



## **MINIMALLY INVASIVE KNEE REPLACEMENT SURGERY**

### **STATE OF THE ART: 2009**

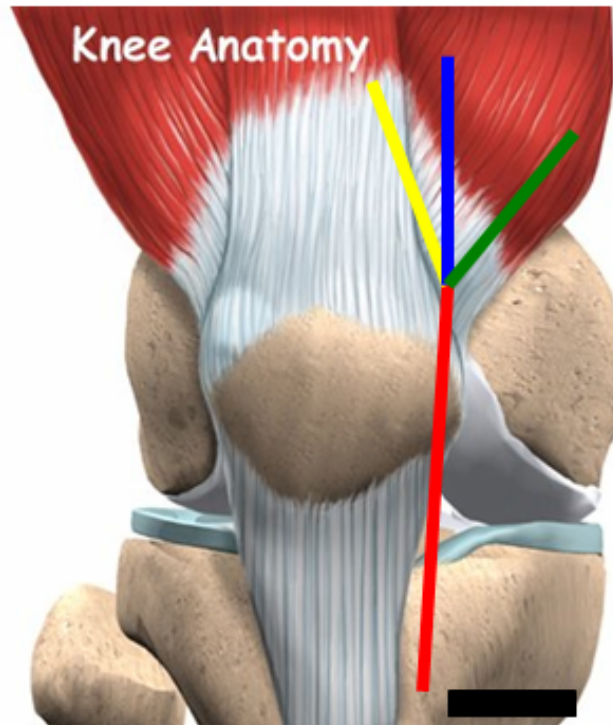
#### **INTRODUCTION**

The last decade has witnessed the evolution of several important advances in Total Knee Replacement (TKR) surgery. Pain management techniques have improved to make immediate postoperative rehabilitation much easier. Implant designs have progressed to allow for greater range of motion and more normal function. However, one of the most significant advances over the last decade has been in the development of a less invasive surgical approach to the knee so as to allow for a quicker and easier recovery and a more rapid return to full function. The development of the minimally invasive surgical approach to the knee has not been without its issues. It is a more demanding technique requiring greater surgical experience. And if applied by inexperienced or untrained surgeons can lead to greater risk of complications.

#### **THE MINIMALLY INVASIVE PROCEDURE – GENERAL CONCEPTS**

The primary feature of minimally invasive knee surgery is not the length of the skin incision but the protection of the underlying quadriceps muscle and tendon (quad mechanism). Older, more traditional surgical approaches involve extensive cutting into the quadriceps muscle or tendon. Incision into the quad mechanism delays return of muscular control of the leg. Patients find they are unable to straight leg raise for several days. Early efforts at walking are difficult due to poor quadriceps muscle function and control. The ability to gain full range of motion is delayed.

The minimally invasive knee approach minimizes quadriceps dissection and protects the muscle throughout the operative procedure. Direct cutting of the quadriceps tendon and muscle is avoided. Instead in the minimally invasive approach the quad muscle is split along the line of its fibers for a very short distance and very near the medial (inside) border of the muscle (see figure 1). Since the muscle is split and not cut, there is much less healing required. And since the muscle split is close to its inside border, the great bulk of the quadriceps muscle is left completely intact and protected. The result is almost immediate return of quad function after surgery.



**Figure 1**

**Yellow line** – cutting through the quadriceps tendon prolongs recovery of the quadriceps mechanism

**Blue line** – cutting through the vastus medialis muscle (VMO) also delays recovery

**Green line** – minimally invasive splitting not cutting the VMO near the medial (inside) border of the muscle protects the vast majority of the quad mechanism and provides for the fastest recovery.

### **ADVANCES REQUIRED FOR SAFE MINIMALLY INVASIVE SURGERY**

In order for the minimally invasive surgical approach for knee replacement surgery to develop, three advances were necessary. First, instruments had to be modified to be much less bulky so as to fit into the smaller spaces provided by the minimally invasive exposure. Second, clinical research had to be performed to determine the best and safest of various proposed minimally invasive techniques (this evolution continues to this day). And finally surgeons adopting these techniques required special training and experience so as to be able to safely employ the minimally invasive techniques that evolved.

### **ADVANTAGES OF MINIMALLY INVASIVE SURGERY TO THE PATIENT**

The primary benefit to the patient of the minimally invasive approach in total knee replacement surgery is the shortened rehabilitation time line leading to a quicker recovery. When combined with new pain management techniques such as the use of femoral and sciatic nerve blocks, the surgical experience is much less painful. Since the quad mechanism is protected, control of the leg is regained quickly after the effects of the nerve blocks have worn off (18 hours on average). This leads to a shorter hospital stay (two nights for relatively young, fit patients – three nights for less fit and older patients). Time on the walker, crutches, and / or cane is shortened and many patients are able to discard all ambulatory aids in a couple of weeks or less. Range of motion is regained more quickly and less physical therapy is required. Time to return to activities of daily

living such as driving, working, and recreational sports is shortened (though there remains great individual variability on the speed of recovery).

### **RISKS OF MINIMALLY INVASIVE SURGERY**

In the early developing years of minimally invasive surgery for knee replacement surgery, there were concerns regarding the possibility of an increased complication rate. These concerns included possible damage to the skin and soft tissues due to forceful surgical retraction that might lead to an increased infection rate. There were also concerns that due to more limited exposure, there would be a possibility of mal-aligning knee components leading to inferior knee function. Studies have since shown though that a trained, experienced surgeon can utilize the techniques of minimally invasive surgery with no increased risk of complications. The key to success and the avoidance of problems and complications is the recognition by the surgeon as to how best to utilize minimally invasive concepts on an individualized basis. In complex and difficult cases, greater surgical exposure may be required. It is the judgment developed by experience that allows the surgeon to understand how far to push minimally invasive concepts in each individual patient so as to ultimately achieve the excellent long term results to which all aspire.

### **WHO IS A CANDIDATE FOR MINIMALLY INVASIVE SURGERY**

Minimally invasive techniques can now be used in all knee replacement surgeries. The ideal candidate in which to fully employ all concepts is a thin patient with a relatively supple knee and little deformity. As the challenge and difficulty of the surgery increases due to factors such as obesity, girth of the knee, soft tissue contractures, and bony deformity, a wider surgical exposure is required to safely implant and align the new knee. However, even in the most challenging cases lessons learned from minimally invasive surgical techniques and the use of smaller low profile instruments that have been developed have dramatically reduced the quadriceps exposure required to safely perform the surgery in all patients. Thus all patients can benefit from minimally invasive concepts and techniques. It is the responsibility of the surgeon to know how to safely implement these techniques for the benefit of each patient without increasing the risks involved.

### **CONCLUSION**

Minimally invasive knee surgical techniques for knee replacement surgery have been developed and perfected over the last decade. Use of this “quadriceps sparing” approach can lessen post operative pain and shorten the recovery period. Though the quad sparing minimally invasive approach is most fully employed in straight forward cases, the techniques that have evolved are such that an experienced surgeon can safely apply principles of this approach to the benefit of all patients.