DE GRUYTER OPEN

Journal of Interdisciplinary Medicine

REVIEW

ORTHOPEDICS // ARTHROSCOPIC SURGERY

Tips and Tricks in Total Knee Arthroplasty

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ARTICLE HISTORY

Received: April 26, 2017
Accepted: May 13, 2017

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ABSTRACT

Being a procedure that is more frequently used in orthopedic surgery and one of the most successful surgeries of the last century, total knee arthroplasty is still a challenge when it comes to matters such as anatomical reconstruction, mobility and stability of the lower limb. This paper reviews the main aspects of planning and surgical technique, by citing procedures that have proven their efficacy, returning very good results, not only on the short term, but also on the medium and long term. From a careful planning, even with personalized guides, to a swift postoperative recovery, total knee arthroplasty is being standardized, thus returning duplicable results and shortening the timespan of the surgical process. The use of tranexamic acid has led to a decrease in postoperative bleeding to 150–200 ml and to a decline in blood transfusion rates. Periarticular infiltrations with ropivacaine allow patients an immediate start for postoperative recovery, offering very good results in terms of mobility. Using state-of-the-art materials and methods with different surgical techniques and approaches, patients are offered a way through which normal life can be regained in a short period of time, with a complete recovery and a long survival that is close to 20 years.

Keywords: total knee arthroplasty, tranexamic acid, postoperative recovery

INTRODUCTION

Emerging as a common technique performed by orthopedic surgeons, total knee arthroplasty (TKA) represents a challenge in terms of anatomical reconstruction, alignment, ligament balancing, and stability of the involved lower limb.

Introduced in the post-war era of the last century, this technique has been subject of important adjustments in terms of materials used, surgical techniques, and, last but not least, postoperative recovery. With the passing of time, patients have become more active, more dynamic, wishing for a life as close to normal as possible, with a short rehabilitation period. Nowadays, TKA is considered a very successful technique, with a 10-year revision rate close to 12%, scoring as high as 70% in terms of patients' satisfaction.[1]

In order to maintain consistency in having the best possible results in knee arthroplasty, a number of conditions and aspects need to be met. As with every procedure, the smaller the deviation from the standard protocol, the better the expected outcome.

PREOPERATIVE PLANNING

The selection of patients is a crucial step, and the indication for the procedure is a knee with arthritis, painful, with an Ahlback score of III–IV, and unresponsive to standard treatment with painkillers and non-steroidal anti-inflammatory drugs (NSAIDs).

Radiological examination of the knee with loading, along with the measurement of the axes and angles of the surgically treated knee, gives very useful information in terms of mechanical alignment, but most importantly — which surgical bone corrections need to be performed intraoperatively.

A full and accurate clinical examination of the affected knee is essential to the evaluation of the stability and kinetics of the knee joint, and it orients the orthopedic surgeon to use either a primary prosthetic or one with an elevated level of constraint in the knee (Legacy Constrained Condylar Knee – LCCK, Hinge).

In recent years, the use of personalized guides has given the patients a very good alternative by considerably shortening the timespan of the surgical procedure, with a better bone mass preservation. In order to create personalized guides, it is imperative to perform a magnetic resonance (MRI) scan of the joint, based on which these guides will be 3D printed.

Based on the knee deformity (valgus, varus, flexum), different approaches can be taken into consideration.

SURGICAL APPROACHES

The midvastus approach is the most frequently used technique, its main advantages being the preservation of the quadriceps tendon and of the nervous and vascular structures, allowing a swift recovery. Its downside is a more difficult joint exposure by providing a poor patellar eversion.

The medial parapatellar approach allows a good patellar eversion, facilitating joint exposure even in patients with a high body mass index (BMI) and a minimal degree of flexum. The main disadvantage of this approach is a longer period for recovery.

The subvastus approach is more anatomical than the medial parapatellar approach, thus allowing the shortest recovery period, but having the downside of a more difficult exposure of the joint and a higher risk of neural and vascular damage due to its proximity to the adductor canal (Hunter's canal).

The lateral parapatellar approach is used in patients with advanced valgus and flexum deformity with external tibial rotation. It allows a fair exposure of the joint, but its disadvantage is that it cannot be used for cases in which the knees present varus deformity, which requires simultaneous tibial tuberosity osteotomy.[2–4]

Extended approaches (rectus snip and quadriceps turndown) are used in cases that present with locked knees and advanced ligament retractions, and it is the only option that allows adequate patellar eversion and joint exposure. The main disadvantage is the longer recovery period, which is associated with all extended approaches.

PERFORMING THE BONE CUTS

The principle of TKA is based on the restoration of the lower limb mechanical shaft. In this regard, there are two types of alignment: classical and kinematic. Physiologically, the angle of the femoral valgus is 5–6 degrees, while the tibia is aligned in neutral position (at 90 degrees). Hence, cuts that obtain 3–4 degrees of valgus are preferred for knees with valgus deformity, while cuts that obtain 5–7 degrees of valgus are preferred for knees with varus deformity.[5,6]

The femoral entry point is located at 0.5–1 cm from the anterior cruciate ligament insertion. Its malalignment can generate secondary varus/valgus or flexion/extension deformities.[5,6]

The joint space needs to be taken into consideration every single time. Landmarks that can be used for its evaluation are: 25–30 mm from the medial epicondyle, 10 mm from the peroneal head or the meniscal insertion on the capsule. If the joint space is modified, the extensor apparatus undergoes important alterations resulting in extension deficit and anterior compartment syndrome.[7]

The distal femoral cut is obtained with a 5–7-degree valgus, resecting 9–11 mm from the reference point, based on the type of implant. If there is a hypoplastic lateral femoral condyle, the reference point is chosen according to the position of the medial condyle.[5]

The femoral rotation is adjusted to the posterior condylar axis, to the transepicondylar axis, and to Whiteside's line. In case of knees with valgus deformity, with hypoplastic lateral femoral condyles, the previous reference point is preferred.[8,9]

The oblique and notch cuts are specific to the implant type, and are performed according to its own principles.

The tibial entry point is located anteriorly from the anterior cruciate ligament in a central position. The alignment

guide can be either centromedullary or extramedullary, in regard to the shape of the tibial diaphysis. Extramedullary guide is preferred in patients with a very curved or narrow tibial diaphysis.[10]

The proximal tibial cut is performed by being adjusted to the healthy tibial area, ignoring defects, by resecting 10 mm with a 5 degrees posterior sagittal slope.

The rotation of the tibial component is adjusted to the tibial tuberosity and tibial crest, in the medial third of the plateau.[11]

LIGAMENT BALANCING

The principles of obtaining a properly balanced knee from a ligament standpoint is by achieving a flexion gap that is equal to the extension gap. The techniques by which ligament balancing is performed are listed below.

The ligament release

For knees with varus rotation, depending on the retraction of the structures, the ligament release presents the following sequence of structures: (1) medial osteophytes at the level of the tibia and femur; (2) deep medial collateral ligament; (3) semimembranous insertion; (4) the medial collateral superficial ligament; (5) pes anserinus; (6) the posterior capsule.[12]

For knees with valgus rotation there is no consensus about the release sequence, therefore the technique presents several alternatives. The Krackow technique comprises in releasing the ilio-tibial tract first, followed by the lateral collateral ligament, the posterolateral capsule, and the bicipital tendon.[13] With the Insall method, the posterolateral capsule is released initially, followed by the lateral collateral ligament, the popliteal tendon, the ilio-tibial tract, and the intermuscular fascia. The release sequence in the Whiteside procedure is as follows: lateral collateral ligament, popliteal tendon, ilio-tibial tract, and posterior external capsule, while the Keblish sequence includes the release of the ilio-tibial tract, the lateral collateral ligament, the popliteal tendon, and the posterior external capsule.[2]

For knees that are locked in flexion, the release sequence is as follows: (1) posterior osteophytes of the tibia and femur; (2) posterior capsule detachment; (3) medial and lateral capsule detachment; (4) transverse incision of the posterior capsule; (5) redoing the femoral cut; (6) elevation of the joint space.[6]

For genu recurvatum, correction is performed through a wider tibial and femoral resection and with adding a larger size insert.

"Pie-crusting" technique

Described by Insall, this technique is performed with the knee in extension, after the femoral and tibial cuts are performed. The goal is to obtain an equal rectangular extension gap. It can be done both medially and laterally. Caution is advised, as the external popliteal nerve is located in the proximity of the capsule and can be damaged.[14]

A size 11 blade is used for puncturing of the structures in a pie-crusting manner while applying a varu/valgus stress depending on location.[15]

BLOOD LOSS MANAGEMENT

Perioperative blood loss can be important, as it ranges from 300 mL to 2 liters in some cases. Therefore, a rigorous approach in this regard involves the use of a hemostatic tourniquet,[16] hemostasis with a mono- or bipolar cautery, and using systemic or local tranexamic acid.[17,18]

Tranexamic acid is given before the surgery, usually 30 minutes before tourniquet inflation. One gram is administered intravenously.[18] During surgery, 30 minutes before the tourniquet is deflated, another gram is administered intravenously.[18] In the immediate postoperative period, 3 grams of tranexamic acid diluted in 100 ml of NaCl are injected through the intraarticular drainage tube, which is clamped for 4 hours. After tranexamic acid administration, the average postoperative bleeding is reduced to 100–200 mL.

PAIN MANAGEMENT

Methods for treating postoperative pain

Pain occurring after TKA should be managed in a systematic fashion, with initiation of treatment after the etiology of the pain has been identified. The pharmacological management of postoperative pain following TKA includes preoperative treatment with NSAIDs, COX2 inhibitors, and pregabalin, as well as oral and intravenous postoperative analgesia (acetaminophen, tramadol chlorhydrate, oxycodone).[19] Other methods include neuraxial or peridural analgesia, peripheral nerve blocks (sciatic and femoral), intraoperative periarticular infiltration.

Intraoperative periarticular infiltration

The intraoperative periarticular infiltration is performed with a mixture of 40 mL of 1% Ropivacaine with 100 mL of NaCl 0.9% solution. Three 50 mL syringes will be mixed with adrenaline, after which the mixture is loaded into

them. Prior to cementation, periarticular injections are administered as follows: the suprapatellar bursa and quadricipital tendon, the medial retinaculum, the medial collateral ligament, the posterior collateral ligament insertion, the lateral collateral ligament, the lateral retinaculum, and Hoffa's fat pad (infrapatellar fat pad).[20]

CONCLUSIONS

The standardization of total knee arthroplasties in association with careful planning and the use of personalized 3D-printed guides has led to the achievement of duplicable results and shortening of the overall operative time, with lesser hemorrhagic complications and a proper pain management before, during, and after the procedure. Ligament balancing is an essential step in the TKA procedure, as it contributes to the overall postprocedural success, including increased joint stability, reduced pain, and decreased rates of revision surgeries. By using state-of-the-art materials and methods with different surgical techniques and approaches, patients are offered a way through which normal life can be regained in a short period of time, with a complete recovery and a long survival that is close to 20 years.

CONFLICT OF INTEREST

Nothing to declare.

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