UKR Surgical Technique: Pearls and Pitfalls

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5.1 Introduction

Before beginning this chapter, perhaps a disclaimer is necessary: I'm not exclusively a knee surgeon, nor is knee surgery the most important and frequent part of my practice. I am neither a designer of the unicompartmental knee replacement (UKR) nor do I receive benefits for implanting them. I'm just saying this because the most frequent accusations, addressed to enthusiast knee surgeons using UKR, are that of expanding the indications and to obtain very positive but non-reproducible results by "normal" surgeons [1–3]. Likewise, there are surgeons inventors of new designs and models who exaggerate in their choices always with excellent results [4–8]. However, I believe, indeed, that almost all surgeons can obtain good results by just respecting the correct indications and following some basic rules of surgical technique.

I've been using the UKR prosthesis since 1988, with a series of over 1,400 patients [9]. I have implanted almost all models on the market and attempted both to understand the best way to improve my results, in a great majority of my cases, and to understand the errors of the few that were failures. Even when I dealt with computer-assisted surgery developing software, my first aim was to make the surgical procedure easy and reproducible [10]. Many of the things written on the pages of this book are still the subject of lively debate among us. There is no full agreement on all the rules, but I hope that the reader, looking at this book, can make up his or her own mind and act accordingly.

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5.2 Principles of UKR Surgery

First of all, I believe the main rules to consider in UKR surgery are:

- Patient selection
- Implant design
- Operative technique

5.2.1 Patient Selection

Topics of this book are our patients with medial or lateral compartment osteoarthritis of different severity [11]. Often, this disease is the result of the congenital morphotype or traumatic events that have produced joint cartilage wear, with consequent mechanical axis deviation. First of all, it is mandatory to examine the patient and see if the problem is compartmental or general. For this, we use the "finger test": ask the patient to indicate with a finger where the knee is painful. If only one compartment is indicated and this corresponds to the pathological one, and the clinical examination is positive, the problem will probably be there and the Uni will be the correct solution. The main aim of our procedure is to remove the pain, and if, then, we get a better joint function and limb correction, then, why not even

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aesthetics, which is so much the better [11]? But remember: no pain, no prosthesis!

5.2.2 Implant Design

To insert a prosthesis, you must create a joint space. You must know the thickness of the prosthesis (the wedge) and the model. In fact, the procedure of implanting the tibia is almost always the same, with a bone cut of varying dimensions [12, 13]. For the femoral component, there are two types of prosthesis: resurfacing, which provides a cartilage, and little bone fraction removal. The other prosthesis requires bone cuts in proportion to the thickness of the femoral component. It removes as much bone as the prosthesis thickness. This is important in determining the tibial cut. With resurfacing you can take into account the thickness of the femoral component: for example, for a thickness of 4.5 mm, you remove 2 mm of cartilage and bone, which leaves 2.5 mm of protrusion from the femur, and you can cut 2 mm less from the tibia. With the other, this is not possible, and the whole deformity correction should be taken into account during the tibial cut. Therefore, in severe axial deviations and using this last type of design, you need to know the maximum thickness of the tibial component because it may not be sufficient to correct the arthritis deformity. As an example: A 15° varus knee, 11 mm maximum thickness of the tibial component (minimum 7 mm): if you use a prosthesis with femoral cuts, even if you do not make any tibial cut, you will have a residual varus of 4° unless you use distal femoral cuts, but this is possible only with some prosthetic models.

It might be that a residual varus is plausible and physiological, but it is still a controversial topic, and there is no certain solution regarding whether this deformity should be totally corrected or not.

5.3 Operative Technique

The operative technique consists of five steps:
- Correction (planning).
- Minimal bone cut.
- Ligament balancing.
- Tibial cut.
- Femoral cut.

5.3.1 Correction

One indisputable fact is that the thickness of the prosthesis changes the axis of the knee according to the joint space that you have created. If the joint space is tight, the minimum wedge will also be tight and the mechanical axis will be overcorrected. If the joint space is abundant, the thickness of the tibial component chosen will decide the axis. A simple rule that we have developed is the “minimum tibia bone cut” (MBC), because it is important to cut the tibial plateau as little as possible in order to create good support for the prosthesis component. Our formula is: the minimum thickness of the prosthesis (TP) – the angular deformity (AD) = MBC.

Let’s take an example: An 8° varus knee, and a resurfacing prosthesis with 4.5 mm of femoral and 7 mm of tibial thickness (total 11.5). Thus, you have 11.5 – 8 = 3.5 mm to remove. With resurfacing, you can also act on the femur. If you remove 2 mm of the femur, you have 2.5 mm of protrusion; you can cut only 1 mm of the tibia (3.5 – 2.5 = 1 mm) to provide a minimum joint space in which to introduce the minimal wedge in order to bring the axis to 0°. Obviously, if you want to undercorrect, you can increase the amount of femoral bone removal or increase the tibial cut. Using this concept, navigation is a useful tool to know the exact value of this procedure (Fig. 5.1).

If you use a prosthesis with femoral cuts, you need not consider the femoral component, because you have to remove all the bone exactly for the femoral component. That will leave you with only the thickness of the tibial component: 7 mm minimum, 11 mm maximum. It is evident that you must increase the thickness of the tibial component, because: 7 – 8 = –1. Even if you cut only 1 mm of bone, the joint space becomes 9 mm, so you can implant a tibial component of 9 mm (the rule becomes 9 mm – 8° = 1 mm). Here, if you

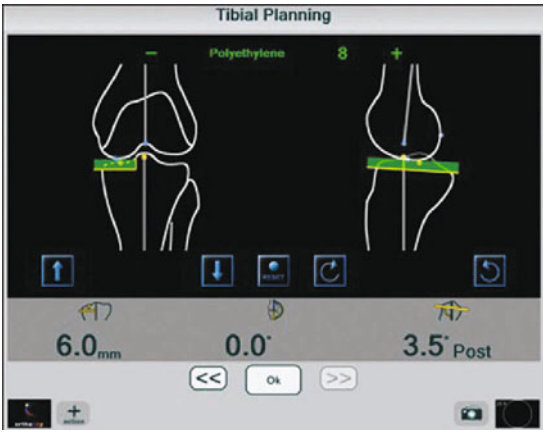

Fig. 5.1 Computer-guided determination of the minimal tibial cut yielding the perfect mechanical axis

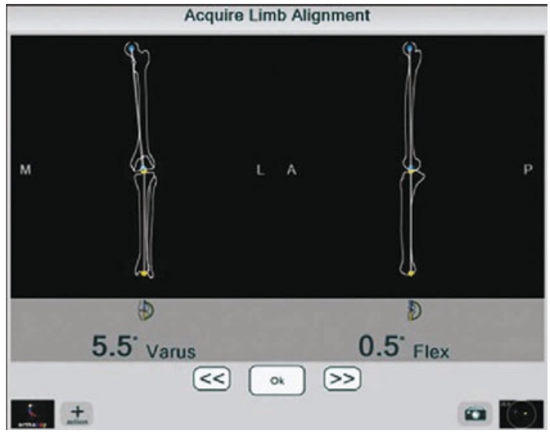

Fig. 5.2 Determination of the mechanical axis

want to undercorrect, keep the minimal thickness of the tibial and you'll have 2° of varus (9 mm – 7 mm = 2°). Sounds complicated, but it's only a matter of mental habit.

Another thing to be said is that sometimes the data do not match, either due to an incorrect orthostatic X-ray and resulting incorrect value of the deformity, or to an error in bone cuts, so you may find some problem with the introduction of the prosthesis. Experience and, for the person who uses it, the computer, will guide us to the best alternative choice of bone cuts (Fig. 5.2). But why would anyone want to undercorrect? And how much? And why in a high tibial osteotomy in a varus knee, is overcorrection of a few degrees recommended?

These questions are still without a definite answer. My experience with long-term follow-up leads me to say that it is better to have a mechanical axis close to 0° [14, 15]. UKR survivorship is close to that of TKR and, in the majority of cases, it fails either with a collapse of the bone under the tibial implant or, in rare cases, on the progression of osteoarthritis in other compartments [1–3, 14, 15]. Thus, it could be supposed that the more you keep the load on the prosthesis compartment, the more the bone suffers. Likewise, the more you transfer the load to the other compartment, and the more you free up the pathological compartment together with ligamentous stress, the better the joint works [16–18]. The rule to keep the morphotype constitutionally precise may be dangerous because the congenital deformity could be the cause of arthritic disease. We believe that an accurate examination of the contralateral knee, the clinical history, and the study of posture with a walking computerized platform (baropodometric test, gait analysis, etc.) should be taken in account together in order to decide the best correction [19–22].

5.3.2 Surgical Technique

Patient supine, knee flexed to 90°, thigh tourniquet inflated with limb at 90° to avoid the tension of the extensor apparatus when you flex the knee. Support for the foot to hold it steady when you flex it, lateral support to the thigh, freedom of motion: flexion–extension and intra and external rotation.

- Varus knee: skin incision less than 10 cm anterior–medial, starting at the upper pole of the patella to 2 cm below the tibial rim, near the anterior tibial tuberosity (ATT).
- Valgus knee: median skin incision, from the upper pole of the patella to the ATT. Lateral capsular arthrotomy. You have the possibility of lengthening the joint approach with the quadriceps tendon snip, using the effect of "sliding skin window."

  However, you should always take in account that MIS (mini invasion surgery) is not a shorter incision, but respect the tissues under the skin, which are essential for joint function, and consider that the aesthetic scar effect depends sometimes on the suture!

For those who use the computer, please consider:

- Screws or pins for the rigid bodies supporting the sensors fixed outside the surgical incision, in the femur and tibia
- Registration of the centers of rotation of the hip, ankle, and knee
- Acquisition of anatomical landmarks of the tibial tuberosity, tibial plateau, femoral condyle, tibial slope, etc.
- Verification of the axial deformity and potential correction (ligament stress)

In all cases, it is necessary to consider:

5.3.2.1 Ligament Balancing

Consider even the ligament balance: a minirelease is possible to attain axial correction. In severe deformity >10°, the release also serves to free the compartment fixed by ligaments overstress.

5.3.2.2 Tibial Cut

We recommend that the frontal cut be perpendicular to the tibial mechanical axis. If the proximal tibial epiphysis is deformed >5° of varus, we recommend a valgus osteotomy in addition, associated with the UKR, in the same surgical step. But how much should we cut? Please follow the rule of the MBC, being ready to recut, if necessary. And how should we cut?

- Varus knee: The vertical cut; keeping the saw blade close to the anterior cruciate ligament (ACL), parallel to the femoral condyle. The horizontal cut: perpendicular to the mechanical axis.
- Valgus knee: The vertical cut: oblique medially starting just in front of the ACL and positioning the saw in contact with the posterior side of the femoral condyle, with an angle open anteriorly. This is to avoid prosthetic femoral impingement with the anterior tibial spine in extension during the “screw home mechanism” that produces a tibial extrarotation in extension. The horizontal cut: with an oscillating saw, perpendicular to the axis (Fig. 5.3).

Fig. 5.3 Tibial cut with a retractor for the patella. The distal part of an intact ACL is visible

And the slope? Retaining the two ligaments, the joint space changes between flexion and extension. It usually drops down in flexion [12, 23, 24]. Our goal is to always get the same joint space in flexion and extension (Fig. 5.4). This can be achieved by adjusting the slope, or with the cuts of the femoral condyle, anterior and posterior. As you know, the two compartments are anatomically different and move differently [20–22, 25, 26]. The medial tibial plateau is concave with a degree of slope to allow the rolling of the femoral condyle in flexion, which has a radius of curvature that is larger posterior. This different offset has been stabilized and balanced in flexion by the meniscus. In contrast, the lateral tibial plateau is convex, to allow femoral roll back. Here, too, the meniscus has a fundamental role in the stabilization and containment of the excursion of the posterior condyle in flexion [19–22, 25, 26]. By removing the meniscus, we have to think about reducing the fall of the femur. On the other hand, we cannot cancel the slope, otherwise there will be a stress load on the posterior edge of the prosthesis, which tends to lift the front (anterior tilt) [24]. In addition, arthritic disease leads to wear of the femoral condyle, more frontal than posterior, increasing the problems of joint space. We must reach a compromise. In the medial compartment: you known the natural slope by means of the lateral X-ray or navigation, but we believe

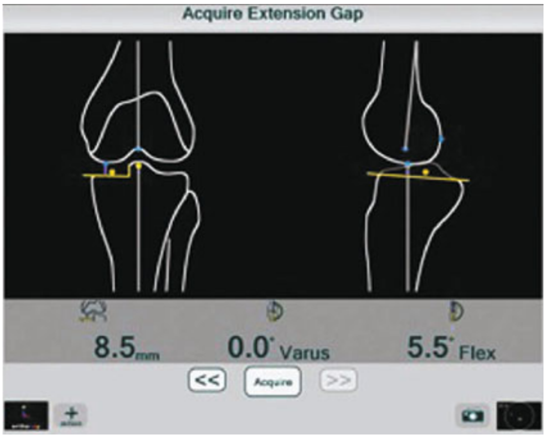

Fig. 5.4 Check of the joint spaces in flexion

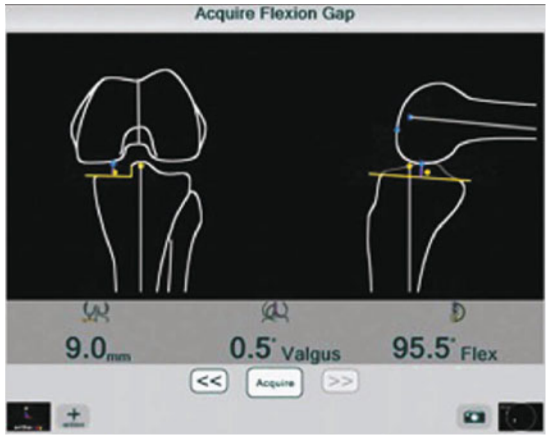

Fig. 5.5 Check of the joint spaces in extension

you should achieve a tibial slope ranging from 0° to 7°, which is proportional to the natural one, but no more than 7° to avoid ACL strain during flexion. At this point, you check the joint space in flexion and in extension by calibrated spacers or by the computer distractors. The spacer with the same extension/flexion thickness must enter and exit from the joint in both flexion and extension, without excessive difficulty, otherwise we have a conflict, usually in flexion, and it must be corrected [13, 27–29]. There are several solutions to increase the joint space. Cutting guides to increase the tibial slope, special inserts (shim, Fig. 5.5) on the distal femoral cutting guide in order to decrease the space in extension (less bone remotion), prosthetic models that have different thicknesses in front and posterior of the femoral component, etc. If you use femoral resurfacing, you can remove more bone posteriorly.

Of course, the computer helps you at this stage and gives you the exact measurements of the difference. In the lateral side, the hypoplastic femoral condyle, mainly responsible for valgus deformity, makes it hard to plan. If you adopt resurfacing, it is easier. You can use many millimeters of thickness of the component, removing only the cartilage, while for the posterior side, you cut the bone according to the thickness of the prosthesis. Be careful when you use a prosthesis with the femoral bone cuts. You may find it difficult to balance the spaces. Also, the slope on the lateral side must remain close to zero to allow the natural femoral condyle to roll back. Furthermore, you can adopt a thicker tibial component, trying to keep the morphotype without raising the joint line too much. If, however, you encounter osteoarthritis, the wear on the anterior condyle is greater than on the posterior, creating space in extension, which is not easy to fill. You must use implants that have distal anterior cuts (shims) that make it possible to resect less bone. However, you can only produce distal cuts up to 3 mm (maximum thickness of the shims). So, if you have a severe valgus knee (>15°, for instance), we recommend implanting a total replacement or performing uni resurfacing. A practical example: 18° valgus; if you use a prosthesis, with the cuts, with the possibility of 3-mm distally, the formula is: 14 mm (3 mm of femoral protrusion + 11 mm of the maximum tibial thickness) – 18°= –4 mm. Also, you resect only 1 mm of the tibial plateau, leaving 5° of valgus (4 + 1).

5.3.2.3 Femoral Cut

The cutting tools and techniques for the femoral component are divided into two groups: one involves the femoral cut joined to the tibia, the other is independent of the tibia. Our aim, however, is always the same: to implant the femoral component perpendicular to the tibia cut to pro-

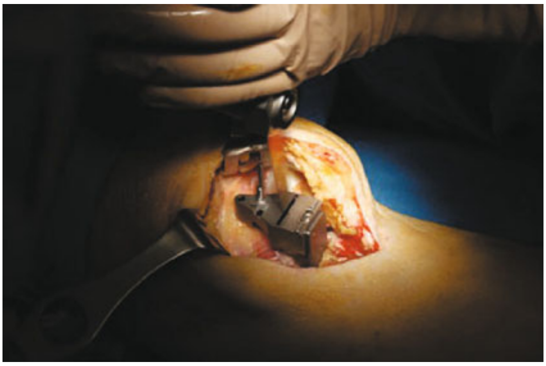

Fig. 5.6 Distal femoral cut with the cutting guide joined to the tibial cut in extension

Fig. 5.7 Chamfers with a spacer supporting the femoral cutting guide in flexion

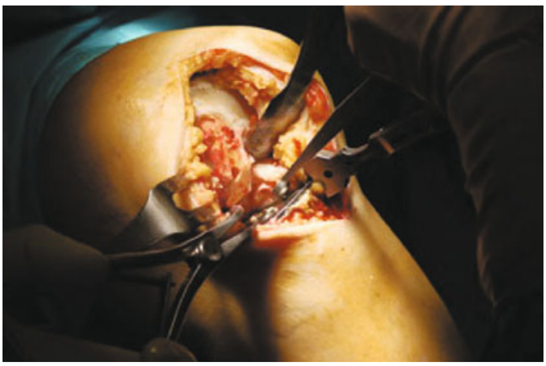

Fig. 5.8 Tibial preparation

Fig. 5.9 Cemented implant: the polyethylene and metal back can be assembled in order to avoid cement cracks or dislocation of the metal back

vide more surface contact and avoid pick wear [19, 20]. If you use cutting guides joined (laying beside) to the tibial cut, the procedure is pretty forced (Fig. 5.6). The only option will be to cut anteriorly and posteriorly with the guide inserted to correct the arthritis deformity both in extension and flexion; otherwise, it will be difficult to implant the prosthesis perpendicular to the mechanical axis of the lower limb (Figs. 5.7, 5.8). This is to obtain the maximum area of the prosthesis supporting the load bearing.

If you use free guides, you need intramedullary femoral instrumentation, or a computer, to be able to implant the femoral component perpendicular to the mechanical axis. But it is not necessarily perpendicular to the tibial component. Therefore the design of the implant will have more tolerance to curves, or guides (milling), that transform the femoral condyle with a single radius of curvature using mobile bearing congruent. Everything is correct when the components are perpendicular to each other and to the mechanical axis, and the limb is correct and well balanced in flexion and extension (Fig. 5.9 and 5.10).

Fig. 5.10 Final check with the implanted components

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