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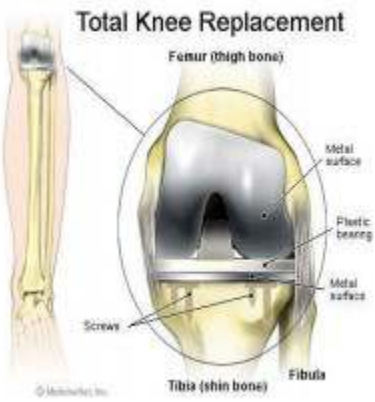
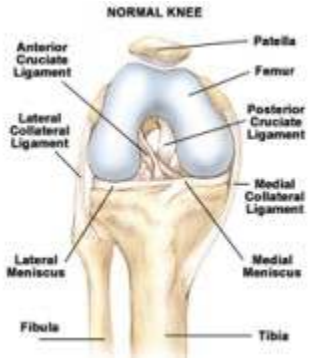
Knee Replacement

By: Christopher B. Lynch, M.D.

Painful arthritis of the knee affects up to 10% of the general United States population over 65 years of age. As a result, data estimates that approximately 350,000 total knee replacements are performed each year in the United States. In the past, knee replacement was typically reserved for the elderly, more sedentary patients with significant disease throughout the entire knee. Increasing demand from younger, more active patients with variable amounts of knee disease has prompted advances in knee replacement designs and techniques and has led to expanded use of total and partial knee replacement. In patients with severe arthritic disease affecting only one compartment, it may not be necessary or wise to replace all three joint surfaces.



In joints that rely on more than one cartilage interface, like the knee, arthritis may not significantly affect all of these opposing cartilage surfaces. Therefore, it is not always necessary to replace the minimally diseased surfaces nor is it necessary to sacrifice, as extensively, essential stabilizing ligaments, muscles or tendons. Knee replacement replace individual diseased compartments while leaving healthy joint surfaces and normal knee stabilizing ligaments intact.



The knee joint consists of three equally important and separate cartilage interfaces. The medial(inside) and lateral(outside) compartments are used while walking. The opposing smooth and slick cartilage. The stability and distribution of weight within these compartments is aided, in each, by the meniscus. Stability is further maintained in these compartments by the anterior and posterior cruciate ligaments (ACL and PCL) and, with assistance from both menisci and the kneecap, are responsible for antero-posterior (front to back) stability of the knee. The medial and lateral collateral ligaments control side to side stability. The interactions between normal medial and lateral cartilage surfaces and surrounding ligaments, muscles and tendons are essential for optimal knee stability, mechanics and function.

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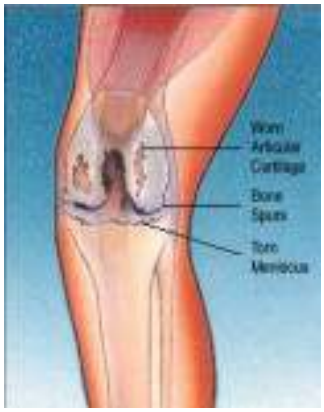
The undersurface of the kneecap, the patello-femoral joint, is the third joint in the knee. With the hamstrings, the kneecap and attached ligaments are the stabilizers preventing “buckling” of the knee and assisting in maintaining optimal knee motion. The relatively small cartilage at the patello-femoral joint experiences extremely high pressures. It functions to improve the strength and efficiency of the extensor mechanism (kicking muscles). These pressures are higher when rising from chair and stair climbing. It is not surprising that pain behind the kneecap frequently accompanies the development of painful arthritis in other compartments in the knee.

In patients with disease affecting two or three compartments (i.e.: medial, lateral and patello-femoral), the most predictable long-term pain relief is achieved with a total knee replacement (TKR). TKR involves a measured removal of all cartilage and a small amount of its underlying bone from the distal femur, proximal tibia and the undersurface of the patella. Each surface is “capped” with polished and extremely smooth metal and/or plastic to replace, as equally as possible, the diseased and surgically removed bone and cartilage. The MCL and LCL are left intact and the extensor mechanism is repaired during closure.

Single compartment knee replacement is most commonly performed for knees with isolated pain medially (inside). The typical patient is a moderately active patient who does not engage in extensive heavy labor activities who complains of isolated medial knee pain. History, physical examination and radiographs should isolate the symptoms to an individual compartment without the involvement of the other two compartments. Patients complaining of medial joint line pain, medial pain with ambulation and particularly with stair climbing or squatting should be absent. The exam should show well maintained joint spaces and absence of pain in both the lateral and patello-femoral compartments. In addition, although the indications for UKR are becoming more controversial, many surgeons believe that significant bent knee deformities (>10 degrees fixed flexion), uncorrectable bow-legged (varus) or knock-knee (valgus) alignment at the joint, loss of motion (

The benefits of UKR design are the ability to retain important structures necessary for optimal stability and function in the knee. The ACL, PCL, collaterals, opposite compartment meniscus and cartilage surfaces at the opposite and patello-femoral compartment are not violated in UKR. This allows improved post-operative stability and more normal knee mechanics than that achieved with a TKR. In addition, the synthetic surfaces utilized in knee replacement do not reproduce the smooth, resilient, lowfriction surfaces of healthy intact cartilage on healthy intact cartilage. Two of the three compartments in UKRs retain these optimal opposing healthy joint

surfaces. A final benefit of performing a UKR is a more limited exposure. The incision into the quadriceps tendon (thigh muscle) is smaller than a standard incision for a TKR. This limited exposure theoretically decreases post-operative thigh weakness and incisional pain, leading to a more rapid rehabilitation course.



The benefits of UKR are numerous and include a less invasive surgical technique, maintenance of stabilizing structures, improved post-operative knee mechanics, improved rehabilitation and variable postponement of a more involved TKR. However, UKR has particular indications and may be unsuccessful and ultimately detrimental if utilized in the wrong patients. While all patients with isolated single compartment disease are candidates for UKR, each candidate must be evaluated on an individual basis taking lifestyle, patient expectations, weight, cause of arthritis, stability and deformity into consideration. In those patients with expectations to return to heavy labor activities, overweight patients, ACL deficient patients, patients suffering from inflammatory arthritis and those with fixed deformities should consider alternative treatments including proximal tibial or distal femoral realigning osteotomies or total knee replacement. Remember, the best results occur only when the surgery matches the problem at hand.

Computer Navigated Total Knee Replacement

By Christopher B. Lynch, M.D.

Total Knee Replacement (TKR) continues to be one of the most successful medical interventions performed today. This procedure allows patients with painful arthritic knees to return to a more active lifestyle and achieve an improved quality and, in many cases, quantity of life. In general, ten-year knee replacement survival studies average > 90%, 15- year @ 85% and 20-year @ 75% survival. These numbers are certainly an improvement over previous survival studies reporting on the use of earlier implant designs and surgical techniques. Rates of survival continue to improve with advances in technology and techniques. Recent advances such as the incorporation of computer navigated systems promises to improve outcomes and long-term survival of currently implanted TKR's.

Initial early implant techniques incorporated "eyeballing" the essential bone cuts without the use of guides or jigs. Failures using this technique were attributed to poor attention to achieving optimal lower extremity alignment (excessive knock-knee or bow leg), and failure to balance ligaments (too loose or too tight on the inside or outside of the knee). Malalignment and

instability causes abnormal stresses on the implant and the bone leading to increased risk of premature failure in TKA.

In an effort to improve outcomes by achieving better alignment, current generation surgical techniques involve the use of jigs and guides that are designed to allow more predictable and reliable bone cuts. Updated techniques have also been developed to allow for appropriate and equal balancing of the ligaments to prevent the knee being too tight or too loose. The use of these jigs and guides has certainly improved the overall alignment of total knee replacements. Alignment and ligament balancing are among the most important aspects of a surgically successful total knee replacement. Optimal alignment, unfortunately, is not a guarantee with any current technique. In fact, several recent studies have determined that optimal alignment is not achieved in 8-25% of patients, even in the hands of the most skilled surgeons, with current cutting systems.

Computer Navigated Knee Systems are the latest tools designed to aid the surgeon in more predictably and reproducibly achieving optimal alignment and in addition, assist in achieving appropriate and necessary ligament balancing. The computer navigation system that I currently use (Ci System, DePuy) involves the use of a “computer eye” that uses infrared beams to read the position of shiny spheres attached in a specific pattern to the thigh and shin bones. The computer “eye” also reads a wand that I use to “register” the outline of the bones at the knee and generate an image of the patients’ knee and entire lower extremity on the computer screen. Using this image and guides specific for the computer, appropriate cuts of both the thigh and shin bones can be made with up to a 0.5 a degree of accuracy in all planes. 0.5 degree is well within the 3-degree safe zone for alignment. The computer may also make suggestions regarding ligament balancing and sizes of implants which I may, or may not, choose to use based on my experience.

Although we joint replacement surgeons do not necessarily “need” the computer, studies from around the world have repeatedly determined that the accuracy of the computer is significantly better than the current techniques at achieving optimal alignment and avoiding outliers of the lower extremity during total knee arthroplasty. The accuracy of the computer navigation system produces optimal alignment in >95% of cases and reduces the risk of any significant outliers. Technology continues to improve and as surgeons we need to remain current. This recent advance promises to be the standard of care in the (near) future improving long-term outcomes. Eventually this technology may allow us to safely reduce incision size and minimize peri-operative soft tissue trauma potentially speeding up post-operative rehabilitation. So far, clinical results in the short term have been excellent and x-ray results have indeed proven that the computer is extremely accurate.

Approximately two years ago, I was the first surgeon in the New Haven area to utilize this technology. I had not used the computer on all my patients over the course of the last two years,

but my early personal results after my first 100 selected computer navigated total knee replacements have been extremely encouraging. As a result of my continued success utilizing the computer during knee replacement, currently all potential knee replacement patients are considered candidates for computer navigated knee replacement. Currently, I continue to incorporate this technique for many total knee replacements at both Milford Hospital and The Hospital of St. Raphael.