Complications during minimally invasive knee surgery

Abstract Since their advent, minimally invasive surgical techniques have achieved good results in knee arthroplasty, earning the approval of many orthopaedic surgeons. The advantages offered by this type of surgery are the respect of the extensor system, early functional recovery and reduced pain. As always in surgery, in order to obtain such results, various problems have been tackled, some of which have now been overcome thanks to the new instruments that are better suited to restricted incisions, whereas others still cause significant complications. The excessive forces exercised on the soft tissues and patella can damage the tissues despite the less invasive incision. All the statistics provided by surgeons who most frequently use these techniques show complications due to the use of a minimally invasive technique that can be avoided with the standard techniques, which have given outstanding results for a long time. Above all, implantation accuracy appears to be reduced through a small incision. The highest complication rates are reported in the quadriceps-sparing technique, which does not allow a perfect view of the joint. In this review, we highlight the possible complications associated with this “new” surgical approach, which still requires further evolution in order to achieve the same results as the standard technique.

Key words Complications • Minimally invasive access • Total replacement

Introduction

Six years after its invention, minimally invasive knee arthroplasty for total knee replacement (TKR) has now achieved good results. It includes various access routes such as the mini-midvastus, subvastus, limited parapatellar and the quad-sparing procedure (Fig. 1) [1–5]. Surgeons are unanimous that these procedures offer advantages such as more rapid functional recovery, reduced post-surgical pain, shorter recovery period and better patellar stability and alignment as a result of the reduced surgical damage to the extensor mechanism. The possibility of a smaller scar also represents an advantage in elective surgery. However, in the most complicated cases, it is still possible to widen access and continue using the standard procedure. Not all of these approaches can be easily extended, especially the mini-midvastus and subvastus procedures.

Laskin et al. [1, 6, 7] illustrated the advantages of the mini-midvastus approach over a standard technique, reporting identical surgical times, reduced blood loss from drainage, reduced post-surgical pain, faster, better recovery of flexion, faster recovery of deambulation and climbing/descending stairs without aids and the same implant precision at radiography. However, a year from the operation the functional results had become similar to those obtained using the standard technique. This means that the
real advantages of the minimally invasive technique are only present in the immediate post-surgical period and the first few months after the procedure. A year earlier, in 2004, using the navigator associated with the same minimidvastus approach, Laskin [8] had obtained good results in terms of implant precision and stability with shorter operation times. The use of the navigator had reduced the risks of embolism, as the use of an intramedullary guide had been avoided. Tria and Coon [9, 10] also claimed to have obtained better results using the quad-sparing approach than the standard technique.

However, controversies exist regarding the real advantages of the minimally invasive techniques and the opinions among authors are far from unanimous. In 2003, Fisher et al. [11] demonstrated that total knee replacement performed using the minimally invasive technique was less precise than those done using standard techniques as regards the positioning of the tibial plate on the frontal plane and the consequent axial alignment on the post-surgical radiographs.

According to a review of the Swedish Register, presented by Bonutti [12] at the 2005 annual meeting of the American Academy of Orthopaedic Surgeons, five years after surgery, the review rate for minimally invasive techniques was twice that of those implanted using the conventional technique. We can therefore claim that these new techniques do not constitute absolute advantages: minimally invasive surgery may present a number of complications in relation to an excessive tension on the soft tissues and excessive stress on the bone tissue, especially in the case of extensive osteoporosis and in particular on the patella. Implant precision and cementing may pose problems and the longer duration of the procedure leads to a higher infection rate. Shorter recovery times may become disadvantageous for patients who need treatment of local or systemic earlier complications. Can we therefore consider minimally invasive knee surgery a reality?

**Soft tissue and bone**

Despite a dedicated, expert team and correct use of the so-called dynamic window concept, during minimally invasive procedure, excessive forces are exerted on the periarticular soft tissues. The complete extensor mechanism and skin particularly suffer excessive traction, far greater than that encountered using the standard technique. Excessive traction leads to a higher risk of skin necrosis. During the minimidvastus approach, the excessive traction through the medial vastus muscle often causes a split of a significant length in a longitudinal direction to the muscle fibres, which is extremely harmful to the muscle. On 150 total knee replacements using a mini-midvastus approach, Laskin [13] experienced one case of skin necrosis, which healed spontaneously, and 6 medial vastus splits during flexion. We used the same approach as a first minimally invasive technique; however, as in our experience muscular split was frequent, we subsequently used limited parapatellar access. However, despite its rarity, we also experienced the same phenomenon along the quadriceps tendon with this technique.

This does not occur in the subvastus approach, although the tractions and compressions on the entire muscular mass of the medial vastus are far higher. In a recent randomized prospective study comparing 60 TKR procedures using the subvastus approach with 60 procedures using the standard technique, Boerger et al. [14] obtained a higher tourniquet application time, a fracture of the external femoral condyle, a patellar tendon rupture and a higher number of patellar lateral releases with the minimally invasive approach and no complication using the standard technique.

In the quad-sparing approach, as the medial vastus tendon does not detach completely from the patella, no muscle damage is created. However given the reduced view, greater traction is required on the patellar tendon and patella. However, in the literature no patellar fractures have been described when the minimally invasive technique was used. In fact, as illustrated by Pagnano [15], the insertion of the medial vastus muscle is always on the proximal third of the patellar and therefore any minimally invasive approach damages the area thus altering the proprioception of the muscle and extensor system. It is therefore impossible to perform TKR in a truly minimally invasive way.

Another possible complication caused by excessive traction and poor vision during minimally invasive approaches is represented by peroneal nerve injury. In a