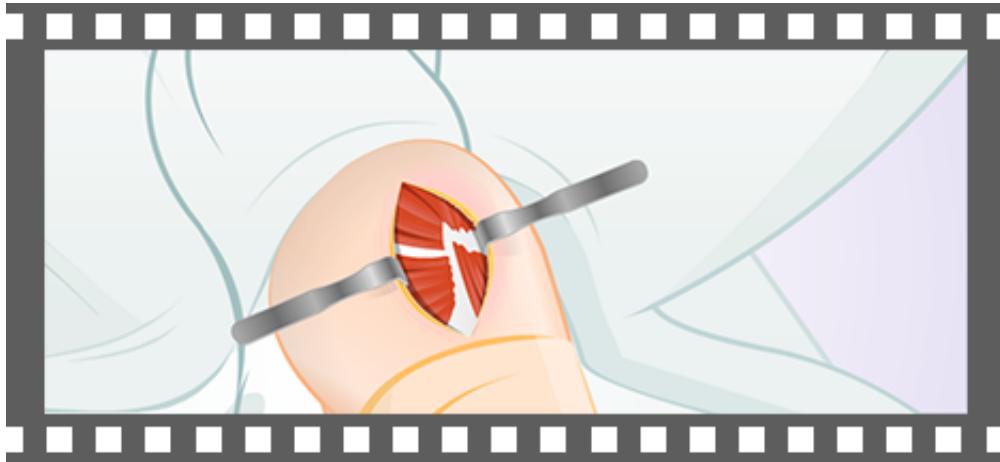
With the retractors, we open the wound for a better view of the muscles beneath.

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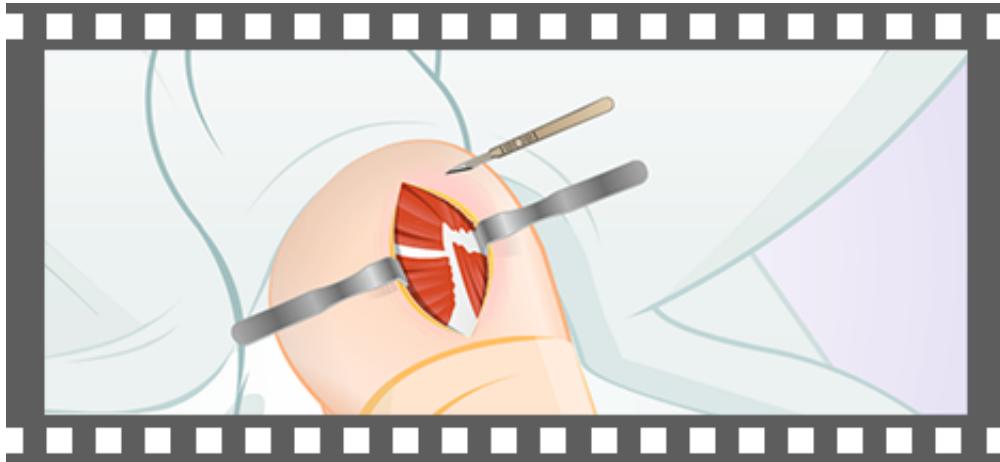
## Orthopedic Surgery



We then cut through the gluteus maximus muscle to the fascia lata muscle.



Now we pull back the split muscles using the deep retractors. We must be careful of the sciatic nerve, which lies within the fat.

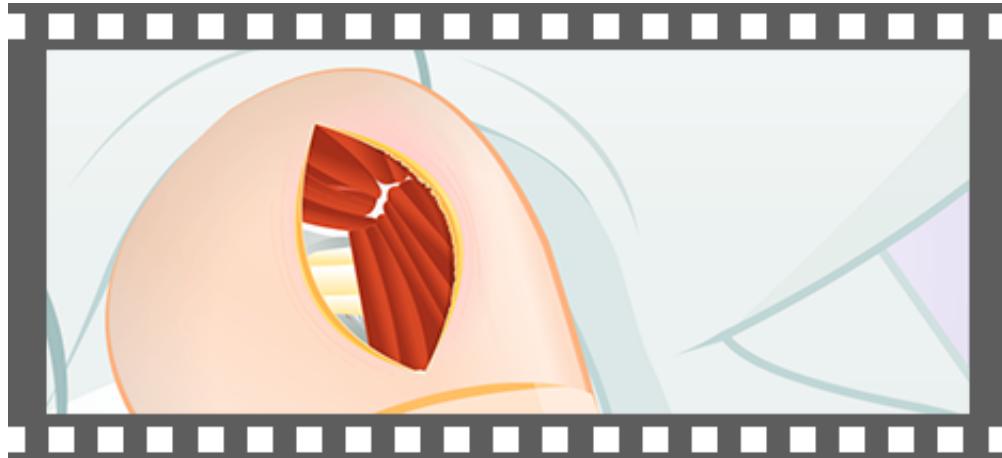


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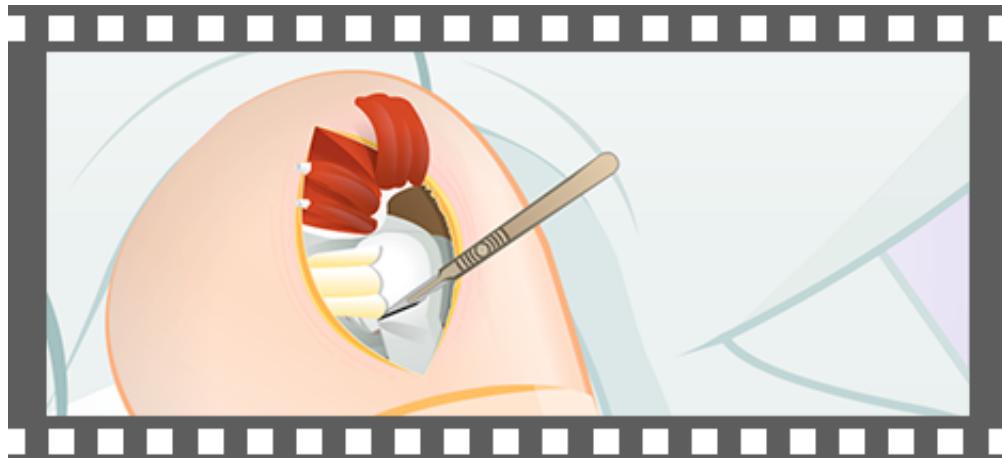
## Orthopedic Surgery

Next we must cut the muscles and tendons that connect the top of the femur.

### Removing the Femoral Head



I've cut the muscles and tendons that connect the top of the femur.



We then fold the whole set of muscles back as one flap. Now we can see the flexible sac, or capsule, around the joint.

We cut open the capsule and put in sutures to hold it back.

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## Orthopedic Surgery



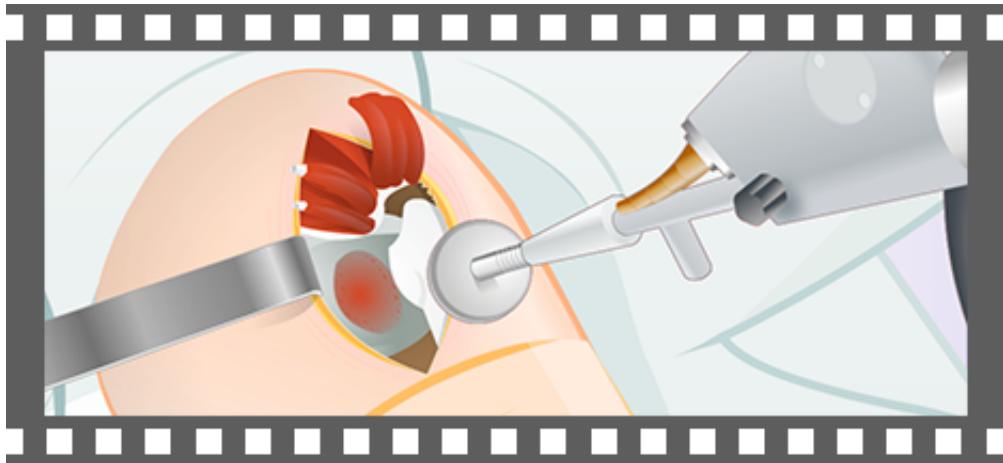
Next, we dislocate the femoral head by flexing and rotating the femur.



We can now see the femoral head, which is visibly arthritic. Before we saw off the femoral head, I've placed a retractor to protect the sciatic nerve and external rotator muscles from an accidental slip. We now cut off the femoral head.

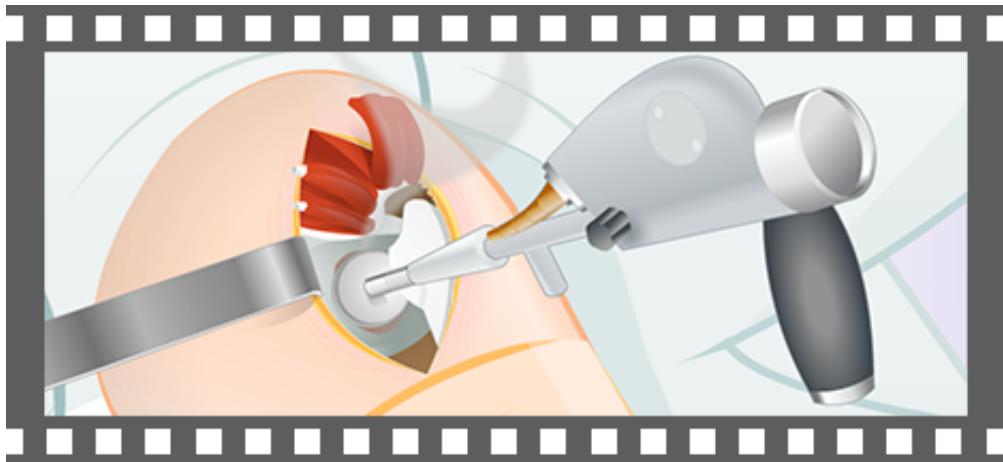
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## Orthopedic Surgery



Next, we need to use the reamer to prepare the socket for the cup.

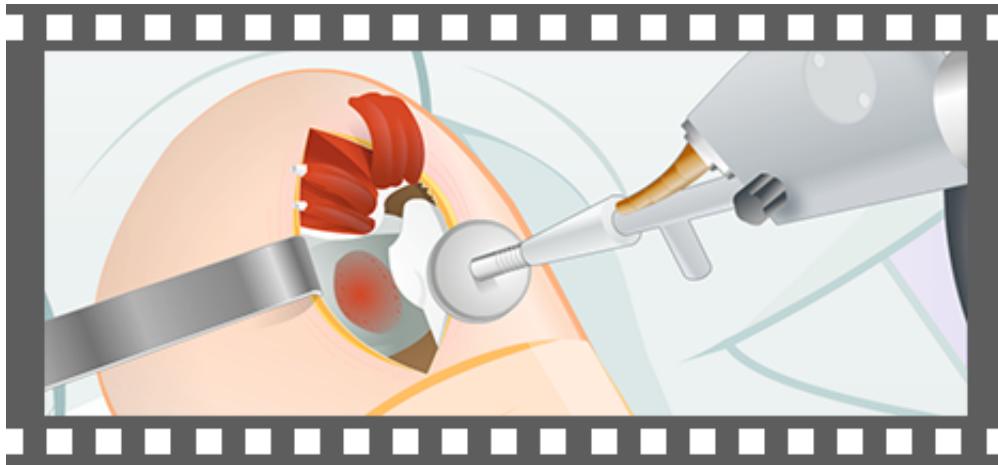
### Prosthetic Cup



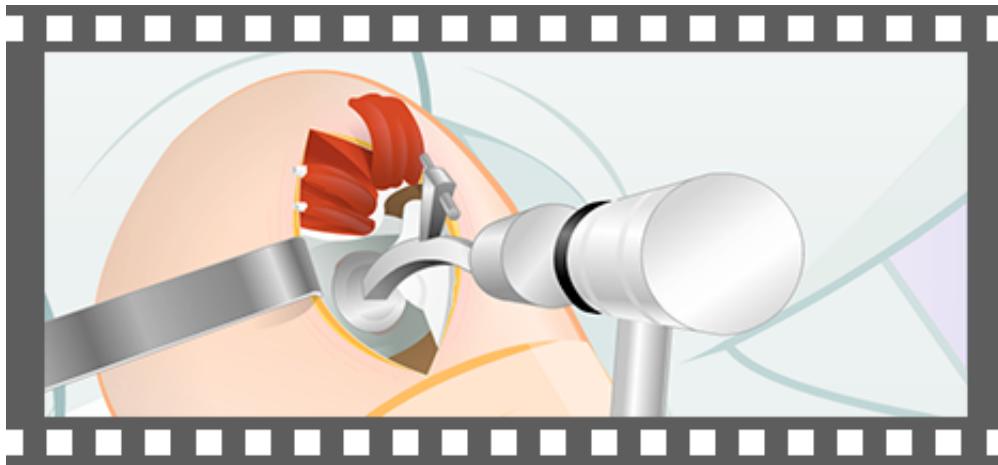
During the preoperative templating, we decided to use a 52 mm cup. We will need to use reamers that are slightly smaller in order to prepare the socket for the cup. It's important to practice conservative bone removal, making sure we preserve as much bone as possible. Let's start with a 46 mm reamer.

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We'll finish with the 51 mm reamer, preparing the acetabulum for the prosthetic cup. Note that it's 1 size smaller than the final 52 mm cup we selected. This is so we get a nice snug fit.



Next, the prosthetic cup is mounted in the socket.

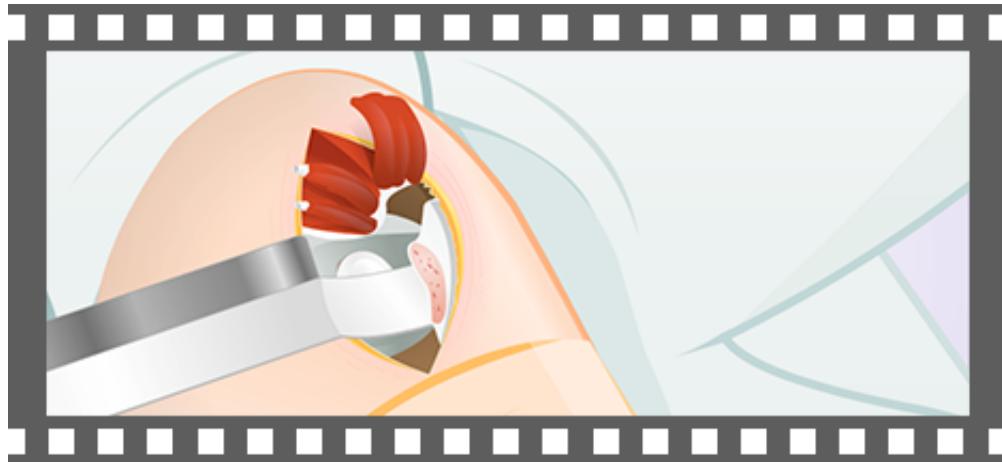


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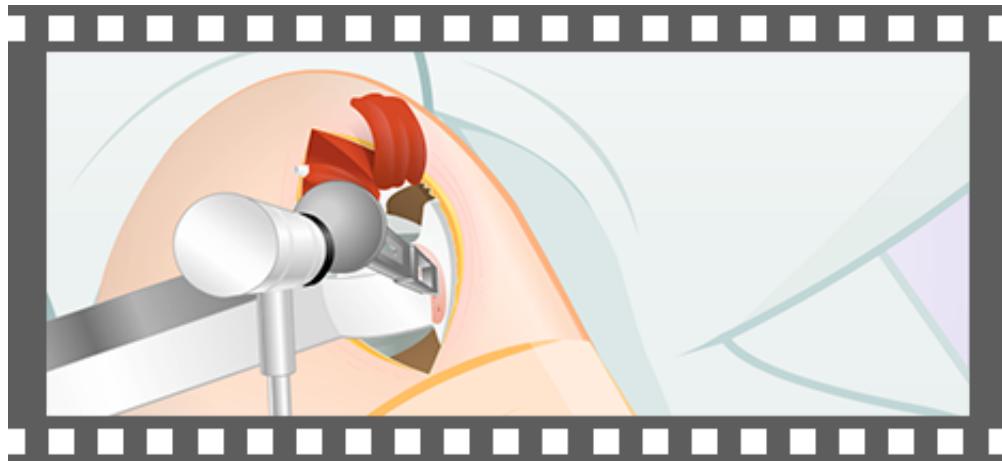
## Orthopedic Surgery

Now we'll need to hollow the femur.

### Hollowing the Femur



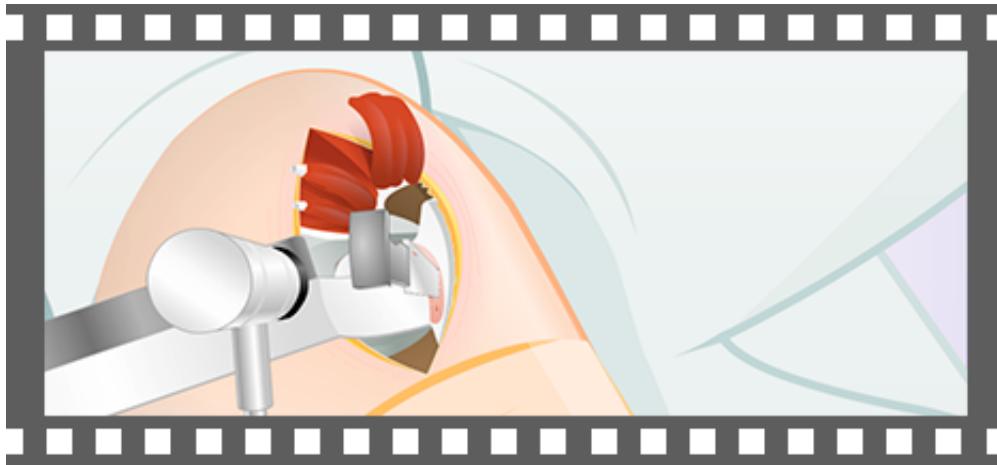
By placing a retractor directly under the femur, near where we removed the head, we elevate the femur.



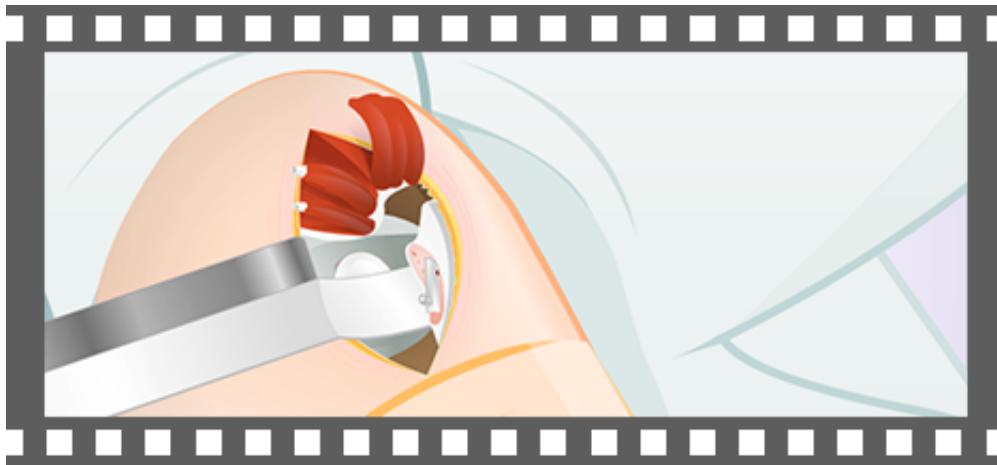
We'll prepare the femur for the implant by hollowing it out with tools.

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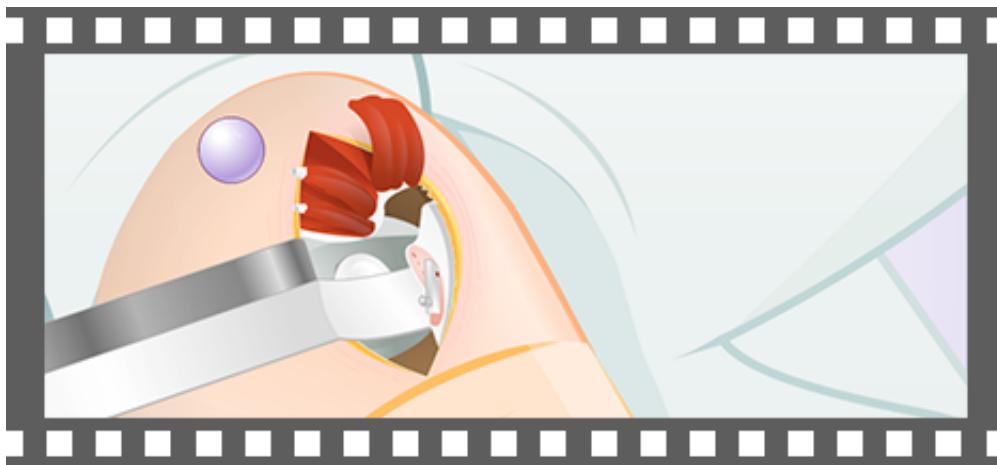
## Orthopedic Surgery



Remember we've templated this patient to a size 13 stem. We'll start with a size 12 trial stem to size the bone for the stem prosthetic. Use the mallet to tap the trial stem into the bone.



Now I'm going to put the size 13 trial stem in place.

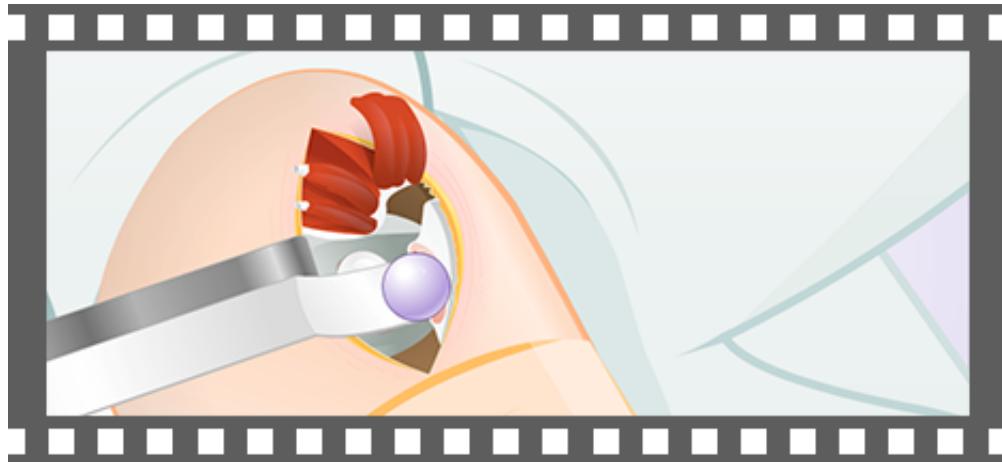


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## Orthopedic Surgery

Next we'll place the trial ball onto the end of the trial stem.

### Testing the Prosthetic Fit



Let's place the trial ball onto the end of the trial stem.



I'll pop the ball into the plastic cup. Now let's test the range of motion, making sure all of the components are the correct size and that the leg is able to move freely.

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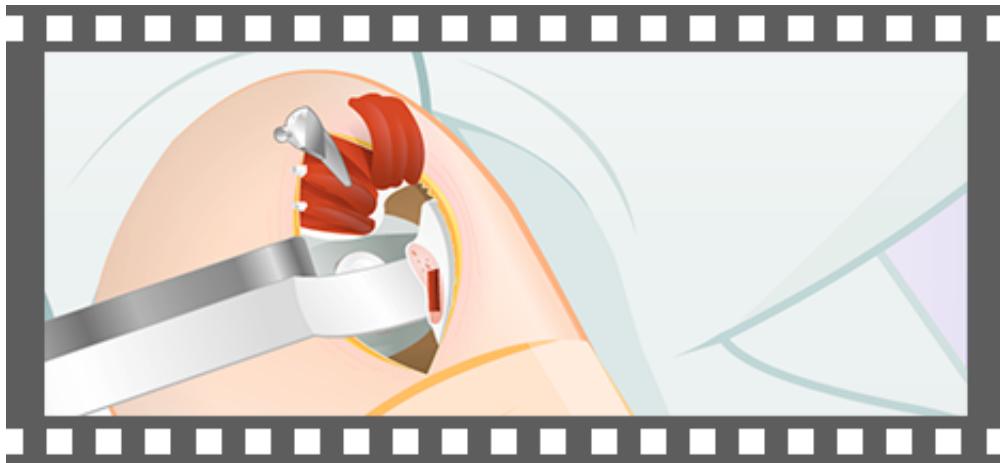
## Orthopedic Surgery



Good. This indicates a good range of motion, and that our patient's hip will be stable.

The limb lengths should also be measured to ensure that they are the same.

### Metal Stem



Okay, let's finish up. We'll dislocate the ball from the plastic cup, and remove the ball and the rasp.

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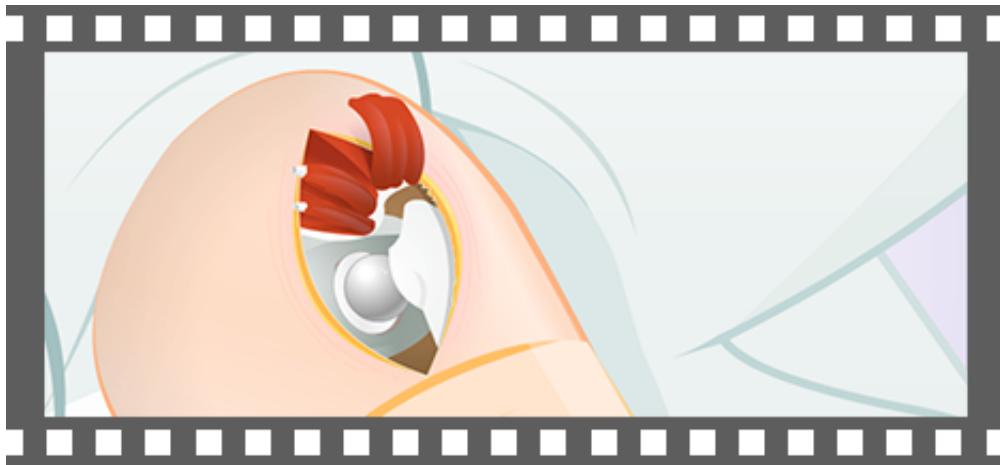
## Orthopedic Surgery



Next, we'll tap the prosthetic stem into the femur bone.



Now we place the ball on the end of the stem.



Finally, we pop the ball into the plastic cup.

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## Orthopedic Surgery



Okay, nice work! We're all done here.

I'll have the nurse close up.

### Postoperative Care

#### A Successful Operation



Congratulations on a successful hip replacement surgery!

Remember, postsurgical care will be just as important in ensuring a successful transplant.

I'll discuss some specific instructions with the patient regarding home care over the next few weeks. Why don't you come along?

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## Orthopedic Surgery

### Patient Counseling



#### Doctor:

How are you feeling this morning, Ms. Summers? I stopped by to discuss your recovery process.

The success of your surgery will depend in large measure on how well you follow these instructions regarding home care after the replacement procedure.

#### Patient:

Oh, okay. I'm feeling much better.

#### Doctor:

Patients typically remain in the hospital for 3 to 5 days after surgery.

Some might need to stay temporarily at a **rehabilitation** unit or long-term care center to assist in regaining muscle strength and joint flexibility, until they are able to safely live independently.

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## Orthopedic Surgery

**Doctor:**

**Wound Care**

You have staples running along your wound and stitches beneath your skin. The staples will be removed in about 2 weeks.

Avoid getting the wound wet until it has thoroughly sealed and dried.

**Patient:**

Okay.

**Doctor:**

**Diet**

A balanced diet is important to promote proper tissue healing and restore muscle strength. Be sure to drink plenty of fluids.

**Patient:**

No problem there. I always eat right.

**Doctor:**

**Activity**

Excellent. Exercise is another critical component of home care, particularly during the first few weeks after surgery. You should follow a program to slowly increase your mobility and endurance, including walking and resuming normal household activities. You might wish to have a physical therapist help you at home.

**Patient:**

I plan to.

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## Orthopedic Surgery

**Doctor:**

### Avoiding Falls

Good. Also, care must be taken not to dislocate the artificial hip. Avoid rigorous activities. A fall may damage your new hip and might result in a need for more surgery.

I would advise you to use a cane, crutches, walker, or handrails, or have a personal assistant help you until you improve your stability and strength. This may take as long as 3 months.

**Doctor:**

### Blood Clot Prevention

We've given you anticoagulants after surgery to help prevent blood clots. After leaving the hospital, follow the instructions I give you carefully to minimize the potential risk of blood clots, which can occur during the first several weeks of your recovery.

Notify me immediately if you develop pain, tenderness, redness, or swelling of the leg that is unrelated to the incision. Warning signs that a blood clot may have traveled to your lung include shortness of breath and/or chest pain.

# Rivaroxaban Learning System

## Orthopedic Surgery

### Chapter 2 Summary

- o In hip replacement surgery, a prosthesis is surgically implanted to replace damaged bone within the hip joint. A total hip prosthesis consists of 3 parts:
  - A cup that replaces the hip socket
  - A ball that replaces the head of the thigh bone
  - A metal stem that is attached to the shaft of the bone
- o Templating is indicated for every primary THR to select the size and shape of the prostheses and to determine the fitting of corresponding bone surfaces.
- o Postsurgical care involves a number of components, including wound care, diet, activity, and blood clot prevention.

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## Orthopedic Surgery

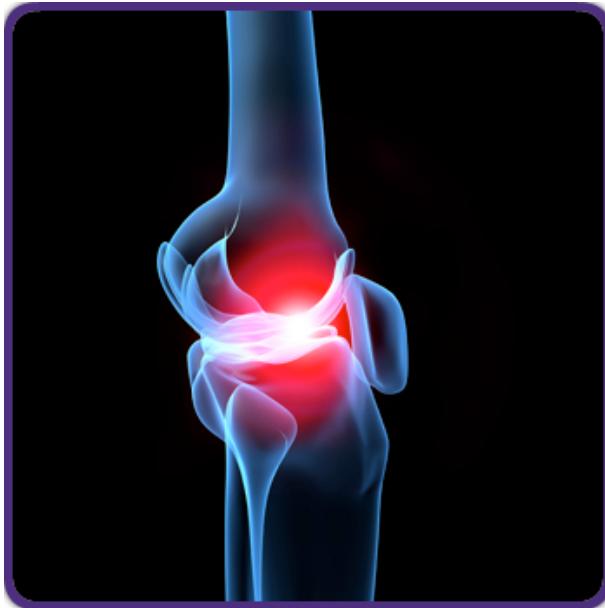
### Knee Replacement Surgery

#### Chapter Overview

In this chapter, you will learn about the surgical procedure of knee replacement surgery.

Knee replacement surgery is one of the most important advances in orthopedic surgery in the twentieth century. Since the first procedure, performed in 1968, improvements in materials and techniques have greatly increased its effectiveness.

**Total knee replacement (TKR)** resurfaces damaged and worn areas of the knee joint, which relieves pain, corrects leg deformity, and helps patients resume normal activities.



# Rivaroxaban Learning System

## Orthopedic Surgery

### Chapter Learning Objectives

After completing this chapter, you should be able to:

1. Understand the preoperative assessment in knee replacement surgery
2. Be familiar with the steps of a knee replacement procedure
3. Discuss postoperative care in knee replacement patients

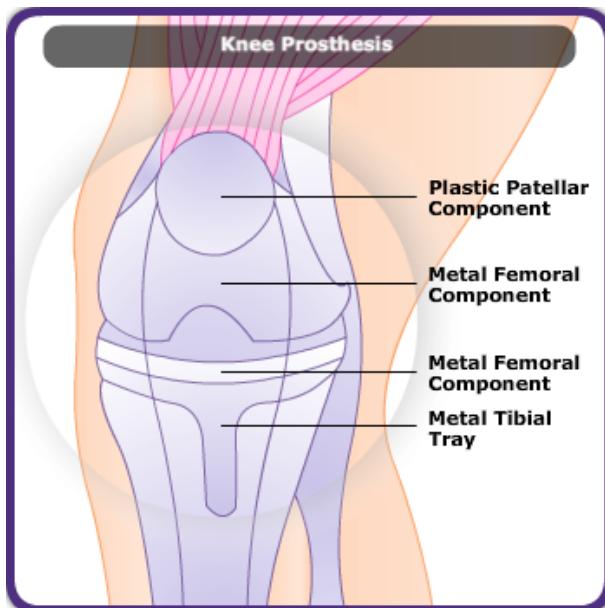


# Rivaroxaban Learning System

## Orthopedic Surgery

### Surgical Overview

- o In knee replacement surgery, an artificial joint replaces a painful, damaged, or diseased knee joint.
- o The knee is the largest joint in the body. Most everyday activities require normal knee function.
- o The knee joint is made up of the femur (lower end of the thighbone), which rotates on the **tibia** (upper end of the shin bone), and the patella, which slides in a groove on the end of the femur.
- o The end of the femur, the end of the tibia, and the undersurface of the patella are shaped to allow the surgeon to fit the prosthetic components.
- o A total knee prosthesis consists of 3 parts:
  - Femoral component (metal)
  - Tibial component (plastic held in a metal tray)
  - Patellar component (plastic)



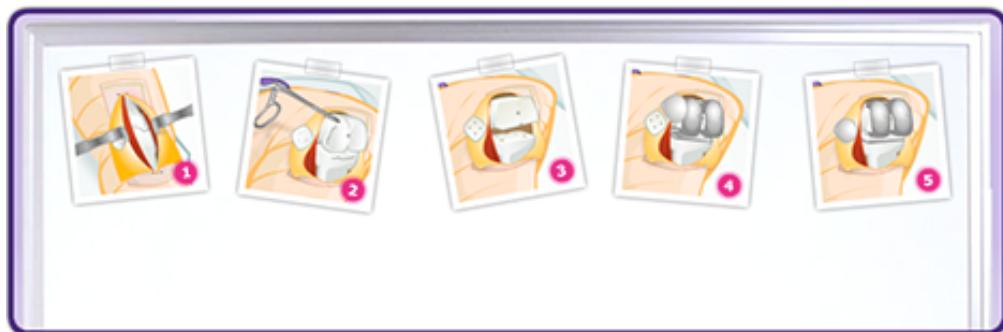
# Rivaroxaban Learning System

## Orthopedic Surgery

### Important Precautions

- o To ensure the longevity of the implant, it is very important to realign the knee properly, even if the knee was out of alignment prior to surgery.
- o Rupture of the patellar tendon is a disastrous complication with no effective solution, and should be avoided.

### Surgical Procedure



**1**

**Step 1:** An incision is made in the front of the knee to expose the joint.

**2**

**Step 2:** The kneecap, or patella, is reflected laterally, and the knee joint is dislocated.

**3**

**Step 3:** The surface of the joint is prepared by shaping the surface to fit the artificial joint.

**4**

**Step 4:** The pieces of the new joint are installed on the tibia, femur, and patella.

# Rivaroxaban Learning System

## Orthopedic Surgery

5

**Step 5:** Finally, a spacer is placed on the tibia surface, and a final check is done to make sure all of the components fit and that the leg can move freely. It is critical to realign the knee perfectly, regardless of the amount of deformity prior to surgery. Misalignment of the knee will seriously reduce the longevity of the implant.

### Preoperative Patient Assessment

#### Welcome to Virtual Surgery Hospital



I'm Dr. Tsai, the chief of orthopedic surgery, and you will be observing me in a knee replacement procedure today.

Before we scrub into the OR, let's take a look at the patient's chart. A preoperative assessment is important to make sure the surgery is appropriate, and to minimize potential complications.

# Rivaroxaban Learning System

## Orthopedic Surgery

### Patient Chart

**Name:** Ted Benz

**Age:** 58

**Gender:** Male

**Height:** 5' 11"

**Weight:** 218 lbs

### History:

- o Patient was diagnosed with rheumatoid arthritis 5 years ago and now complains of pain in all of their joints, a swollen left knee, and stiffness every morning.
- o Reported symptoms of the left knee have been occurring with increasing severity for the past 6 months.
- o He presented with similar symptoms 3 months ago, at which time his **methotrexate** dose was increased.
- o Smoker x30 years.

### Medications:

- o **Nabumetone**
- o **Prednisone**
- o Methotrexate
- o **Folic acid**

# Rivaroxaban Learning System

## Orthopedic Surgery

Operating Room

### About Minimally Invasive Approaches

#### Recent Advance

A recent advance in the performance of **TKR** is the use of minimally invasive surgical approaches.



#### Challenges for Minimally Invasive Knee Replacement

- o This technique is still relatively new, and is more challenging because the incisions are about half the size of those used in the standard approach.
- o Although the risks are not well known, they are probably comparable to those for a standard TKR.

#### Goals of Minimally Invasive Surgery

- o The incisions are approximately half the size of those used in standard approach.
- o This method may reduce hospitalization and the need for an extended stay for inpatient rehabilitation in most patients.

# Rivaroxaban Learning System

## Orthopedic Surgery

### Preparing for Incision



The patient has been anesthetized and is in a supine position. Before we can make the first incision, we need to establish a sterile field around the surgical area.

Let's elevate the leg and isolate the surgical area from the rest of the patient's body with a series of sterile drapes.

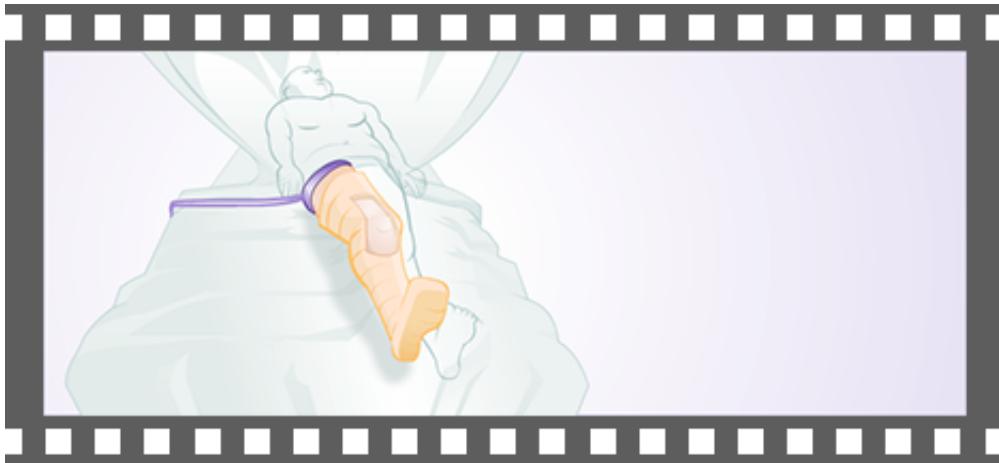
We'll also apply a tourniquet to cut off blood flow.



We will now clean the patient's leg with an iodine solution to limit the chance of bacterial infection.

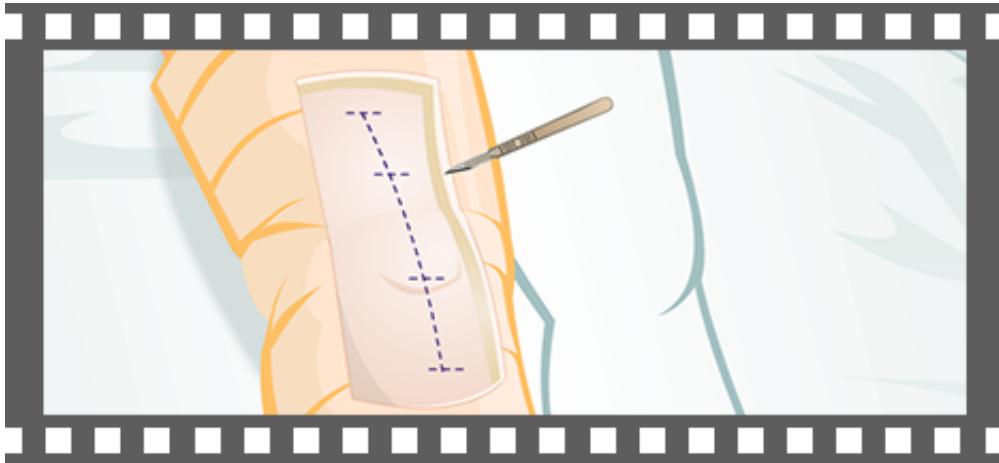
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## Orthopedic Surgery



Next, we'll put a series of stockings and sterile drapes in place.

The surgical area is then exposed by cutting a long hole in the stockings.

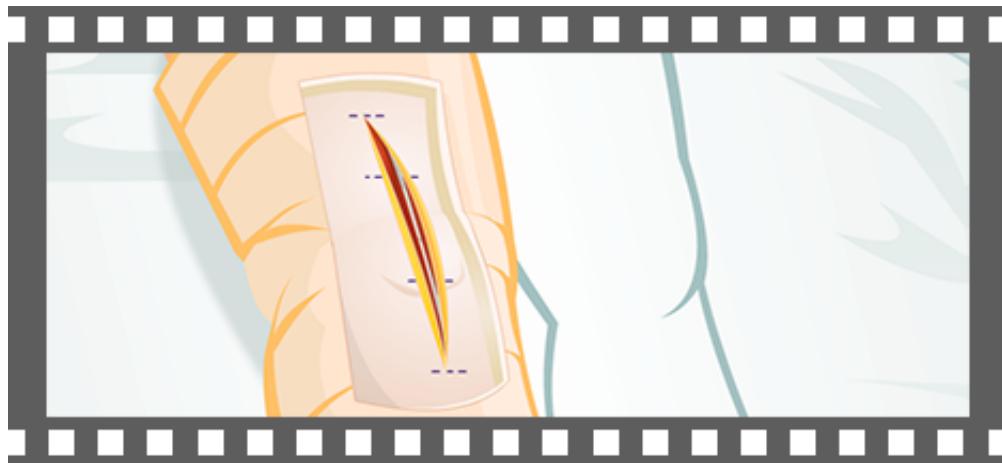


We're now ready to make the first incision.

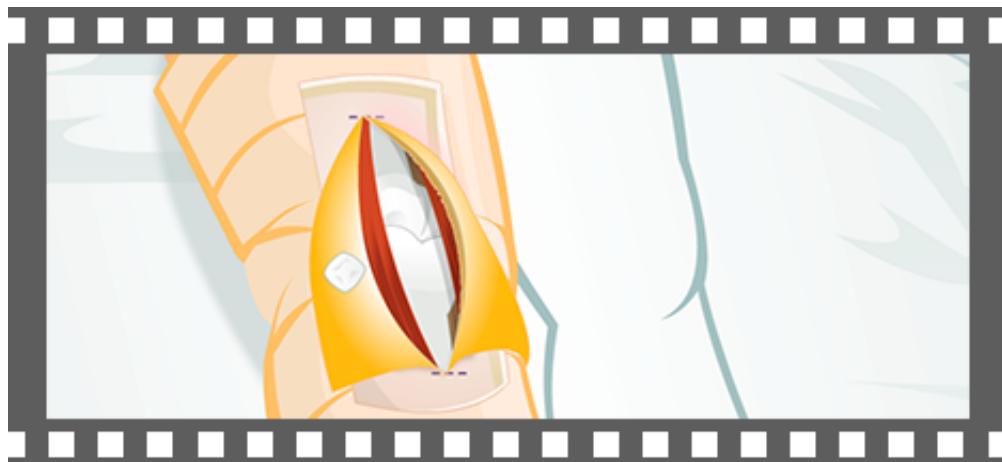
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## Orthopedic Surgery

### The Incision



We make the first incision down the front of the knee, cutting through subcutaneous tissue and exposing the knee joint.

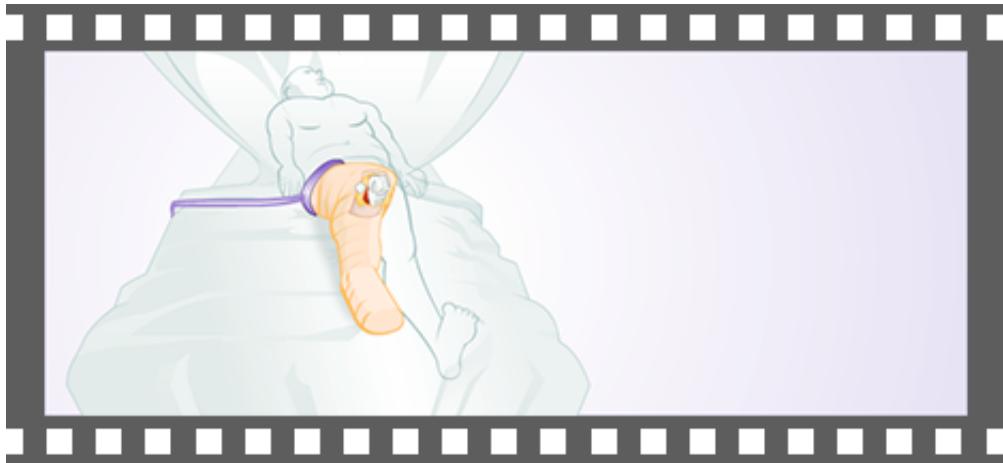


I'll use rake retractors to hold back skin and tissues out of the way so that we can access the knee joint.

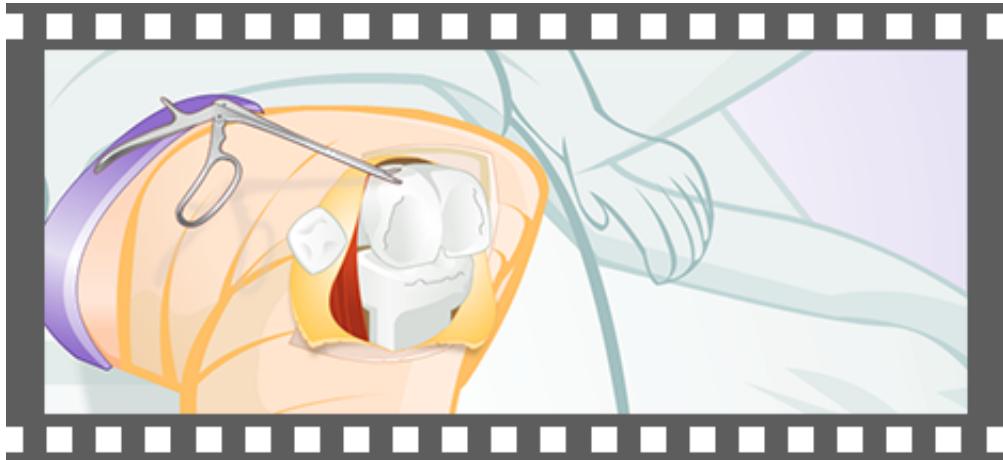
Then, we'll move the patella, or kneecap, to the side.

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## Orthopedic Surgery



We elevate and flex the patient's knee so that the bones are fully exposed.

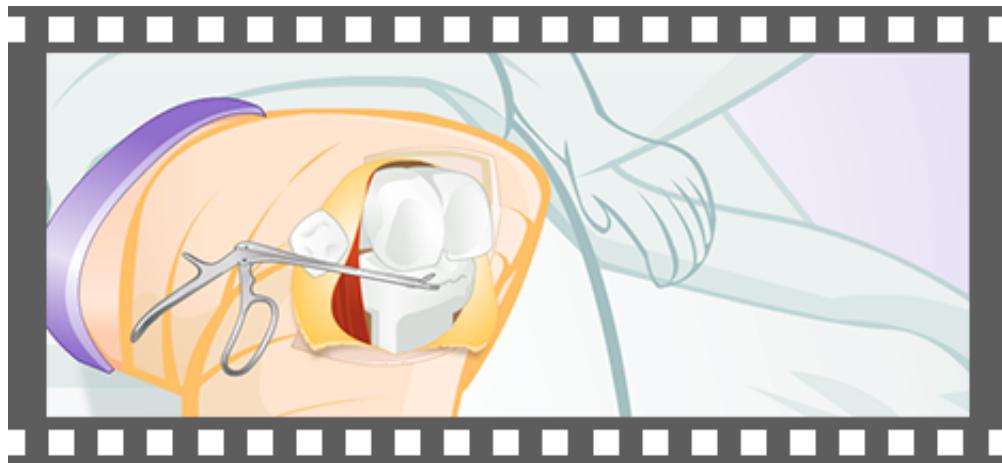


We can now clearly see the three major bones: the tibia, femur, and patella.

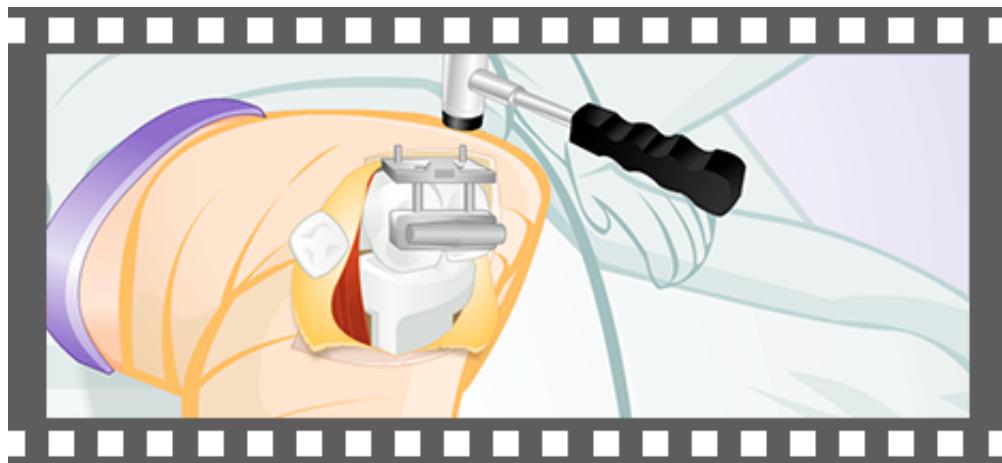
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## Orthopedic Surgery

### Shaping the Bones



Using a tool called a rongeur that is used to cut and remove small pieces of bone or tough tissue, we remove the anterior cruciate ligament, or ACL, meniscus, and any osteophytes that could cause incorrect positioning of the components.

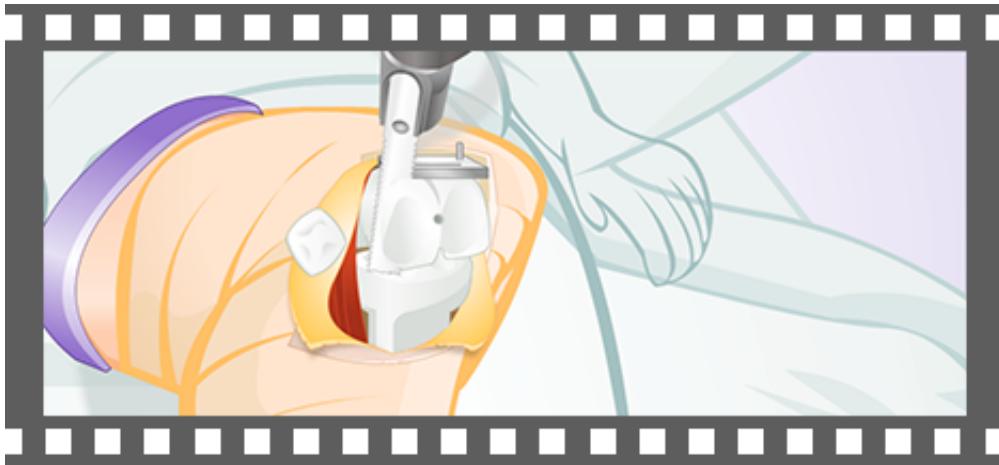


Now it's time to shape the femur, tibia, and patella so the new knee components fit properly.

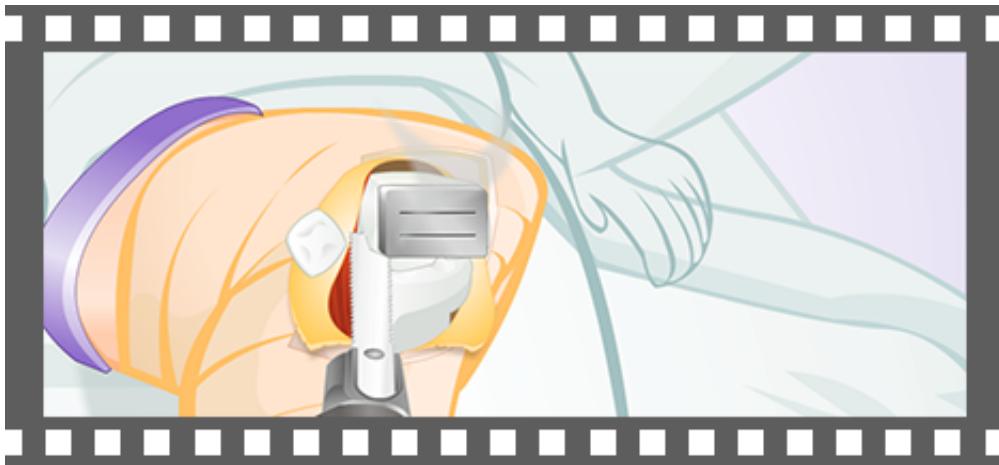
Let's start with the femur. We'll put a jig into position with an alignment device and pin. These help ensure that the cuts we make to the bone are exact.

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## Orthopedic Surgery



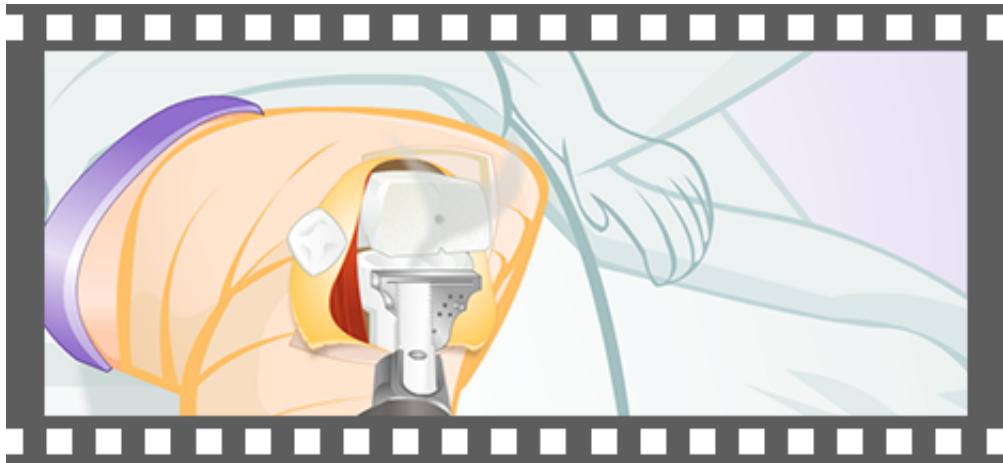
Ok, now let's remove the alignment device; the pins will hold the jig in place. Now we'll use the bone saw to shape the femoral head so that it is ready to accept the femoral component.



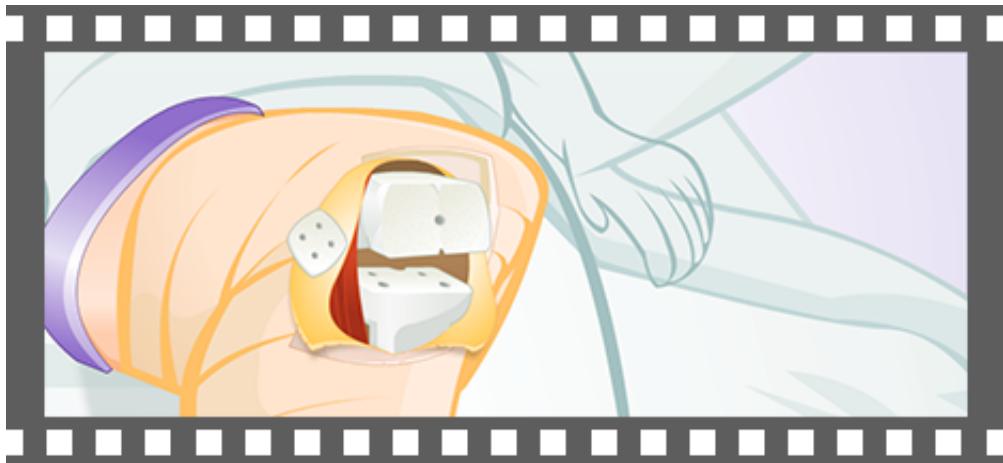
Another cutting jig along with the bone saw allows us to finish shaping the femoral head.

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## Orthopedic Surgery



We align the tibial jig to ensure that the knee will be able to flex properly. We'll use the bone saw to cut off the top of the tibia and prepare it for the tibia component.

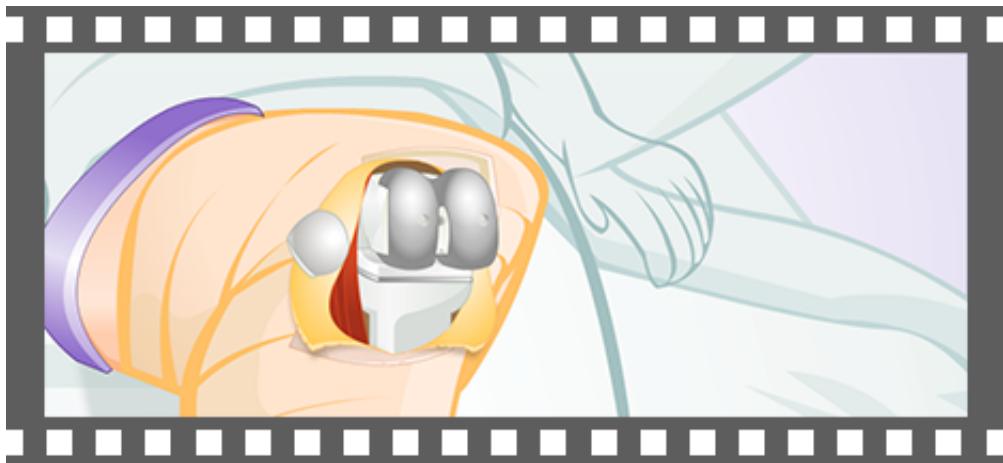


Now we'll drill holes in the bones to allow the attachment of the trial components.

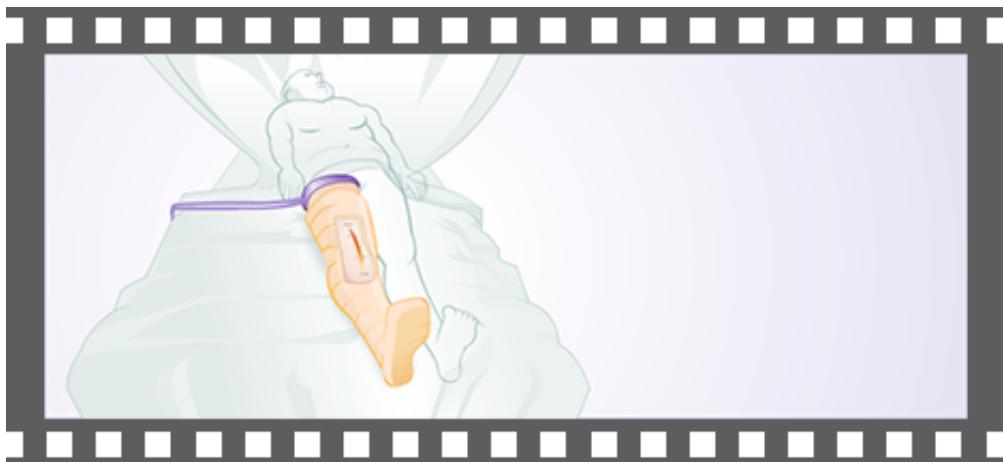
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## Orthopedic Surgery

### Trial and Permanent Knee Components



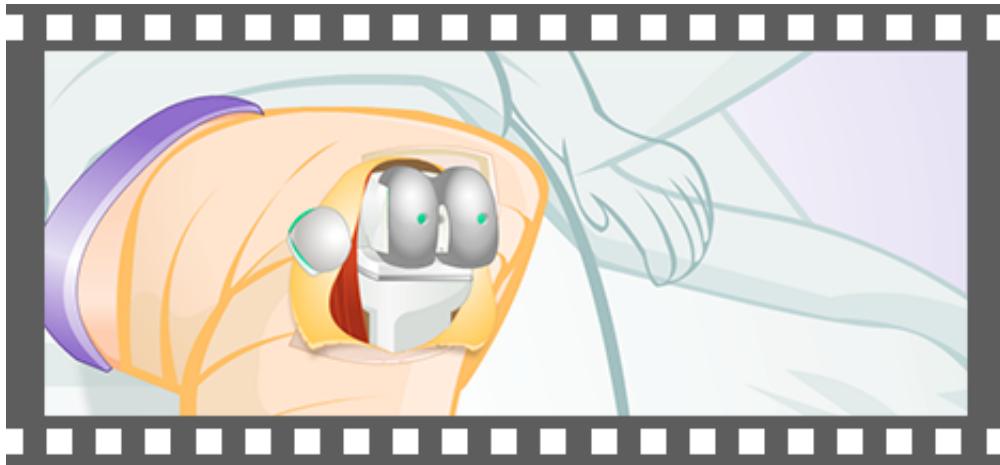
Now let's install the trial components in the knee, including the femoral component, metal tray component, plastic spacer, and patellar component.



We should conduct a range-of-motion test to test for fit.

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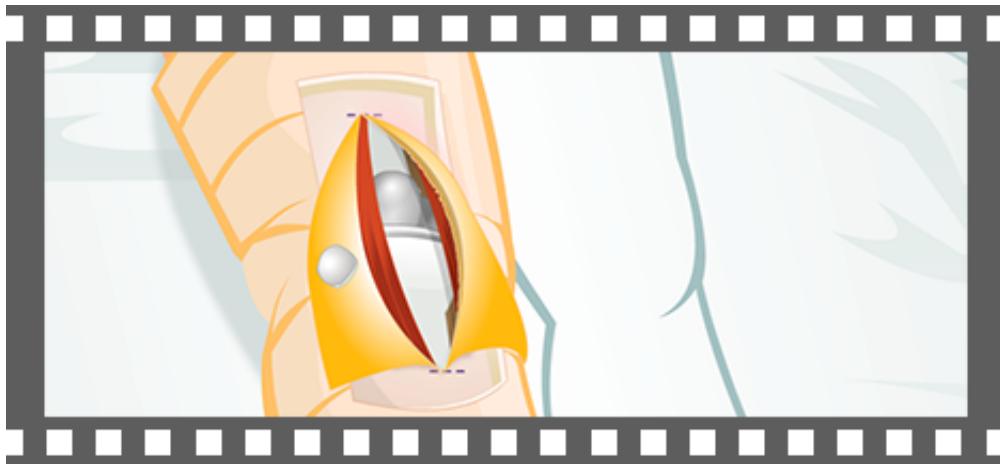
## Orthopedic Surgery



Ok. Now we're ready to apply the permanent components. We'll use a special cement that bonds metal and bone.



Now we'll perform a final range-of-motion test.



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## Orthopedic Surgery

Well, we're all done here.

The new knee looks like a good fit! The surgical team will close up the incision using sutures and staples.

### Postoperative Care

#### A Successful Operation



Congratulations on a successful knee replacement surgery! Remember, postsurgical care will be just as important in ensuring a successful replacement. Take a look at these instructions I gave the patient regarding home care over the next few weeks.

### Patient Counseling



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## Orthopedic Surgery

**Doctor:**

Hello, Mr. Benz. I'd like to discuss your discharge instructions. We've prescribed pain medicine, as well as **antibiotics** to prevent infection.

**Patient:**

That's a relief. How long will it take to recover?

**Doctor:****Activity**

The total recovery period varies from 2 to 3 months to a year. As I've already explained, you should be able to resume most normal activities of daily living within 3 to 6 weeks following surgery. It is important to perform specific exercises that help to restore movement and strengthen the knee.

**Patient:**

I'll do my best, Doc. When can I take these bandages off my knee?

**Doctor:****Wound Care**

You will have staples running along your wound or beneath your skin. The staples or stitches will be removed several weeks after surgery. In the meantime, avoid getting the wound wet until it has thoroughly sealed and dried.

**Patient:**

Okay. Do I have to be careful about anything I eat?

# Rivaroxaban Learning System

## Orthopedic Surgery

**Doctor:**

**Diet**

A balanced diet is important to promote proper tissue healing and to restore muscle strength.

**Doctor:**

**Blood Clot Prevention**

Along with the anticoagulant I've prescribed, you'll also want to do regular lower leg exercises and wear support stockings which will also reduce risk of getting blood clots. I also recommend using a continuous passive motion machine which will help speed your recovery and reduce pain, bleeding, and infection. It works by bending the knee while you're in bed; increasing the rate and amount of bending over time.

**Patient:**

Okay, I'll make sure I do that.

**Doctor:**

Also you should immediately contact a doctor if you develop increasing pain in your calf, tenderness, redness, or swelling of the leg that is unrelated to the incision, or any shortness of breath or chest pain.

# Rivaroxaban Learning System

## Orthopedic Surgery

### Chapter 3 Summary

- o A total knee prosthesis consists of 3 parts:
  - Femoral component (metal)
  - Tibial component (plastic held in a metal tray)
  - Patellar component (plastic)
- o Postsurgical care involves a number of components, including blood clot prevention, activity, wound care, infection, and diet.

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# Rivaroxaban Learning System

## Orthopedic Surgery

### Prevention of Venous Thromboembolism After Orthopedic Surgery

#### Chapter Overview

- o Patients undergoing major orthopedic surgery are at particularly high risk for **VTE**.
- o In this chapter, you will learn about the routine **prophylaxis** of VTE in patients undergoing THR or TKR, according to the Eighth American College of Chest Physicians (ACCP) on Antithrombotic and Thrombolytic Therapy: Evidence-Based Guidelines.
- o You will also learn about the prevention of symptomatic **PE** in patients undergoing THR or TKR according to the American Academy of Orthopaedic Surgeons Clinical Guideline.



# Rivaroxaban Learning System

## Orthopedic Surgery

### Chapter Learning Objectives

After completing this chapter, you should be able to:

1. Describe the epidemiology of VTE in orthopedic surgery patients
2. Explain the significance of the 2008 ACCP Guidelines and the 2007 AAOS Guidelines
3. Discuss thromboprophylaxis recommendations in THR and TKR patients according to the ACCP and AAOS guidelines

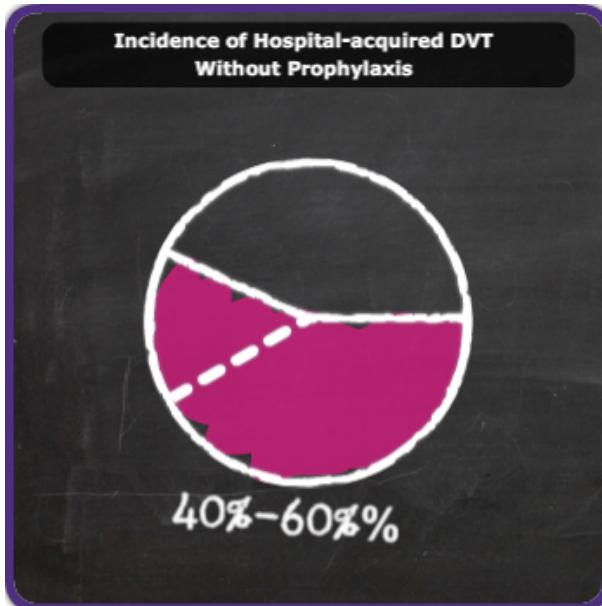


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## Orthopedic Surgery

### Epidemiology

- o Without thromboprophylaxis, the incidence of hospital-acquired DVT is approximately 40%-60% following major orthopedic surgery.
- o Asymptomatic DVT is common and, in the absence of thromboprophylaxis, affects at least half of all patients.
- o Most symptomatic VTE occurs after hospital discharge, and the risk continues to be high for at least 2 months after surgery.



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## Orthopedic Surgery

### ACCP Guidelines

#### Overview

- o The ACCP Guidelines on Antithrombotic and Thrombolytic Therapy were published in 2008 and provide an extensive critical review of the literature related to management of **thromboembolic** disorders.
- o We will be reviewing the ACCP recommendations for the prevention of VTE in the 2 types of orthopedic surgery patients: THR and TKR patients.



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## Orthopedic Surgery

### VTE in THR and TKR Surgery

#### THR Surgery

- o THR patients are at a high risk for both asymptomatic DVT (incidence, 40%-60%) and symptomatic VTE (incidence, 2%-5%).
- o If thromboprophylaxis is not used, fatal PE occurs in approximately 1 patient per 300 electives.

#### TKR Surgery

- o Without thromboprophylaxis, the risk of DVT is higher in TKR patients than hip replacement patients.
- o However, **proximal** DVT occurs less commonly after TKR and the period of increased risk for symptomatic VTE after discharge is shorter.

### ACCP Dosing Guidelines for Prophylactic Agents

Prophylactic Agent	Dosing Guidelines
Low molecular weight heparin (LMWH)	High-risk dose, started 12 hours before surgery or 12 to 24 hours after surgery, or 4 to 6 hours after surgery at half the usual high-risk dose the following day
Fondaparinux	2.5 mg started 6 to 24 hours after surgery
Adjusted-dose vitamin K antagonist (VKA) (ie, warfarin)	Started preoperatively or the evening of the surgical day (INR goal, 2.5)
For patients undergoing elective THR or TKR, the ACCP recommends the routine use of 1 of the 3 anticoagulants listed.	

### Thromboprophylaxis

- o It is important to note that the ACCP Guidelines recommend AGAINST the use of aspirin, dextran, low-dose unfractionated heparin, graduated compression stockings (GCS), and venous foot pumps (VFP) as the sole method of thromboprophylaxis.
- o Decisions about thromboprophylaxis after hip or knee replacement using LMWH, fondaparinux, or a VKA should be made at a specific hospital level, and on occasion, at the level of the individual patient.

# Rivaroxaban Learning System

## Orthopedic Surgery

### **Patients at High Risk of Bleeding**

For patients undergoing THR or TKR who have a high risk of bleeding, the ACCP Guidelines recommend optimal use of a mechanical thromboprophylaxis including either:

- o Intermittent pneumatic compression (IPC) or
- o Venous foot pump (VFP)

When the bleeding risk decreases, pharmacologic thromboprophylaxis can be added to or replace the mechanical interventions.



# Rivaroxaban Learning System

## Orthopedic Surgery

### AAOS Guidelines

#### Overview

- o The American Academy of Orthopaedic Surgeons (AAOS) Clinical Guideline on Prevention of Symptomatic Pulmonary Embolism in Patients Undergoing Total Hip or Knee Arthroplasty was issued in 2007.
- o The AAOS guidelines were created to improve patient care by outlining the appropriate information gathering and decision making processes involved in managing the prevention of symptomatic PE in patients undergoing total hip or knee **arthroplasty**.

Note that the ACCP guidelines focus on the prevention of all VTE, including asymptomatic VTE, whereas the AAOS guidelines focus on the prevention of symptomatic PE only.



# Rivaroxaban Learning System

## Orthopedic Surgery

### **Patients at Standard Risk of PE and/or Bleeding**

- o The optimal prophylactic regimen for a particular patient should reflect a clinical judgment regarding the relative risks of both major bleeding and symptomatic PE.
- o Patients with standard risk of PE and standard risk of major bleeding represent the majority of total joint replacement patients.
- o Patients at standard risk of both PE and major bleeding should be considered for one of the following agents (listed in alphabetical order):
  - Aspirin
  - LMWH**
  - Synthetic pentasaccharides** (ie, fondaparinux)
  - Warfarin**

### **AAOS Dosing Guidelines for Prophylactic Agents**

Prophylactic Agent	Dosing Guidelines
Aspirin	325 mg twice daily for 6 weeks, starting the day of surgery (reduce to 81 mg once daily if gastrointestinal symptoms develop)
LMWH	Dose per PI for 7 to 12 days, starting 12 to 24 hours postoperatively (or after an <b>indwelling epidural catheter</b> has been removed)
Synthetic pentasaccharides (ie, fondaparinux)	Dose per PI for 7 to 12 days, starting 12 to 24 hours postoperatively (or after an indwelling epidural catheter has been removed)
Warfarin	<b>INR</b> goal of $\leq 2.0$ for 2 to 6 weeks, starting either the night before or the night after surgery

# Rivaroxaban Learning System

## Orthopedic Surgery

### **Patients at Elevated Risk of PE and/or Bleeding**

- o Patients at elevated risk of PE and at standard risk of major bleeding should be considered for one of the following agents:
  - LMWH
  - Synthetic pentasaccharides
  - Warfarin
- o Patients at standard risk of PE and at elevated risk of major bleeding should be considered for one of the following agents:
  - Aspirin
  - Warfarin
  - No prophylaxis
- o Patients at elevated risk of both PE and major bleeding should be considered for one of the following agents:
  - Aspirin
  - Warfarin
  - No prophylaxis

### **AAOS Dosing Guidelines for Prophylactic Agents**

Prophylactic Agent	Dosing Guidelines
Aspirin	325 mg twice daily for 6 weeks, starting the day of surgery (reduce to 81 mg once daily if gastrointestinal symptoms develop)
LMWH	Dose per PI for 7 to 12 days, starting 12 to 24 hours postoperatively (or after an indwelling epidural catheter has been removed)
Synthetic pentasaccharides (ie, fondaparinux)	Dose per PI for 7 to 12 days, starting 12 to 24 hours postoperatively (or after an indwelling epidural catheter has been removed)
Warfarin	INR goal of $\leq 2.0$ for 2 to 6 weeks, starting either the night before or the night after surgery

# Rivaroxaban Learning System

## Orthopedic Surgery

### AAOS Versus ACCP Guidelines

Note that there are some differences between the two sets of guidelines. For example:

- o The AAOS recommends the use of aspirin (325 mg twice daily for 6 weeks) whereas the ACCP recommends against the use of aspirin as the sole means of thromboprophylaxis.
- o The target INR for warfarin by the AAOS is  $\leq 2.0$  but 2.5 by the ACCP.

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## Orthopedic Surgery

### Chapter 4 Summary

- o The ACCP Guidelines on Antithrombotic and Thrombolytic Therapy were published in 2008 and provide an extensive critical review of the literature related to management of thromboembolic disorders.
- o For patients undergoing elective THR or TKR, the ACCP recommends the routine use of 1 of the following 3 anticoagulants:
  - LMWH
  - Fondaparinux
  - Adjusted-dose VKA (ie, warfarin)
- o The American Academy of Orthopaedic Surgeons (AAOS) Clinical Guideline on Prevention of Symptomatic Pulmonary Embolism in Patients Undergoing Total Hip or Knee Arthroplasty was issued in 2007.
- o For patients undergoing THR or TKR surgery, the AAOS guidelines recommend one of the following, depending on the individual patient's risk of PE and major bleeding:
  - Aspirin
  - LMWH
  - Synthetic pentasaccharides (ie, fondaparinux)
  - Warfarin
  - None

# Rivaroxaban Learning System

## Orthopedic Surgery

### Key Takeaways

#### What are the components of a total hip prosthesis?

- o A hip socket component (cup), a femoral head component (ball), and a femoral shaft component (metal stem)

#### What are the components of a total knee prosthesis?

- o A femoral component (metal), a tibial component (plastic held in a metal tray), and a patellar component (plastic)

#### Why is prevention of VTE in orthopedic surgery patients important?

- o THR patients are at a high risk for both asymptomatic DVT (incidence, 40%-60%) and symptomatic VTE (incidence, 2%-5%).

#### Are there guideline recommendations for the prevention of VTE in orthopedic surgery patients?

- o The ACCP Guidelines on Antithrombotic and Thrombolytic Therapy were published in 2008 and provide an extensive critical review of the literature related to management of thromboembolic disorders. For patients undergoing elective THR or TKR, the ACCP recommends the routine use of LMWH, fondaparinux, or adjusted-dose VKA.
- o The American Academy of Orthopaedic Surgeons (AAOS) Clinical Guideline on Prevention of Symptomatic Pulmonary Embolism in Patients Undergoing Total Hip or Knee Arthroplasty was issued in 2007. For patients undergoing THR or TKR surgery, the AAOS guidelines recommend one of the following, depending on the individual patient's risk of PE and major bleeding: aspirin, LMWH, synthetic pentasaccharides, warfarin, or none.

# Rivaroxaban Learning System

## Orthopedic Surgery

### Glossary

**Acetabulum** - The cavity or depression on the hip bone that provides the socket into which the head of the femur fits.

**Anesthesia** - Loss of sensation resulting from pharmacologic depression of nerve function.

**Antibiotics** - natural or synthetic substances that destroy microorganisms or inhibit their growth. Antibiotics are used extensively to treat infectious diseases in plants, animals, and humans

**Anticoagulant** - An agent that prevents or delays blood coagulation; common anticoagulants are heparin, sodium citrate, and warfarin sodium.

**Anti-inflammatory** - Counteracting inflammation, the immunological defense against injury, infection, or allergy.

**Antiplatelet** - An agent that destroys or inactivates platelets, which prevents them from forming blood clots.

**Arthroplasty** - A surgical procedure used to reshape, reconstruct, or replace a diseased or damaged joint to alleviate pain, to allow normal function, or to correct a joint defect.

**Charges** - Cost to the patient or third-party payer for medical services.

**Clotting time** - The time required for blood to clot in a glass tube.

**Comorbid** - A disease that worsens or impacts a primary disease.

**Congenital** - Existing at birth; referring to certain mental or physical traits, anomalies, malformations, diseases, etc, which may be either hereditary or due to an influence occurring during gestation up to the moment of birth.

**Deep vein thrombosis (DVT)** - A blood clot in one of the deep veins of the legs (most common site), arms, pelvis, neck, axilla, or chest.

**Epidural block** - A method of regional anesthesia, administered or situated in the space between the spinal cord and the connective tissue membrane covering the spinal cord, used to stop the passage of sensory impulses in the spinal cord, thus depriving a patient of sensation in the area involved.

**Femur** - The thigh bone. It extends from the hip to the knee and is the longest and strongest bone in the skeleton.

**Folic acid** - a water-soluble B complex vitamin needed for DNA synthesis and occurring naturally in green leafy vegetables, beans and yeast

# Rivaroxaban Learning System

## Orthopedic Surgery

**Fondaparinux sodium** - A compound that selectively binds to antithrombin III, thereby potentiating the innate neutralization of factor Xa by antithrombin. Neutralization of factor Xa inhibits its activity and interrupts the blood coagulation cascade, thereby preventing thrombin formation and thrombus development. Fondaparinux is manufactured by GlaxoSmithKline under the trade name Arixtra®.

**Indwelling epidural catheters** - A tubular instrument that remains inside the body for a prolonged period of time that is used to allow passage of fluids or liquids from or into the space between the spinal cord and the connective tissue membrane covering the spinal cord.

**International normalized ratio (INR)** - The internationally recognized standard for monitoring warfarin therapy. Regular intensity therapy is defined as achieving a goal INR of 2.5 (range 2.0 to 3.0) and is appropriate for most cases that require the prevention and/or treatment of thromboembolic disease.

**Low molecular weight heparins (LMWHs)** - The most bioavailable fraction of heparin that also has a more precise anticoagulant effect than unfractionated heparins. It is used to treat and prevent deep venous thrombosis, pulmonary embolisms, and unstable coronary syndromes.

**Methotrexate** - an inhibitor of dihydrofolate reductase that is used to treat rheumatoid arthritis, Crohn's disease, psoriasis, and several cancers. Side effects to the use of this drug may include suppression of bone marrow production of blood cells, hepatitis, and others.

**Nabumetone** - an anti-inflammatory agent used to relieve pain, tenderness, swelling and stiffness caused by osteoarthritis and rheumatoid arthritis.

**Necrosis** - The death of cells, tissues, or organs.

**Osteoarthritis** - A type of arthritis marked by progressive cartilage deterioration in synovial joints and vertebrae.

**Patella** - A lens-shaped bone situated in front of the knee in the tendon of the quadriceps femoris muscle.

**Pelvis** - The bony compartment consisting of the sacrum and coccyx, that supports the vertebral column and articulates with the lower limbs.

**Prednisone** - a glucocorticoid that is used as an anti-inflammatory, antineoplastic, and immunosuppressant agent.

**Prophylaxis** - The prevention of a disease or of a process that could potentially lead to disease.

**Prosthesis** - Replacement of a body part by an artificial substitute.

**Prosthetic** - Relating to a prosthesis or to an artificial part.

# Rivaroxaban Learning System

## Orthopedic Surgery

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**Proximal** - A location that is nearest to the point of origin, center of the body, or a given reference point.

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**Pulmonary embolism (PE)** - An obstruction of the pulmonary artery or one of its branches that is usually caused by an embolus from an embolism, such as a blood clot, in a lower extremity.

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**Radiographic** - Relating to the exposure of x-rays to produce an image on film.

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**Radiographs** - The film on which an image is produced through exposure to x-rays.

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**Rehabilitation** - The processes of treatment and education that help disabled individuals to attain maximum function, a sense of well-being, and a personally satisfying level of independence.

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**Rheumatoid arthritis** - A chronic disease characterized by inflammation of multiple joints. The disease usually affects similar groups of joints on both sides of the body, and can create bony erosions that can be seen radiographically.

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**Skyline view** - A radiograph taken with the knee bent and the X-ray beam directed at an angle to the bent knee. The skyline view allows fracture or dislocation of patella to be visualized.

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**Spinal** - Pertaining to the spinal column, or backbone, which consists of 33 vertebrae.

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**Synthetic pentasaccharides** - An artificially prepared carbohydrate that on hydrolysis yields five molecules of simple sugars (monosaccharides).

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**Thromboembolic** - Pertaining to the obstruction of a blood vessel due to a clot or part of a clot that has detached from its original place of formation and has traveled to another organ.

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**Thromboprophylaxis** - The prevention of clot formation in the cardiovascular system, or the prevention of a process that could potentially lead to a blood clot in the cardiovascular system.

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**Tibia** - The inner and larger bone of the leg between the knee and the ankle; it articulates with the femur above and the talus below.

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**Total hip replacement (THR)** - Surgery to replace the hip joint with an artificial device.

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**Total knee replacement (TKR)** - Surgery to replace a painful, damaged, or diseased knee joint with an artificial joint.

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# Rivaroxaban Learning System

## Orthopedic Surgery

**Venous thromboembolism (VTE)** - The collective term used to describe deep-vein thrombosis (DVT) and pulmonary embolism (PE).

**Vitamin K antagonist (VKA)** - Because vitamin K is necessary for synthesis of clotting factors and prothrombin by the liver, its blocking by VKAs such as warfarin prolongs blood clotting time. Warfarin is manufactured by Bristol-Myers Squibb Company under the trade name Coumadin®.

**Warfarin sodium** - An anticoagulant drug. It is manufactured by Bristol-Myers Squibb Company under the trade name Coumadin®. Warfarin is also available generically by many manufacturers.