Chapter 1

Planning Primary Total Knee Arthroplasties

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Additional information is available at the end of the chapter

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Abstract

Preoperative planning is routinely recommended prior to total knee arthroplasty (TKA). We introduce a methodology for planning TKA based on mechanical alignment. A methodology for planning total knee arthroplasty was discussed among experienced knee surgeons. A rational methodology for planning TKA was stablished and it was setted to an application for mobile devices. It has proved to be useful and revealed accuracy compared to the manual form of preoperative planning. It was able to reduce planning time by more than a half and it was still reliable in measuring the anatomical-mechanical femoral angle (MAFÂ). This chapter introduces a TKA planning method based on mechanical alignment and GAP balancing principles. Kinematic alignment and strategies for soft-tissue balancing in special situations are cited as well.

Keywords: knee surgery, arthroplasty, knee injuries surgery, mobile applications operative time

1. History and introduction

The very first concept of improving knee function was introduced by Verneuil in 1860. He proposed an interposition of soft tissues in order to reconstruct articular surface. Unfortunately, it has led to disappointing results. In the same year, Ferguson resected the entire surface of the knee, which culminated with a better range of motion but lacked stability. In 1958, MacIntosh described a hemiarthroplasty using an acrylic tibial plateau later upgraded by McKeever for a prosthesis made of metal, showing better results.

Guston developed a polycentric prosthesis wich arculates metal to a polyethylene base fixed to the bone by acrylic cement, but the actual concepts used in total knee arthroplasty (TKA) have been established by Freeman in 1973: minimal bone resection; minimal chance of loosening;

minimal debris production; not leaving dead spaces; avoiding long intramedullary stem and intramedullary cement; a standard insertion procedure; minimal range of motion (5–90°); resisting rotation; and resisting excessive movements in any direction.

During the early 1970s, a range of prostheses such as unicondylar, bicondylar, and hinged were used with respect to the patient's preoperative condition and deformity. Since then, a lot of different kinds of implants have been developed following the tendency of maximizing flexion, minimizing wear, and better accommodation of gender and racial anatomic variation. Nowadays, a resurrection of old strategies such as uncemented fixation and partial knee replacement has been noted and minimally invasive approaches are growing respecting the patient's desire of shortening postoperative recovery [1, 2].

This chapter introduces a TKA preoperative planning method based on mechanical alignment and the modified GAP balancing principles. Kinematic alignment (KA) principle, anterolateral approach, and strategies for soft tissue balancing in special situations are cited as well.

2. Biomechanics and templating

The most important surgical technique that affects patient satisfaction and functional outcomes is the correct positioning and alignment of the components. Despite the introduction of computer assisted surgery, patient-specific designs, and kinematic knee alignment, the concept of optimal restoration of alignment still has added controversy on the best approach of planning TKA [3–5].

Most surgeons still agree, and it is traditionally accepted that the alignment of the lower limb should be within 0° ± 3° of the mechanical axis after surgery (measured by the angle formed by the center of the femoral head, the center of the knee, and the center of ankle) [6] (**Figure 1**). By positioning the femoral and tibial components perpendicular to its mechanical axis, there is a balanced distribution of mediolateral forces, not overloading the bone implant interface as well as the bone itself which could lead to loosening of the implant. Furthermore, malalignment causes increased polyethylene wear, leading to osteolysis.

In order to plan a TKA, a preoperative image exam that evidences all reference points is necessary to estimate the anatomical and mechanical axis of the femur and tibia. Since short-leg X-rays do not expose the whole lower limb references, they are not suitable for planning TKA when it is used alone. Long-leg radiograph (LLR) is traditionally used to estimate alignment of the lower limb. It is acquired on weight-bearing films, including the hip, knee, and ankle, with the patella facing forwards. The X-ray beam should be parallel to the articular surface [7]. Although the LLR acquisition is quite standardized, has long track records and it is fairly available, there are concerns about its use, since flexion contractures and rotational malposition could distort the interpretation of the native anatomy [8].

Besides the fact that LLR is quite standardized, has a long track record, and is fairly available, there have been reported concerns about the accuracy when there are flexion contractures and when the position of image acquisition is not neutral, since rotation of the limb could distort the interpretation of native anatomy.

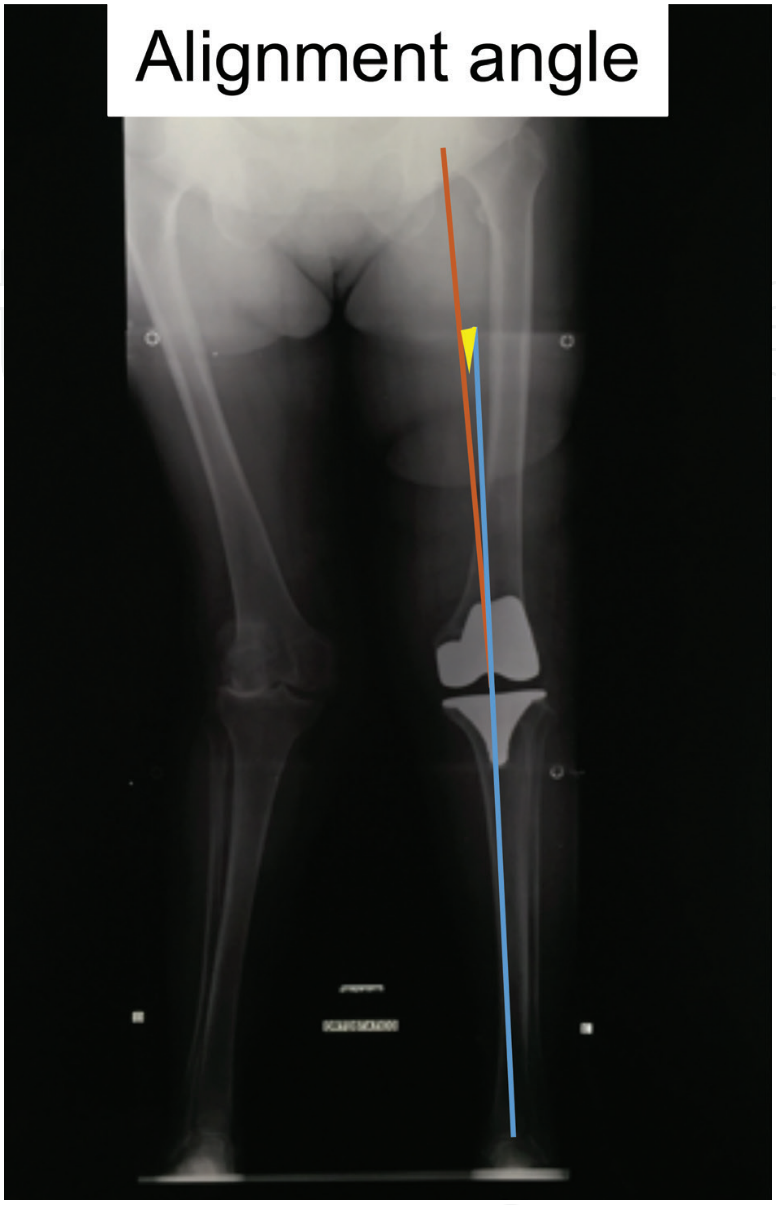

Figure 1. Alignment angle. Measured by the center of the femoral head to center of the knee and center of the ankle. It should be within 0° ± 3°.

2.1. Manual templating

For this instance, we propose a step-by-step methodology for planning TKA based on mechanical alignment, using LLR. We suggest the use of a parchment paper as it avoids scratching the LLR. First, the mechanical axis of the femur (MAF) is defined by connecting a line from the center of the femoral head to the femoral intercondylar notch. Then, the anatomical axis of the femur (AAF) is estimated by connecting a line from the center of the intramedullary femoral canal to the femoral intercondylar notch. The angle formed by the mechanical and anatomical axis of the femur (MAFÂ) is measured, using a protractor. This part of planning has particular importance for those who intend to use intramedullary distal femoral cut guides. Since the femoral stem follows the path of the AAF, the surgeon would know how to accomplish a perpendicular cut to the MAF, by positioning the distal femoral cut guide in a valgus angle to the AAF, referenced by MAFÂ.

After knowing the inclination of the distal femoral cut, the surgeon should evaluate the level of bone resection, anticipating the amount of bone resection. Usually, in a primary TKA, the level of bone resection corresponds to the femoral component thickness (e.g., 9 mm). This step simulates the surgical moment when the surgeon places the distal femoral cut guide onto the distal femoral bone. Using a protractor, the surgeon draws a line perpendicular to the MAF above the first point of the distal femoral bone contact (e.g., 9 mm), from distal to proximal. By doing it, the surgeon could simulate the level and inclination of the distal femoral cut. One should notice that the LLR film does not correspond to real size, being reduced to fit on the film frame. Typically, the amount of reduction in size is reported on the printed film and should be used to make a conversion between film size and actual size.

The same rationality is applied to the tibial bone. The mechanical and anatomical axes are coincident on the tibia, so the mechanical axis of the tibia (MAT) can be defined as a line drawn from the center of the tibial spines to the center of the talus. Mechanical and anatomical axes are usually coincident on the tibia. The mechanical axis of the tibia (MAT) can be defined as a line drawn from the center of the tibial spines to the center of the talus. After defining MAT, tibial cut is planned perpendicular to the MAT. Usually, surgeons plan to cut 8–10 mm below the unworn side of the tibial plateau, but it can be adjusted to best fit the components and balance the knee. So, the surgeon places a line from proximal to distal, at the level desired below the unworn side of the plateau. Still, conversion between LLR size and real size should be adjusted using a mathematical calculation. The whole process of manual templating technique is illustrated in **Figure 2**.

The more parallel the bone cut planes, the less ligament release is necessary. The less parallel the bone cut planes, the more ligament release is necessary. One must note that there is a limit for releasing ligaments. When a great amount of releasing is necessary, the surgeon should consider a more constrained implant, since it could get into a situation called “over resection looseness,” when the ligament function capacity is exceeded.

The size of the components can be also estimated during the planning of a TKA. To do it so, the surgeon must have the specific prosthesis templates and should order a short-leg X-ray in an actual size (1:1).

2.2. Digital planning using ATJ® mobile phone application

Despite the fact that manual planning is an affordable method, it lacks portability. The surgeon must have manual tools such as a pencil; an eraser; a protractor; and rulers, big enough to measure the whole LLR film. Besides, the surgeon needs to make mathematical conversions and must comprehend a rational methodology of planning on TKA.

Considering the current computational resources used as tools to support medical practices, the paradigm known as *mHealth*, which consists of the use of mobile computing resources in health, stands out. When applied to favor teaching and learning processes, mobile technologies provide numerous benefits, such as increased resources for student learning, access to

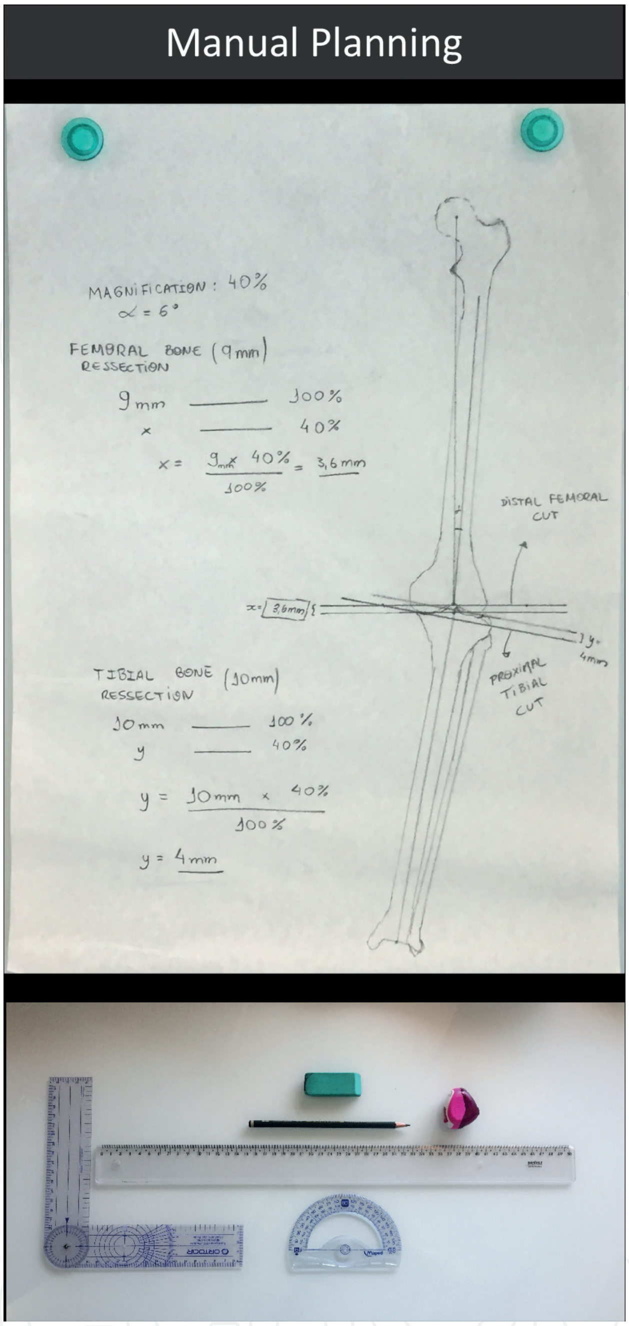

Figure 2. Manual templating. First, the anatomical and mechanical axis of the femur and tibia are defined. MAFÂ is measured by using a protractor. A perpendicular cut is measured from MAF and MAT. To correctly place the bone cut lines, the surgeon must mathematically convert printed LLR film size to real size. To do it, the surgeon needs manual tools such as pencil, eraser, rulers, protector, and goniometer.

textbooks anywhere, anytime, and the provision of resources for the development of innovative teaching methods [9]. By facilitating real-world integration, mobile learning aided by mobile computing (Mobile Learning or m-learning) has created opportunities for development of new teaching strategies in different areas [10].

An interdisciplinary team, involving health and computer science areas, developed an application (ATJ®) that is capable of conducting the surgeon though a step-by-step process (same described

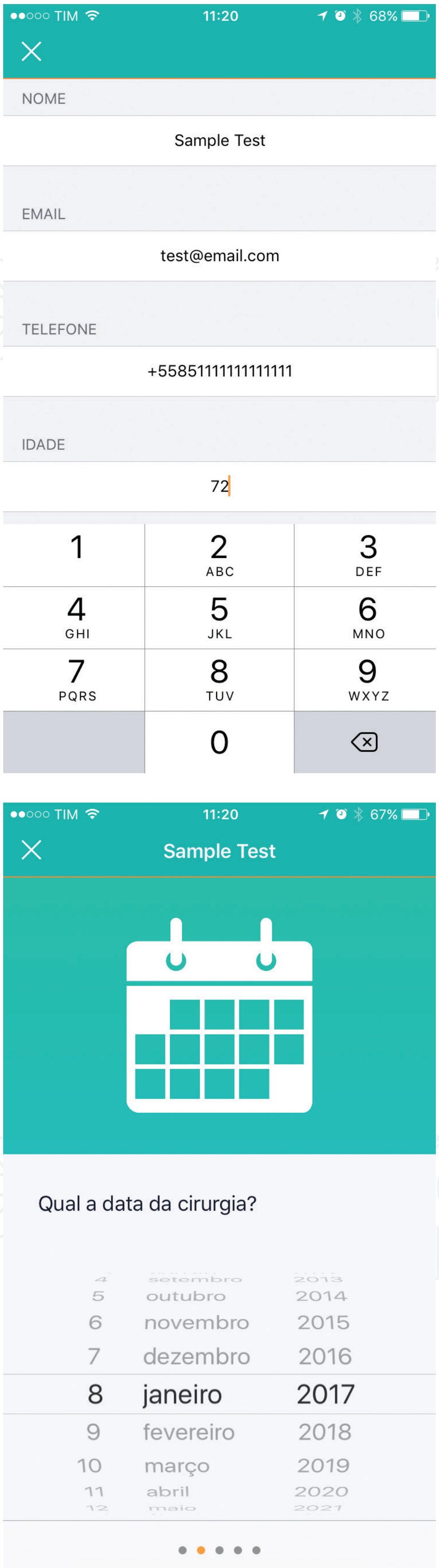

Figure 3. Fields of the medical register. They are available *offline* and *online,* in a cloud host.

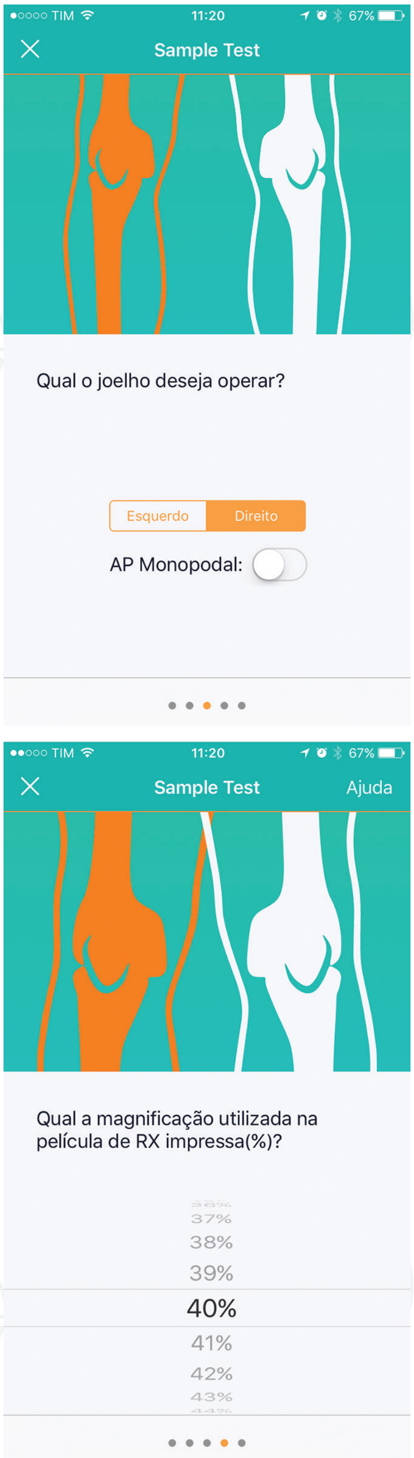

Figure 4. After choosing between the left or right knee, the surgeon must inform the application in which size scale is adopted on LLR. By doing so, the surgeon does not need to make mathematical calculations, since the application is able to convert LLR size to real size.

for manual planning) adapted for digital planning. Besides, explanations about rationality of the methodology and surgical tips on each step of planning were incorporated to the application. It is able to recognize the type of deformity (valgus or varus) and automatically measure MAFÂ. It also suggests soft tissue releases, according to the deformity [11].

Figure 5. The LLR should be uploaded from the device's camera roll or the device's camera can be used to acquire the LLR image (Figure Planning).

Before getting into planning, the surgeon is presented with a video that briefly describes the method used in the application. Fields of registration such as name, email, telephone, age, gender, medical record number, and date are available. The data are stored on the device and in a cloud host. Anytime, wherever the surgeon is, it is possible to access it from any computer if desired (**Figure 3**).

Planning starts by choosing the intended knee to be operated (left or right). After choosing the side, the application inquiries on size scale used on LLR, which is usually informed on LLR margins. This is an important step since the application needs to know the relation between the LLR film size and real size, avoiding the surgeon making mathematical conversions (**Figure 4**).

The LLR can be acquired by two modes: uploading an image from device's camera roll or using the device's camera to photograph the LLR on a negatoscope (**Figure 5**). The application

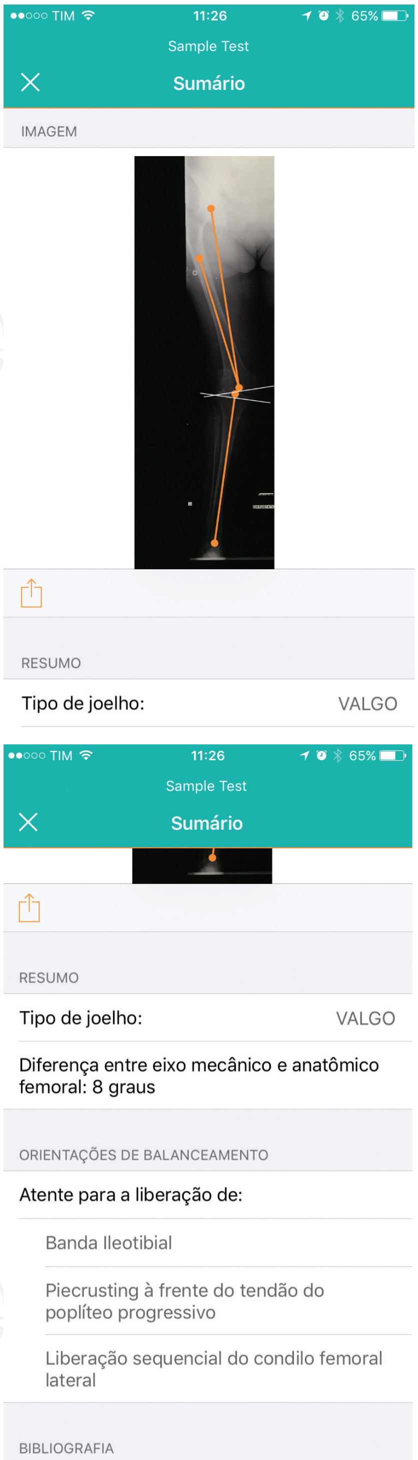

Figure 6. Step-by-step planning process. After defining AAF, MAF, MAFÂ, and MAT, the surgeon should simulate the level and inclination of distal femoral and proximal tibial bone cuts. Application ATJ® is capable of automatically recognizing the knee-type deformity. It also suggests a sequence for ligament releasing.

then takes the surgeon through the whole process of planning by inquiring the surgeon to point references (center of the femoral head, center of the medullary femoral canal, center of the intercondylar notch, center of the tibial spines, and center of the talus). After setting points, the application automatically defines AAF, MAF, MAFÂ, and MAT. It also positions a moveable bone cutting line, perpendicular to MAF and MAT. At the end of the methodology process, it automatically shows the type of deformity, the MAFÂ, and soft tissue releasing sequence (**Figure 6**). Then, scientific references used to build the application are presented.

The application ATJ® has proved to be useful in the context of planning TKA. It has revealed accuracy when measuring the MAFÂ when compared to the manual form of planning. It was also capable of reducing the planning time by more than a half [11, 12].

3. Surgery

3.1. Surgical approaches

A straight anterior skin incision allows exposure for medial and lateral structures and it's the standard skin incision for TKA. Arthrotomy may be done from the medial or lateral side. Anteromedial arthrotomy is the most used approach on TKA and provides excellent exposure of the knee joint (**Figure 7**). After eversion or patella lateral subluxation, the knee is flexed. One must be aware of avulsing off the patellar tendon from the tibial tubercle, if there is too much tension.

Because the most important component of blood supply runs medially, anteromedial approach could affect patellar circulation, and some authors have advocated subvastus and midvastus approaches (**Figure 8**). They are less invasive and can be used specially in moderate knee deformity.

For fixed valgus deformities, the lateral parapatellar approach may be considered. A mild lateral skin incision is made and extended over the lateral border of the tibial tubercle. In the original description, a thin segment of the tubercle is osteotomized with the attached patellar tendon. A medial periosteal hinge is maintained along with the infrapatellar fat pad, which is used for later closer of the lateral retinacula. Some surgeons suggest not to osteotomize the tibial tubercle, turning it into a less invasive approach.

Extended approaches have been described and are very useful in stiff knees and great deformities. Coonse and Adams described a quadriceps turndown. The quadriceps are split down the middle, in an inverted "V" fashion, at about 1 cm above the patella, so the patella could be turned down, allowing the exposure of the joint. Quadriceps snip was described by Insall by an oblique incision at the proximal apex of the quadriceps tendon, at about a 45° angle, directly in line with the fibers of the vastus lateralis. It relaxes the extensor mechanism and protects the tibial tubercle. Tibial tubercle osteotomy enhances exposure and it could be very useful in stiff knees. Tibial crest should be osteotomized 8–10 cm below the tibial tubercle, using the oscillating saw and osteotomes. The shape of osteotomy is trapezoidal, 5-m long, 2-cm wide, and 1.5-cm wide distally. The entire extensor mechanism is then elevated proximally.

Limited approaches are described and could be useful, especially when planning unicompartmental arthroplasties. Limited approaches are part of a traditional extensile approach, and the surgeon tends to use it as he becomes familiar with the surgical technique.

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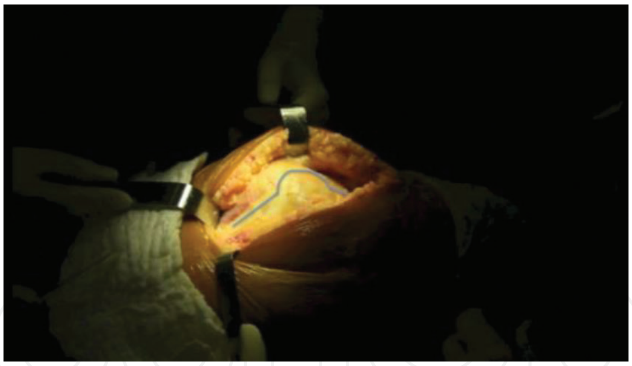

Figure 7. Anteromedial approach to the knee. After a medial skin incision, a medial parapatellar arthrotomy is made. It is suitable for most TKA and allows great exposure of the knee joint.

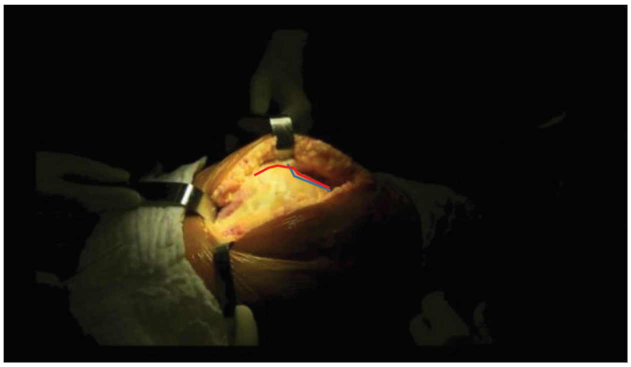

Figure 8. Subvastus approach does not sacrifice the extensor mechanism (blue line) and it is useful specially for minimal invasive approaches. In midvastus approach (red line), the oblique medial vastus is split sharply in line with its fibers, at the level of the superior pole of the patella.

3.2. Surgical theories

3.2.1. Anatomical, mechanical alignment, and gap balance technique

Since the beginning of the implants and instruments, two concepts that guide surgical techniques were established: gap balance and measured resection technique. Universally spread, gap balance surged for cruciate substituting prostheses. Measured resection technique was favored for those who defended cruciate retention implants.

For gap balance technique, either the femur or tibia may be osteotomized first. The main goal is to equalize flexion and extension gaps, most of the time transforming a trapezoidal gap into a rectangular gap (**Figure 9**). For those who favor to start cutting proximal tibial (at about 8–10 mm below the less worn tibial plateau surface), it should be perpendicular to the MAT, and when posterior cruciate ligament (PCL) is sacrificed, the flexion gap opens up a few millimeters more. That situation can implicate in a slightly upper distal femur cut, which can elevate the joint line and bring the patella in a lower position. Distal femoral cut is often parallel to the tibial cut, following the transepicondylar axis. Rotational alignment of the femur is tuned by ligament release or femoral rotation. In a varus knee, when the surgeon opts for

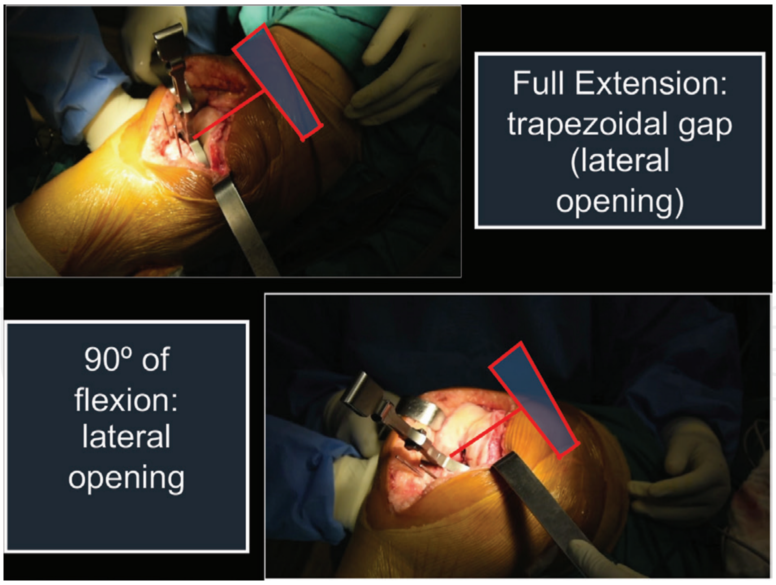

Figure 9. Before ligament releasing, there is usually a trapezoidal gap.

not releasing medial ligaments he usually needs to add external rotation to the femoral cuts. Some references help to establish the appropriate rotation: transepicondylar axis, posterior femoral condyles, Whitside's line (trochlear groove axis), tibial shaft axis, and ligament tension. In some situations, even a small degree of internal rotation could be applied. Before implant is settled, the gap must be rectangular and symmetrical (**Figure 10**).

The measured resection technique aims not to move the joint line position. That situation, in theory, preserves knee's anatomy, sparing the PCL, when possible. Some advocate that preserving the PCL has advantages as it is an important varus/valgus stabilizer of the knee; it can absorb stress; and it can control the movement of rolling back of the femur onto the tibia

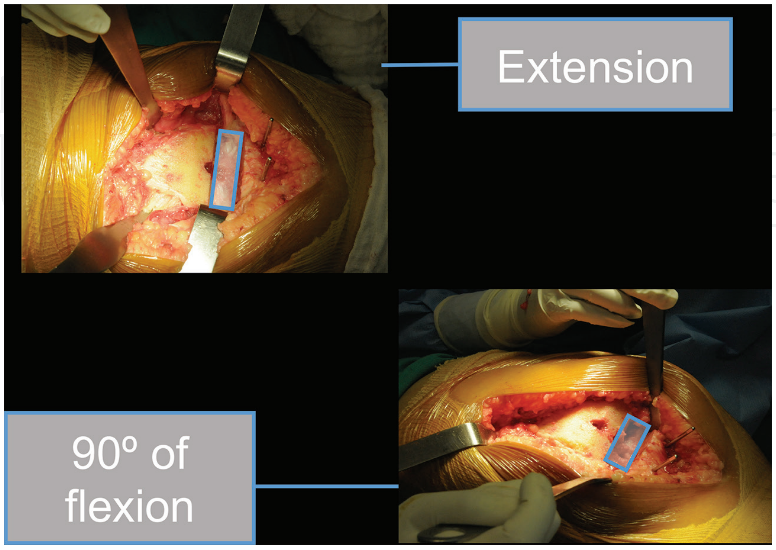

Figure 10. Rectangular gap. Before the implant is set, there must be a rectangular gap.

during flexion. When the ligament is left too tight it could increase posterior stress, causing a movement described by Insall as “open like a book” and “lift-off” of the tibial tray. When the PCL is insufficient, it could cause a paradoxal movement of rolling forward in flexion, limiting flexion by posterior impingement. The tibial cut is made preserving its mild varus and femur cut is made preserving its natural valgus. Equalization of the gaps is not strictly necessary.

During the evolution of the implants some concepts were mixed and the surgeon conquered freedom to make bone cuts a little bit off the outliers. Even for situations when the PCL is preserved, conformed tibial surfaces could be used. Sometimes, the surgeon can choose not to cut the bone perpendicular to the mechanical axis, sparing extensive ligament releases.

3.2.2. Kinematic alignment

The refinement of surgical techniques, implant designs and an individualized tendency of surgical treatment have contributed to resurrection of the discussion about restoration of the native’s knee anatomy and preservation of the articular line.

Some authors have noticed that neutral mechanical alignment does not restore biomechanics in a significant part of the population [13–15].

Kinematic Alignment (KA) aims to restore constitutional alignment, ligament tension, and the joint’s line level and orientation [16, 17]. Hungerford, Kenna, and Krakow defended a slight varus alignment for the tibia in relation to the MAT. They are considered precursors on KA [18].

According to Howell et al., there are three kinematic knee axis: the primary femoral axis, wich is a transverse axis of femur around which the tibia flexes and extends; the secondary femoral axis, wiich is a traverse axis in the femur around which the patella flexes and extends; and the longitudinal tibial axis, around which the tibia internally or externally rotates on the femur [19] (**Figure 11**). Each axis is parallel or perpendicular to the natural joint line between the femur and tibia throughout the motion arc.

The preoperative plan of a kinematic TKA can be done by using MRI exams in order to estimate chondral and bone erosion [20–22]. These parameters are used to compensate implant’s position that should be parallel to the primary and secondary kinematic femoral axis. A patient-specific implant or a conventional implant can be used.

The KA principle is a promising alternative for the execution of TKA. In the centers where it was adopted, the results in the short and medium term were favorable [22], with the premise of restoration of the biomechanics of the knee, which may point to a new paradigm. Nevertheless, studies on durability and long-term function are needed before universal adoption of this new methodology.

Its applicability in patients with a higher degree of bone erosion should also be evaluated cautiously because of the increased risk of malalignment, which may be caused by the difficulty in identifying the references that guide the positioning of the bone cutting guides.

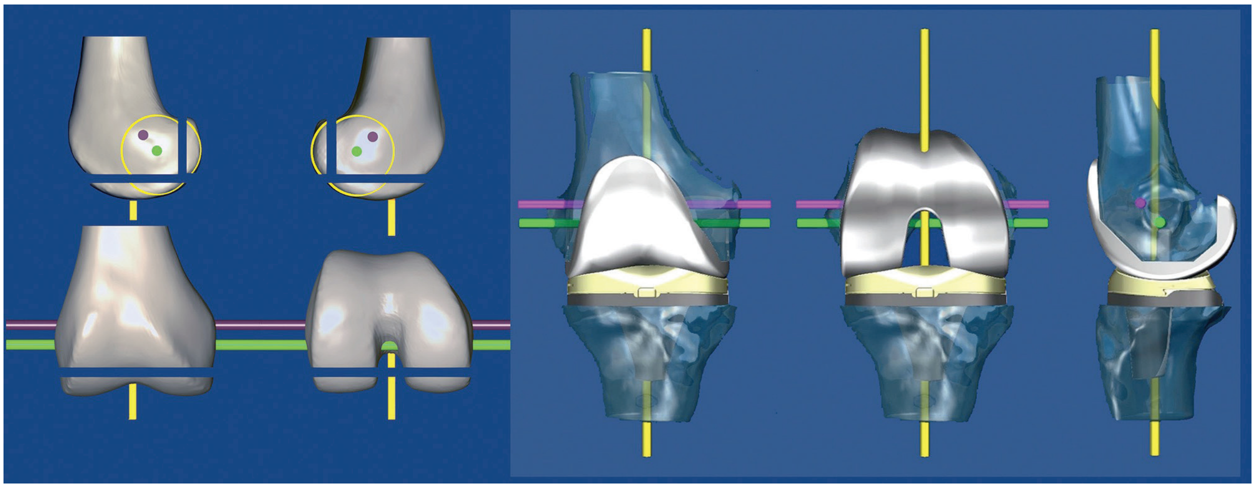

Figure 11. Kinematics axis of the knee (from Howell's studies with authorization).

4. Management of deformities

4.1. Varus deformity

During the arthritic course, there are expected modifications in native alignment and ligament function. Loss of cartilage can create an asymmetrical compartment balance, leading to contracture of soft tissues on the concave side and contralateral loosening on the convex side. As the deformity progresses, these modifications tend to establish into fixed deformities. In varus knees, contraction of medial side involves medial collateral ligament and the whole medial periosteal sleeve, including hamstrings, posteromedial capsule, and PCL. As the deformity progresses, the lateral compartment becomes insufficient, causing abnormal lateral opening and instability.

Instability of the arthritic knee may be viewed as symmetrical or asymmetrical. Symmetrical instability is seen during early arthritis, when there is erosion of cartilage or bone without associated adaptive soft tissue changes. During physical examination, the deformity can be corrected under active reciprocal stress on physical examination. This kind of instability is easily corrected during surgery without needing extensive ligament releasing.

As the deformity progresses it tends to turn into an asymmetrical instability, which is not corrected by active reciprocal stress during physical examination. This kind of fixed deformity occurs when cartilage and bone loss lead to adaptive ligamentous changes. In order to correct this kind of deformity, ligamentous release is mandatory, turning a trapezoidal gap into a rectangular gap. In asymmetrical instabilities, the bone cuts alone are not sufficient to accomplish articular balance.

Instead of only releasing ligaments from the contracted concave side someone could advocate to advance ligament complexes on the convex side, especially when the opposing ligaments are stretched to the point of being incompetent. These authors do not favor ligament advances or reconstructions on the convex side since the functional outcomes have not been acceptable in most series. In such cases, the authors advise considering a more constrained knee design (**Figure 12**).

Figure 12. In advanced deformities, when there is great medial bone loss, the surgeon must consider using metal augmentation and more constrained implants.

4.2. Valgus deformity

In the valgus knee, the lateral structures contract, while the medial soft tissues stretch. Differing from varus knees, where the bone erosion occurs more in the tibial bone, in valgus knees most of the bone deformity comes from the femoral side (**Figure 13**). As the deformity progresses it tends to involve the tibial bone and cartilage as well.

Lateral soft tissue structures, including the lateral collateral ligament (LCL), iliotibial band (ITB), and the lateral capsule, contract, while the medial soft tissues stretch. When this

Figure 13. Most part of the bone wear occurs on lateral femoral condyle, although it could involve tibial bone as well.

imbalance becomes permanent it may result in medial thrust during gait. In both varus and valgus deformities, it could be associated with flexion contractures (**Figure 14**).

Krackow has classified valgus deformities into three stages: type I involves lateral femoral bone loss, lateral soft tissue contracture, and intact medial soft tissues; type II adds medial lengthened soft tissues; and type III represents alteration of the proximal tibial joint line, that usually happens as a result of a high tibial osteotomy. As the ITB gets contracted, external rotation is often observed.

Insall and colleagues traditionally recommended releasing lateral capsule, LCL, arcuate ligament, popliteus tendon, lateral femoral periosteum, distal ITB, and the adjacent lateral intermuscular septum from their bone attachments. Some degree of lateral laxity after an extensive lateral release was typically well tolerated. Although extensive release generally corrects the deformity, posterolateral flexion instability may still occur postoperatively. These authors do not favor extensive releasing from bone attachments. Instead, the authors recommend progressively intra-articular liberations ahead of the popliteus tendon, using the pie-crusting technique.

4.3. Flexion contracture

As the degenerative disease progresses, it involves posterior capsule, PCL, and musculotendinous at the posterior aspect of the knee. Bone erosion of posterior femoral condyles and osteophytes may contribute to flexion contracture on arthritis. Despite the fact that some authors understand that postoperative residual flexion contractures are well tolerated, these authors do not favor residual flexion contractures, since residual deformities tend to worsen with time.

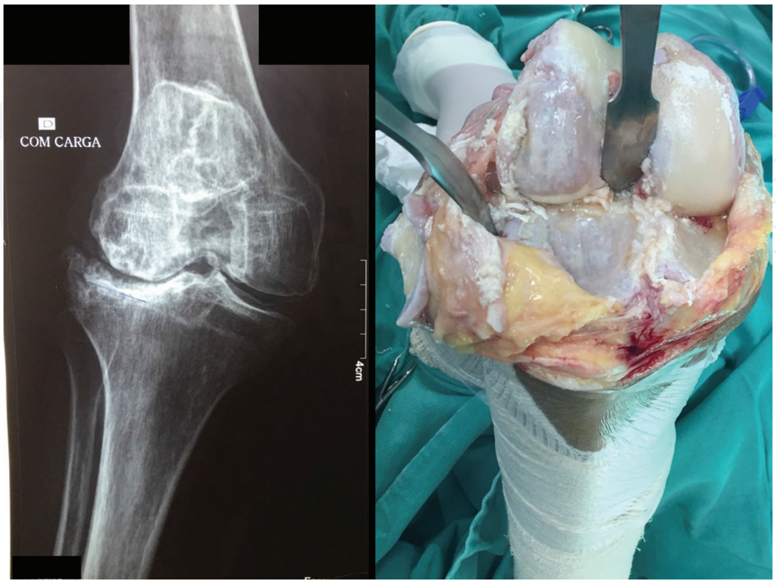

Figure 14. Valgus deformity. Contraction of the lateral compartment causes bone erosion and an imbalance of natural kinematics.

After bone cuts, posterior capsule can be released. For those who agree with principles of KA, the preservation of PCL is desirable. That could hamper flexion contracture correction but changing the slope orientation could in part correct that kind of deformity.

Small contractures can be reduced by removal of posterior osteophytes, but posterior capsulotomy is necessary for moderate and severe flexion contractures. These authors advise the resection of PCL when the mechanical alignment theory is chosen.

4.4. Extension contracture

Stiff knees are a challenging situation even for the most experienced knee surgeons. Typically, the techniques described for difficult exposures are necessary. Sometimes, everting the patella is not possible, leading the surgeon only to subluxate it laterally. The soft tissue releases applied for varus and valgus techniques are used and extensive soft tissue release is usually necessary.

4.5. Genu recurvatum

Recurvatum is usually mild and it's treated with under-resection of the distal femoral and proximal tibia. However, in patients with neuromuscular diseases, such as poliomyelitis and Ehler-Danlos, even under-resection and use of thicker components are insufficient to correct recurvatum. For these extreme conditions, the authors recommend the use of constrained prosthesis or hinged implants.

5. Management of bone defects

As osteoarthritis advances, bone defects can distort the natural anatomy of the knee and cause to difficult alignment and implant set.

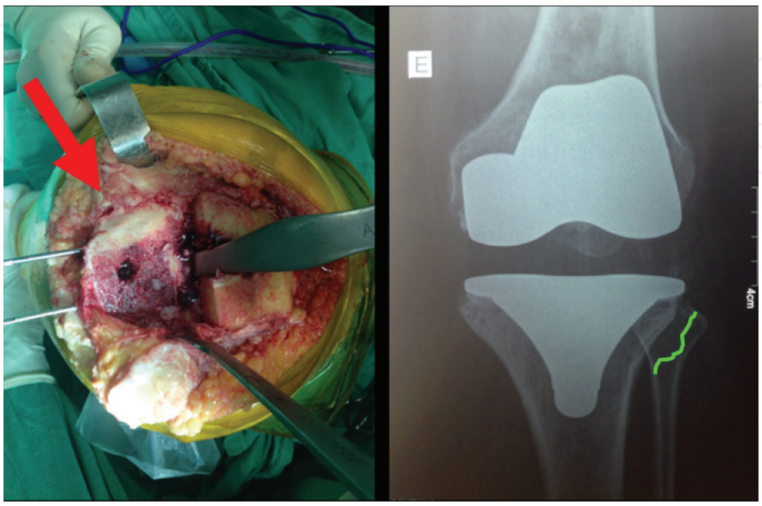

Figure 15. Peripheral medial bone defect on medial tibial plateau. One must avoid over-resection of the medial tibial plateau as it could fracture proximal fibula. Cancellous bone is insufficient to support the tibial implant.

Contained defects occur from a cyst or a cavity and are treated by filling off the defect or bone cut. One must remember that there is a limit for moving the bone cut level. Augmentation with cement, bone, or metal wedges or blocks should be considered in these cases.

Peripheral defects typically occur in varus knees in the posteromedial plateau and in valgus knees in the distal lateral femur. These kinds of defects are also managed with cement, bone graft, and metal augments. When they occur in tibia, the translation of the tibial tray away from the location of the defect could be sufficient. If not deeper than 10 mm, the defect can be eliminated by resecting the tibia at a lower level until, at a maximum of, 20 mm, but these authors recommend using metal augmentation and intramedullary stems to protect the implant from interface shear forces (**Figure 15**).

6. Choice of implant

There are theoretical concerns when choosing the right implant. For those who choose anatomical and kinematic alignment, the implant tends to reproduce the knee's anatomy and the surgeon should preserve at the most ligaments and the natural inclination of the native's articular line. In such cases, the PCL should be preserved whenever it's possible, since it is a varus/valgus stabilizer, and it can absorb stress.

Anterior cruciate ligament (ACL) plays a role with PCL during knee flexion and extension. As the knee flexes, the femur slides back in tibia (rollback) until a point where the ACL is completely strengthened. As the knee extends, the femur slides forward until a point that the PCL resists this movement. For arthrosis of one compartment, when ALC and PCL are intact, a meniscal-bearing design could be used (e.g., Oxford® unicompartmental prosthesis). As arthrosis progresses, ACL becomes insufficient. When PCL is not sacrificed, the movement of rollback occurs and theoretically, the tibial baseplate should be flat. When PCL is sacrificed, the tibial baseplate should be concave, containing forward and backward motion. However, some of the newer implants now allow PCL sacrifice or retention, regardless the shape of tibial baseplate.

Mobile-bearing designs have increased the sagittal plane conformity which helps to control anteroposterior translation. The increased coronal plane conformity typically presented in mobile-bearing TKA also increases the contact area and lessens contact stresses. These advantages tend to reduce the rate of polyethylene wear. Polyethylene is self-aligned with the femoral component. It reduces the cross-shear stresses and facilitates central patellar tracking. In a fixed-bearing TKA, if the tibial component is left in internal rotation, it moves tibial tuberosity laterally, enhancing the risk of patellar subluxation. Besides, mobile-bearing designs also contribute to diminish the incidence of lateral releasing. Clinically, the fixed-bearing and mobile-bearing TKA systems have performed similarly in outcome studies. These authors favor the use of mobile-bearing designs, especially for younger and higher-demand patients with longer life expectancies.

7. Emerging technologies

Patient-specific instruments could be made from preoperative imaging (MRI or CT scans of specific sequences). It could allow the production of manufactured specific cutting guides. These guides are made in respect of the individual anatomy, including osteophytes and bone defects in the correct orientation. It would direct the bone resection before the preplanned knee, avoiding using standard intraoperative cutting guides. Specific guides should require fewer trays of kit, leading to greater operative efficiency, and are expected to reduce operative time and produce more accurate bone cuts. At this point, there are a lot of studies that suggest the use of specific guides with good functional outcomes. Nevertheless, cost-effectiveness still needs to be proven.

Robotic surgery combines navigation with a robot that performs the bony resection, controlled by the surgeon. A preoperative CT scan is used to template the knee. It has a theoretical advantage of not deviating from the defined cutting plane or axes of resection. Despite the appeal that it would reproduce better mechanical axis, additional studies are necessary to justify its use outside the experimental environment before it gets universally used.

8. Conclusion

The restoration of adequate mechanical axes is critical for implant survival. Preoperative planning anticipates surgical difficulties and gives a chance for creating resolutive strategies.

The ATJ® application for mobile phones has proven useful and comes to optimize the surgical planning in TKAs. As it establishes a rational step-by-step process, based on literature, it directs the user to a possible reliable form of surgical planning.

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