As in all fields, changes sometimes lead to improved outcomes and are incorporated into everyday use, and in other cases, changes are shown to have worse outcomes and are abandoned. Modern knee replacement surgery is based on a number of time-tested techniques, and the outcomes can be expected to be good in 90% of operations. However, this leaves considerable room for improvement, and our specialty is constantly striving to achieve better results. Some of the controversies in knee replacement surgery are discussed below. While different surgeons may have strong opinions on these issues, they are many very knowledgeable and capable people on both sides! For most patients, these are not critical issues, but the engineers among you, please read on!

Some of the controversies are:

- Cemented vs. uncemented fixation
- Fixed bearing vs. mobile bearing knee replacement
- Minimally invasive surgery (MIS)
- Cruciate retaining vs. cruciate substituting knee replacement
- Partial knee replacements vs. total knee replacements
- Gender specific and high knee flexion designs
- Computer assisted surgery

**Cemented vs. uncemented fixation**

Total knee implants can be fixed to the bone with or without bone cement. In uncemented fixation, there is usually a surface on the metal implant into which the bone can grow. If the bone grows into the metal surface, then there is the potential for a very durable bone-implant interface. Cemented fixation is the so-called gold standard, and it has provided excellent results for decades. Unfortunately, cement eventually fatigues and cracks, which can lead to implant loosening. Despite the promise of uncemented fixation (which has become the standard in the hip), studies show better results with cemented fixation, especially on the tibial surface, where it is more difficult to achieve bone ingrowth into the implant. Some surgeons will opt to place the femoral component without cement, and cement in the other implants (hybrid knee replacement).

**Fixed bearing vs. mobile bearing**

Most total knee designs incorporate a fixed bearing. In other words, the implants are fixed to the bone, and they do not move independently as the knee moves. In a mobile bearing design, the plastic between the femoral and tibial components is able to rotate with the femoral component as the knee moves. This is also known as a rotating platform knee. Theoretically, this type of knee should reduce the stresses on the interface between the implant and the shin bone, leading to a lower rate of wear and failure. These designs have been available for quite some time, although many patients thought the design was new, largely owing to a direct manufacturer to consumer advertising campaign. There is no statistically significant data to recommend a mobile bearing design over a fixed bearing design, and there may be some potential additional complications with the mobile bearing knee. Virtually all of the knee replacements performed at Kaiser Santa Clara are of the fixed bearing design.
Minimally invasive surgery (MIS)

In the past few years, there has been renewed interest in doing knee replacements through smaller incisions, in order to reduce pain, speed recover, and produce a more cosmetic scar. Several variations of surgical technique have been developed, along with smaller instruments, to facilitate doing the surgery through a smaller incision. Smaller incisions are not for every patient; the ideal patient is slim, has minimal deformity, and good soft tissue mobility. There is no convincing data that long-term outcomes are any different with MIS procedures, but some studies have shown less pain and a faster recovery of muscle control and motion. Unfortunately, there is a concern that the surgery will not be done as well because the surgeon cannot see as well, the cementing technique may be compromised, and there may be skin injuries as the skin needs to be stretched to allow surgery through small spaces. While this surgery can be done well with MIS techniques, studies have shown that there is a considerable learning curve to achieve reliable and high quality outcomes with MIS knee replacement.

Cruciate retaining vs. cruciate substituting

In virtually all total knee replacements, the anterior cruciate ligament is removed if it is still intact. Some knee designs preserve the posterior cruciate ligament; others remove it and use the implant to provide for ligament stability in the posterior (or backwards) direction. Proponents of the PCL sparing knees say the knee moves more normally and more bone is preserved; proponents of the PCL substituting knee argue that this knee provides better motion and easier correction of deformity. There is no convincing evidence that either design is superior, so the choice is usually made by the surgeon. There are some newer designs which claim to provide both posterior and anterior stability; there is no long-term data available on these implants.

Partial knee replacements vs. total knee replacements

The knee joint is thought of as having three parts, or compartments. These include the contact areas between the kneecap and the thigh bone (patellofemoral compartment), and between the thigh bone and shin bone on the inside (medial compartment) and on the outside (lateral compartment) of the knee. In a total knee replacement, all three compartments are replaced. Most patients have involvement of more than one compartment, so they are best served by having a total knee replacement. Some patients have virtually all the arthritis is one of the three compartments, so partial knee replacements have been designed. Most partial knee replacements are done for arthritis in the medial compartment. The advantages of a unicompartmental knee replacement include the potential for a faster recovery, better mobility, and a knee which feels more like a normal knee. Disadvantages may include less durability of the knee replacement, since progression of arthritis in the non-replaced parts of the knee can cause symptoms, and a revision operation can be more difficult than a first time knee replacement. The ideal patient is thought to be slim, relatively elderly and sedentary, and with good knee motion and very little deformity. However, these operations are being done on some younger and heavier patients; time will tell if the outcomes support the expanded use of these devices. Because very few patients fit the ideal candidate for the partial knee replacement, some surgeons prefer to do total knee replacements in all their patients. Both types of knee replacements are done at Kaiser Santa Clara.

Gender specific and high knee flexion designs

Manufacturers and surgeons are always trying to improve implants to address different issues. Two design changes which have received a great deal of press, largely due to direct to consumer marketing, include so-called gender specific designs
and high flexion designs. Studies of bone shapes have revealed differences between male and female bones. Gender specific designs attempt to address these differences. There is currently no data to support the widespread use of a gender specific implant, also known as the “female” knee, instead of a standard implant. However, the gender specific implant does tend to be narrower in width for each available size, so in some cases, it may fit the bone of a specific patient better than the standard width implant.

Design changes have also been incorporated into knee replacements so that they have the potential to allow greater knee flexion. Most knee implants are designed to allow about 120 degrees of flexion (where a straight knee is considered to be at 0 degrees of flexion). Some of the high flexion designs attempt to achieve up to 155 degrees of flexion. They were designed to be used for patients who need high amounts of knee bending on a routine basis (such as in cultures who sit on the floor much of the time). Of course, most patients with severe osteoarthritis of the knee do not have nearly this much knee flexion, and they are unlikely to achieve it after surgery because the soft tissues around the knee will not permit it. Studies in normal US subjects have shown that we spend less than 0.2% of our time with the knee bent greater than 120 degrees, so most patients would not benefit from additional knee flexion, even if they were able to attain it. These implants may require more bone resection, and there is currently no long-term data available to see if there are any problems caused by these newer designs.

**Computer Assisted Surgery**

One of the newer technological advances has been the use of computerized navigation systems to help with placement of implants in both knee and hip replacement surgery. While consistent use of these systems can improve accuracy in the positioning of implants, there is not yet good evidence that the outcomes for the patients are improved. There are risks with using these systems, including added surgical time, and there are reports of fractures occurring through the holes in the bone which are needed in order to temporarily attach the navigation instruments to the bone. As a result, computer navigation is not routinely used for joint replacement by most surgeons, although it can be especially helpful if there is a significant bony deformity which limits the use of standard bony landmarks.