Knee Replacement Implants

Your doctor may recommend knee replacement surgery if you have severe knee pain and disability from rheumatoid arthritis, osteoarthritis, or traumatic injury. A knee replacement can relieve pain and help you live a fuller, more active life.

During the surgery, an orthopaedic surgeon will replace your damaged knee with an artificial device (implant). Although replacing the total knee joint is the most common procedure, some people can benefit from just a partial knee replacement.

Implants are made of metal alloys, ceramic material, or strong plastic parts, and can be joined to your bone by acrylic cement. There are many different types of implants. Your surgeon will discuss with you the type of implant that best meets your needs.

Implant Design

Normal Knee Function
Your knee is the largest and strongest joint in your body. The knee joint is where the lower end of your femur (thighbone) meets the upper end of your tibia (shinbone). Your patella (kneecap) sits in front of the joint to provide some protection.

A healthy knee lets you move your lower leg forward and backward, and swivel slightly to point your toes in or out. Ligaments and cartilage stabilize and support the joint, preventing your knee from moving too far from side to side.

Types of Designs
For simplicity, the knee is considered a “hinge” joint because of its ability to bend and straighten like a hinged door. In reality, the knee is much more complex because the bone surfaces actually roll and glide as the knee bends.

The first implant designs used the hinge concept and included a connecting hinge between the parts. Newer implant designs recognize the complexity of the joint and more closely mimic the motion of a normal knee. Some designs preserve the patient’s own ligaments, while others substitute for them.

Several manufacturers make knee implants and there are more than 150 knee replacement designs on the market today.

Recent developments in design include "gender specific" implants. A number of studies indicate that the shape and proportions of a woman’s knee differ from those of a man’s knee. As a result, several manufacturers have developed components for the end of the thighbone which more closely match the average woman’s knee. However, there are no studies to show that “gender specific” implants last longer or provide better function than standard implants.

The Right Implant for You
The brand and design used by your doctor or hospital depends on many factors, including your needs (based on your age, weight, activity level, and health), your doctor’s experience and familiarity with the device, and the cost and performance record of the implant. You should discuss these issues with your doctor.
Implant Components

Up to three bone surfaces may be replaced in a total knee replacement:

- **The lower ends of the femur.** The metal femoral component curves around the end of the femur (thighbone). It is grooved so the kneecap can move up and down smoothly against the bone as the knee bends and straightens.

- **The top surface of the tibia.** The tibial component is typically a flat metal platform with a cushion of strong, durable plastic, called polyethylene. Some designs do not have the metal portion and attach the polyethylene directly to the bone. For additional stability, the metal portion of the component may have a stem that inserts into the center of the tibia bone.

- **The back surface of the patella.** The patellar component is a dome-shaped piece of polyethylene that duplicates the shape of the patella (kneecap).

Components are designed so that metal always adjoins with plastic, which provides smooth movement and results in minimal wear.

**Posterior-Stabilized Designs**
In these designs, the cushion of the tibial component has a raised surface with an internal post that fits into a special bar (called a cam) in the femoral component. The posterior cruciate ligament is removed to fit the components to the bone. The pieces work together to do what the posterior cruciate ligament does: prevent the thighbone from sliding forward too far on the shinbone when you bend your knee.

**Cruciate-Retaining Designs**
As the name implies, the posterior cruciate ligament is kept with this implant design. Cruciate-retaining implants do not have the center post and cam design. This implant may be appropriate for a patient whose posterior cruciate ligament is healthy enough to continue stabilizing the knee joint.

**Unicompartmental Implants**
In total knee replacement, large implants are used to resurface the ends of the femur and tibia. If only one side of the knee joint is damaged, smaller implants can be used (unicompartmental knee replacement) to resurface just that side.

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**Fixed- vs. Mobile-Bearing Prosthesis (Implant)**

- **Fixed-Bearing Prosthesis**
  Most patients get a fixed-bearing prosthesis. In this design, the polyethylene of the tibial
component is attached firmly to the metal implant beneath. The femoral component then rolls on this cushioned surface.

In some cases, excessive activity and/or extra weight can cause a fixed-bearing prosthesis to wear down more quickly. Worn components can loosen from the bone and cause pain. Loosening is a major reason some artificial joints fail.

If you are younger, more active, and/or overweight, your doctor may recommend a rotating platform/mobile-bearing knee replacement. These implants are designed for potentially longer performance with less wear.

**Mobile-Bearing Prosthesis**

Like fixed-bearing implants, mobile-bearing implants use three components to provide a relatively natural joint. In a mobile-bearing knee, however, the polyethylene insert can rotate short distances inside the metal tibial tray.

This is designed to allow patients a few degrees of greater rotation to the medial and lateral sides of their knee.

Compared with fixed-bearing designs, mobile-bearing knee implants require more support from soft tissues, such as the ligaments surrounding the knee. If the soft tissues are not strong enough, mobile-bearing knees are more likely to dislocate. They also may cost more than fixed-bearing implants.

In addition, there are no studies which show better durability, improvement in pain, or improvement of function with a mobile bearing design.

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**Implant Materials**

The metal parts of the implant are made of titanium or cobalt-chromium based alloys. The plastic parts are made of ultra high molecular weight polyethylene. All together, the components weigh between 15 and 20 ounces, depending on the size selected.

**Material Criteria**

The construction materials used must meet several criteria:

- They must be biocompatible; that is, they can be placed in the body without creating a rejection response.
- They must be able to duplicate the knee structures they are intended to replace; for example, they are strong enough to take weightbearing loads, flexible enough to bear stress without breaking, and able to move smoothly against each other as required.
- They must be able to retain their strength and shape for a long time.

**Cemented and Cementless Implants**

Two types of fixation are used to hold knee implants in place. Cemented fixation uses a fast-curing bone cement (polymethylmethacrylate). Cementless fixation relies on new bone growing into the surface of the implant for fixation.

Cementless implants are made of a material that attracts new bone growth. Most are textured or coated so that the new bone actually grows into the surface of the implant.

There is also hybrid fixation. In hybrid fixation for total knee replacement, the femoral component is inserted without cement, and the tibial and patellar components are inserted with cement.

Your surgeon will evaluate your situation carefully before making any decisions about components and fixation. Do not hesitate to ask what type of fixation will be used in your situation and why that choice is appropriate for you.

**Revision Components**

The longevity and performance of a knee replacement depends on several factors, including your activity level, weight, and general health.

Just as wear in the natural joint contributed to the need for a replacement, wear in the implant may eventually require a second surgery (called a joint revision).

Revision surgery may require special components. Typically they will have longer stems which fit into the femur and tibia. They may also have attached metal pieces called augments which substitute for missing bone.

Revision components often have a cam in the center of the knee similar to a posterior stabilized component. In revision components, though, the cam is larger to give the knee more stability.

In cases where the knee is very unstable and a large amount of bone is missing, it may be necessary to join the femur and tibia with a metal "hinge" in the center.

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*Revision components usually have longer stems that insert into the bones.*
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