REVIEW ARTICLE

Fixed-bearing unicompartmental knee arthroplasty. Patients’ selection and operative technique∗

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Summary Unicompartmental knee arthroplasty (UKA) is designed for patients presenting arthritic wear limited to a single medial or lateral tibiofemoral compartment. The indication is based on strict criteria. Wear must stem from degenerative osteoarthritis or be secondary to aseptic necrosis of the medial condyle. Inflammatory rheumatism is a contraindication. Age and activity level should be compatible with an indication for arthroplasty. The body mass index should be less than 30 kg/m². The ligament system must be intact, particularly both cruciate ligaments. Any pre-existing axis deformity should be moderate and the residual axis deformity, after correction of wear with a unicompartmental tibial augmentation spacer, should not exceed 7–10° varus or valgus. These highly restrictive conditions result in the ideal indications for UKA suitable for no more than 15–20% of knee arthroplasty candidates for most surgeons experienced in this procedure. Although the results of certain early series worried potential users, today it can be asserted that recent series whose indications and technique correspond to modern use criteria, have shown results that are as reliable as those of total knee arthroplasty (TKA) at a 10 years’ follow-up. Beyond this time frame, the risk of polyethylene wear related to the technical restrictions of the UKA is another consideration. Indeed, to prevent the risk of rapid extension of osteoarthritis to the opposite compartment, the procedure should be limited to restoring the patient’s constitutional axis before wear phenomena had set in. This makes UKA a surgical procedure at risk of failure due to wear phenomena. Much of this paper will describe the precise rules for UKA positioning, which are critical to observe to warrant these implants outcome and longevity.

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Introduction

Unicompartmental knee arthroplasty (UKA) is designed for patients presenting isolated degenerative unicompartmental medial or lateral femorotibial wear or wear related to aseptic osteonecrosis of the femoral condyle, most frequently medial.
Our experience with this procedure, supplemented with recent data reported in the literature, has defined three principles:

- in 2011, UKA is a validated and recommendable choice. The published results of modern UKAs shows that, provided that scrupulous rules are respected on the indications and surgical technique, the survival rate is close to that of total knee arthroplasties (TKAs) at 10 years [1–13];
- beyond 10 years, the technical principles of UKA, which we will delineate herein, expose this arthroplasty to a certain degradation that we can qualify as unavoidable [14–23]. We should draw conclusions from this experience on the indications for this procedure and the contract that we engage with the patient. This should also lead to certain orientations in terms of the material so that later revision is not aggravated;
- the early UKA failures were, and remain, the aspect that turns some surgeons away from this indication. We believe that new data today may nearly eliminate these particularly penalizing unpredictable events. We will indicate the principles to follow.

Therefore, today we can propose instructions for this intervention, whose value compared to TKA is expressed not only in easier postoperative recovery, but also because the flexion and function obtained at completion are highly advantageous compared to TKAs. These arguments, which several recent publications have emphasized [1,5,7,20,24–29], explain the renewed interest in this procedure and the refinement of modern rules for its indications and use.

The first part of this article will redefine the principle of UKA and its place in the surgical treatment of unicompartmental osteoarthritis. The second will explore the consequences of this analysis on the technical rules to follow in the procedure. The third part will describe the operative technique and the choices that we have adopted. We will see that they are different depending on the type of osteoarthritis, medial or lateral, as well as the extent of the arthritic wear.

Unicompartmental knee arthroplasty in the treatment of unicompartmental osteoarthritis

Unicompartmental knee arthroplasty compared to osteotomy

In the past, we proposed an osteotomy, in particular high tibial osteotomy (HTO), even at advanced stages of osteoarthritis. Some uncertainty existed in the indications for HTO in medial femorotibial osteoarthritis (MFTA) in absence of axis deformity (frequent in the obese). Today, we believe it is reasonable:

- to reserve HTO for cases of stage 2 or 3 femorotibial osteoarthritis [30] associated with constitutional bone axis deformity (tibia varum);
- to debate the cases in which femorotibial wear is highly advanced with cup wear. In these cases, the patient should be exposed to the limitations involved in the procedure in terms of quality of results. Only physical activity that is incompatible with knee arthroplasty can warrant favoring the indication by explaining to the patient the reasons for this defensive and imperfect procedure as well as the reservations in terms of pain relief during exercise. In these cases, osteotomy can be proposed only for reasons of security in terms of the life span of the implants and not as an equivalent alternative in terms of daily quality of life.

In all cases, the determining factor is defining whether the patient’s activity and age can be compatible with the indication for an implant. It is only then that the discussion can be opened so as to define when a UKA is possible and when TKA is preferable.

Unicompartmental arthroplasty compared to total knee arthroplasty

As soon as wear with complete femorotibial joint space narrowing exists on weight-bearing frontal X-Rays or Schuss views (Fig. 1A, B), the indication for arthroplasty should be discussed if the patient’s age and/or the level of activity allow this indication. UKA can be envisaged as a priority choice if the following conditions are met:

- the patient designates the femorotibial compartment as the elective location of pain and recognizes it as his or her habitual pain [25]. This is the "finger sign";
- the axis deformity is moderate or correctible within the limits that will be defined below;
- the ligament system is intact, particularly the anterior cruciate ligament (ACL), as are the peripheral formations of the deformity’s convexity. This means excluding cases of medial osteoarthritis associated with lateral tibial translation (Fig. 2) or medial laxity in lateral osteoarthritis;
- the patient accepts the restrictions in physical activities that include jumps or shocks, activities with abrupt rotation of the knee, and carrying heavy loads. On the other hand, the desire to squat or kneel (Fig. 3) are arguments in favor of UKA [1,14,20,28,29,31,32].

Should UKA be reserved for the very old or can UKA be accepted as a temporary solution while waiting for TKA? [33–36]. The response to this question is complex because it depends on three factors:

- the need or obligation for regular follow-up of patients to prevent difficult revision procedures;
- the patient’s acceptance of revision beyond 10 years to change a part of the UKA in case of polyethylene (PE) wear or a change to TKA, which is a more extensive procedure. This risk is only warranted if estimation of deterioration brings the patient to the idea of a possible revision at an "acceptable" age for this surgery;
- the implant should be easy to revise. We have come to considering that the UKA with an all-PE tray is undoubtedly a logical choice, even though a few publications have...

Fixed-bearing unicompartmental knee arthroplasty

Figure 1  A. Medial femorotibial osteoarthritis: frontal (AP) X-ray with load. B. Schuss view.

Figure 2  Medial femorotibial osteoarthritis with lateral subluxation. Lateral tibial translation with loss of alignment between the femur and the tibia contraindicates unicompartmental knee arthroplasty.

reported random results [37], which our personal experience does not confirm [38,39].

With unicompartmental osteoarthritis, which factors argue in favor of preferring TKA?

We believe that the high frequency of overweight individuals (BMI > 30 kg/m²) in the population of arthritic knees suffices to displace the indication to TKA, even in cases of purely unicompartmental wear.

On the clinical level, TKA is preferred:

• when pain appears more diffuse with a patellofemoral component. The same holds true for an inflammatory component with abundant effusion. In these cases, the patient often designates the entire knee as the location of pain. This is the "grasp sign". Mobility is also limited, rarely exceeding 90°;

• with radiological involvement of other compartments, except for asymptomatic patellofemoral osteoarthritis or false chondrocalcinosis with no clinical signs. The same is true for osteoarthritis beyond Ahlback stage IV [30] with an aspect of lateral subluxation of the tibia under the femur (Fig. 2), deformities that cannot be reduced or only slightly reduced, osteoarthritis secondary to laxity...
or extra-articular deformity greater than 7°. Generally speaking, as discussed below, as soon as the residual axis deformity in correction exceeds 7–8° varus or valgus, TKA should be preferred [3,4,9], as when the axis deformity measured on long leg films corresponds to a bone deformity, which in itself exceeds the established limits (Fig. 4). UKA should only correct the deformity’s wear component. If the bone deformity exceeds the angle limits defined as acceptable, this deformity will persist after placing the unicompartamental prosthesis, compromising its longevity;

- as for the absence of the ACL, which we have described since 1987 as the cause of potential failure in UKA [40], the debate seemed closed after Goodfellow et al.’s publication [41]. The discussion has recently been reopened by Engh et al. [42], who, based on favorable results despite ACL rupture, with certain UKA models [26,27]. They have proposed accepting this indication in cases of fortuitous discovery of a defective ACL if it involves primary osteoarthritis, exclusively medial femorotibial, with no associated deficiency of the posteromedial formations. Our personal experience is fundamentally different. In these cases of primary osteoarthritis, the posterior osteophyte prevents anterior subluxation of the tibia under the femur and the cup of wear is centered. When placing the unicompartamental implant, the stabilizing osteophyte is resected by the tibial cut and progressive posterior wear of the UKA plateau always ends up deteriorating, even if it is much slower than in osteoarthritis associated with chronic anterior laxity with preoperative subluxation that can be measured on the lateral X-ray with load (Fig. 5). In our opinion, this time span is too brief to accept this indication in a relatively young patient. We have no experience in ACL reconstruction indications associated with UKA [43–45]. We believe the important point is to analyze this risk and MRI can be warranted if there is doubt as to the integrity of the ACL while the indication otherwise seems perfect.

In summary:

- if we wish to respect strict indication criteria, the number of patients who can be candidates for a UKA implant is limited. Most studies that have taken these restrictions into account show that the UKA rate does not exceed 15–20% of the indications for arthroplasty, even for specialized teams [7,8,46–48]. Our personal experience confirms these figures;
- among the failures, whose causes we have listed, most reflect two types of survival curve interruption for UKA, carefully analyzed by Deschmuck and Scott [18]:
  - early failures are related to ligament problems and technical errors. Consequently, extreme caution should be exercised, especially in the very old subject whom it would be regrettable to expose to early revision;
  - later failures relate to the material and technical implantation requirements of UKA, which expose these implants to the risk of wear or loosening (correction of the axis limited to restoration of the patient’s constitutional axis). The risks of failure due to wear have been the subject of careful analysis. In particular, one should avoid this argument becoming a pretext for, in elderly patients, unnecessarily orienting the choice toward supposedly hard-wearing implant models that are associated with an aggravated risk of failure because of their complexity of use [8,22,26,49].

The unicompartmental knee arthroplasty: concept and its technical consequences

UKA consists of an intra-articular tibial augmentation plate, which can and should only compensate cartilage wear in the femorotibial intraligamental space. In no case can UKA correct the bone component of a deformity. Therefore, unlike TKA in which one seeks to correct the bone axes, the radiological objective of UKA is to restore the limb’s constitutional axis to what it was before wear. The stress radiograph is used to assess the joint wear value and verify that the deformity has not been overcorrected. UKA only fills in the cartilaginous substance loss. This concept has three consequences that must be understood before proceeding to analysis of the surgical technique.

Residual varus or valgus of the unicompartmental knee arthroplasty

Certain limits in the indication for this procedure are related to residual varus or valgus that the UKA PE can bear once wear is compensated. These limits have been established by several recent publications to deformities that do not exceed 7° in the residual postoperative mechanical femorotibial angle (MFTA) [4,9,17,38,50,51]. To calculate these values before surgery, the long leg axis X-rays in correction has been by the past very useful [52]. New digital X-rays do not allow reproducing this stress correction. Only standard short stress X-rays allows one to make this assessment.

We wish to emphasize a notion that is ambiguous in the literature concerning undercorrection [47,53]. We find that the term “undercorrection” can be a source of interpretation error. The radiological objective is a personalized correction whose value depends on the individual’s constitutional mechanical axis, as it was before arthritics wear.

Undercorrection of an arbitrary pre-established value cannot be advised, as we do for overcorrection during an osteotomy. The ideal correction is that which is obtained after compensation for wear and restoration of the constitutional axis. The limitations in the indication can be defined in relation to our patient reviews over the long term [9]. These limitations can be evaluated on preoperative stress X-rays.

Degree of ligament tension of the concavity

On the purely technical level, the absolute reference to ensure not going over the filling threshold of the worn compartment is the degree of ligament tension of the concavity.

It is therefore crucial not to carry out any ligament release procedure, contrary to what is done in TKA [50]. The ligaments of the concavity are the sole reference to prevent overcorrection (Fig. 6). We advise leaving a 1- to 2-mm safety margin of laxity in extension between the femoral and tibial components. A certain number of ancillary instrument kits (Zimmer®, Tornier®) even provide a specific minispace to measure this safety margin [7].

It is also essential to understand that overfilling the knee, which consists in introducing a thicker plateau to correct a bone axis deformity beyond the wear present is an error that does not only involve the frontal plane in extension. Maintaining the ligament isometry intact should also include the space in flexion by preventing overfilling. This tibial augmentation plate principle requires applying two complementary rules:

• resecting the posterior condyle by the thickness necessary to house the future posterior femoral implant pad. This is indispensable in that there is never any posterior wear of the femoral condyle at the stages of osteoarthritis suitable for UKA;

Figure 6 Overfilling of the joint resulting in overcorrection of the femorotibial axis.

respecting the patient’s tibial slope and not a mean slope that is not adapted to the physiological tension of the ligaments. This is essential to prevent posterior hyperpressure and a risk of premature loosening [25]. We describe our specific technique to respect the patient’s tibial slope as well as the frontal orientation of the tibial cut, which should align parallel to the tibial joint line (Fig. 7).

The prosthetic joint line level

The third important aspect is the analysis of the prosthetic joint line level (PJL). Wear is compensated by the two prosthetic components, one femoral and the other tibial, and it can be observed that the positioning and the dimensions of these two components define the level of prosthetic joint line, which can differ from the patient’s original joint line. Thus, in case of incomplete wear of the distal femur surface (aseptic osteonecrosis or limited impingement on the Schuss views), a resurfacing femoral implant risks creating a femoral superstructure, leading to excessive cutting of the tibia to “make room” for the UKA in the medial compartment. In addition to making the tibial PE rest on a more fragile cancellous zone [54], excessive tibial cutting also leads to shifting the contact point of the femoral pad to the periphery of the tibial plateau because of the plateau’s funnel shape. This can also encourage the appearance of radiolucent lines [25,38]. Some authors have even described tibial loosening with this excessive tibial cut (Fig. 8) [25].

It is therefore important to redefine the implant choice depending on the type of deformity and whether or not there is femoral wear. This leads to distinguishing between the MFTA in which case we now prefer UKA with a cut, and lateral femorotibial osteoarthritides (LFTA), in which we remain loyal to resurfacing UKA. Indeed:

- in LFTA, wear is for the most part femoral with condyle dysplasia. Femoral resurfacing in this case is therefore a logical and ideal solution to compensate for distal femoral dysplasia;
- in MFTA, however, wear is most often tibial. Resurfacing UKA risks resulting in a superstructure of the prosthetic condyle. This situation is potentially harmful to the longevity of plateau sealing [32]. In our series of 122 UKAs presented at the ISAKOS [38], we observed a significant trend toward under positioning of the PJL in medial UKAs. This could be aggravated by a metal-back plateau, which requires lodging an additional thickness of metal (Fig. 8). It therefore appears particularly necessary to have a UKA with femoral distal cut on the medial side.

Operative technique

Since the limitations and the problems encountered differ, we differentiate medial and lateral UKAs. The technique described below is for the UKA that we have developed (HLS Uni Evolution, Tornier®) and its recent cutting version proposed for the medial compartment (U. Kneetec, Tornier®).

Medial unicompartmental knee arthroplasty technique

Preoperative planning

The patient work-up should include AP and lateral X-rays with load. A Schuss view can be necessary to demonstrate inapparent wear in complete extension, while examination of the knee with forced valgus shows a gap in the joint, proof of joint wear, which should not be confused with ligament laxity (Fig. 1 A, B).

The stress views confirm that the wear can be corrected without overcorrection (Fig. 9).

The skyline views do not show patellofemoral osteoarthritis (or it is totally asymptomatic). There is no irregular wear, typical of chondrocalcinosis, which would be a true contraindication.

The long leg film can be used to measure the overall axis deformity and most particularly to ensure that there is no diaphyseal or metaphyseal deformity itself exceeding 7–10° on a single segment of the limb. A bone deformity greater than this value on a single segment of a limb (Fig. 4) should eliminate the indication for UKA because, after compensation of the cartilage wear by the UKA “wedge”, residual varus equal to or greater than the predefined limits of the indication would remain. This analysis is particularly important in cases of post-traumatic osteoarthritis with malunion.

The obliquity of the medial joint line corresponding to the line perpendicular to the axis of the condyle will be measured on the stress images (Fig. 9). This frontal obliquity represents the inclination objective of the tibial cut in the frontal plane. Adjustable guides are useful to reproduce this direction. Several recent publications [17,25] give the same recommendation concerning the orientation of the frontal cut, which we have emphasized for several years with P. Cartier [55,56].

In restoration of the tibial slope, we do not take into account the radiological measurement on the lateral views, but certain ancillary instrumentation kits require this...
Figure 8 Early loosening of a metal-back unicompartmental knee arthroplasty tibial component. The probable cause is subsidence of the component in the tibial cancellous bone related to initial cutting the tibia excessively to "house" the implant components: resurfacing femur and metal-back tray.

The approach runs along the medial edge of the extensor apparatus approximately 8–10 cm. It is occasionally necessary to cut into the lower fibers of the vastus medialis muscle according to Engh and Parks [57], which we recommend doing subcutaneously until the patella reclines laterally without excessive effort. The knee must be flexed sufficiently, with the patella subluxated, to implant the femoral pad and its anchoring peg without deteriorating the medial facet of the patella. Two-peg UKAs require greater flexion than UKAs with a keel and a single anterior stud.

Tibial preparation
Two objectives must be respected:

- align the cut in the frontal plane parallel to the joint line measured on the X-rays (Fig. 9). This orientation guarantees perfect congruence between the future femoral pad and the plateau surface (Fig. 7). The goal is to avoid a position on the edges of the condylar pad;
- reproduce the tibia’s natural slope. This objective responds to the concept of the unicompartmental "wedge". It is dangerous to choose a poorly adapted tibial PE position or thickness and to force in the trial implant. Any weakening of the posterior part of the plateau related to too much pressure during the trials can create an anchoring surface imperfection, then a radiolucent line, and finally loosening. As a general rule, we advise using spacers to test that the space created by the bone cuts does not result in excessive tension. The gauge should be able to slide in easily, both in extension and in flexion, given the laxity safety margin.

Approach
Since 1987, we have recommended using small approaches that are today called minimally invasive.

In practice, we use the adjustable cutting guide (HLS UNI®; Tornier).

Figure 9 AP stress X-ray with valgus showing perfect correction of medial narrowed joint space (same patient as in Fig. 1A). Preoperative construction of the lines made it possible to measure the inclination angle of the ideal tibial cutting plane according to the projection of the axis of the future condylar implant (medial unicompartmental knee arthroplasty).

measurement. We will explain our technique for restoring the patient’s tibial slope below.
Figure 10  The adjustable tibial guide is aligned on the anterior crest of the tibia.

This guide includes a degree-by-degree adjustable compass (Fig. 10), allowing predetermination of the frontal cut’s obliquity according to the radiographic measurements (Fig. 9). The cutting jig is positioned facing the flexed tibia. The extramedullary tibial stem is aligned on the anterior crest of the tibia (Fig. 10). In these cases of osteoarthritis, with a low level of bone deformity, the anterior crest of the tibia can be equivalent to the tibia’s mechanical axis. A pin is inserted in the cutting tray, tangentially to the tibial plateau. This allows one to adjust the slope (Fig. 11). The cutting jig is then attached with a central pin driven 1–2 cm under the surface of the intercondylar tibial spines.

A sliding flange is brought into contact with this central pin and locked using a screw. The intra-articular pin is pulled out and a stylus is positioned in the groove so that wear can be measured in relation to the healthy cartilage residue in front of the plateau surface (Fig. 12). The cutting level defined by the ancillary is 4 mm from this landmark. A lateral interlocking screw anchors the cutting plate and the central ruler displays the approximate cutting value by reference to the femoral condyle. A plate inserted into the cutting groove provides a visual impression of the resection level. Two or three pins are inserted to anchor the cutting plate and to guide the saw blade. The plateau is extracted after having cut its central part vertically. This sagittal cut should scrupulously preserve the ACL insertion. Its rotation should provide good anterior coverage. The operator can be guided in defining this rotation by sliding a Lambotte osteotome tangent to the condyle in the intercondylar notch. The resection slice should ideally have the same thickness from front to back, like the tibial PE. This means keeping the patient’s tibial slope intact; a 9-mm spacer can be used to check the absence of posterior hyperpressure in flexion.

Femoral preparation

Tornier’s HLS UNI unicompartimental implant was a resurfacing prosthesis. In cases with true wear, resurfacing is perfect because it fills in the cartilaginous substance loss. However, in osteonecrosis of the condyle or certain Ahlbke stage II cases of osteoarthritis [30], distal wear is incomplete. In these cases, we either resurface the condyle using a free-hand technique or, as we recommend today, we make a distal cut. It has been necessary to slightly modify the femoral implant design to create a flat distal surface adapted to the femoral cut (U. Kneetec®). We have also developed specific ancillary instrumentation (Fig. 13).

Since the tibial cut has been made before, as indicated above, a spacer corresponding to the desired plateau thickness is put in place with the knee extended. It serves as a cutting guide, giving the distal femoral resection level and the cutting direction (Fig. 13). The cut’s frontal orientation is parallel to the plateau, which will guarantee the proper position of the femoral implant on the PE surface. This cut should therefore be defined after having positioned the knee in extension. Two- to 4-mm adjustable tibial augmentation plates can be clipped on the guide’s...

Figure 11  Intra-articular pin serving to identify the slope whose position will be set by the central pin (central metallic sleeve adaptor with three circles).

Figure 12  Palpation stylus to adjust the tibial resection height in relation to the junction between the worn and the residual intact cartilage.
surface on either the tibial or femoral side. In the latter case, they allow one to reduce the thickness of the distal femoral resection if femoral wear is substantial (mechanical femoral angle < 90°). The distal femoral cutting direction is thus dependent on the tibial cut in the frontal plane, which has resulted in our preferring performing a distal femoral cut after the tibial cut rather than the other way around.

In the sagittal plane, one should also prevent malposition of the condylar implant. The proper position of the cutting jig corresponds to replacing the ligaments under tension using the cutting spacer. Adjustable tibial augmentation plates can be adapted to the ligament situation and the thickness of the tibial resection, preventing any extension lag or recurvatum of the femoral cut.

The femoral cutting guide is attached in the proper position using two screws. The cutting groove can thus guide the sawblade so that the cut is perfectly parallel to the plane of the plateau.

The knee is then positioned in flexion. The template of the posterior cut and bevel (Fig. 14) is positioned on the distal femoral cut. Each of the templates corresponds to one of the four femoral implant sizes. The objective is to obtain good anteroposterior coverage. In front, the guide is flush to the anterior part of the distal cut. The implant pad is symmetrical and therefore the rotation should be adjusted such that the template is aligned at the center of the cutting surface. If rotation is to be applied, excess internal rotation should be prevented, which would result in risk of impingement with the medial side of the patella during flexion as well as misalignment of the contact point of the posterior part of the condyle in relation to the tibial plateau surface.

The trial condyle is put in place. A central orifice allows preparation of the anchoring peg and the groove. Before drilling the peg hole, it is still possible to change the size for a smaller condyle or to recut the posterior condyle 2 mm. This can be advantageous in case there is excessive tightening in flexion, while the balance in extension is perfect. In these cases, one must reassess the anteroposterior dimension of the femoral implant, possibly opting for one size smaller so that an excessive posterior femoral cut does not result in overflow and/or impingement of the anterior edge of the condylar pad with the medial facet of the patella. However, once the peg’s hole has been prepared, it is no longer possible to change the position of the femoral pad. Consequently, perfect kinematics is essential (trial parts perfectly stable, no impingement during flexion-extension) before preparing the femoral peg and grooves. The PE thickness should be chosen to allow a safety margin of 1–2 mm of laxity in extension.

For the sealing stage, one should begin with the tibia, which facilitates removal of posterior cement residue. The parts should be maintained under compression in extension. We carry out the sealing with the same dose of cement. The ascending guiding angle of the posterior femoral cut and the single central peg facilitate implantation of the femur. UKAs including two pegs, one in the posterior chamfer may require greater flexion and occasionally enlarging the approach so as to luxate the patella sufficiently.

**Lateral unicompartmental knee arthroplasty technique**

**Generalities**

Our UKA series [38] allowed us to verify that lateral osteoarthritis includes wear or a constitutional deformity that is mainly femoral. Lateral UKA can therefore logically be a resurfacing prosthesis.

Another characteristic of lateral osteoarthritis is the frequent internal rotation of the femoral condyle in relation to the tangent to the plateaux on a knee flexed 90°C. If guided by the natural direction of the lateral condyle, excessive internal rotation of the prosthetic condyle results, thus
risking impingement with the patella in flexion [58] and with the intercondylar eminence in extension. To prevent this, one must not be guided by the natural orientation of the condyle and position the anterior part of the femoral pad off center, which will then rest on the lateral osteophyte, which must be carefully preserved. This is an additional reason to prefer resurfacing UKAs in lateral osteoarthritis. Instrumentation allowing adjustment of this rotation in extension is essential to prevent malposition when the knee is placed in extension (Fig. 15).

Tibial plateau orientation is also crucial. A certain degree of internal rotation should be given to prevent femoral impingement with the intercondylar eminence. One must resist the temptation to make a varus cut, as done in the medial UKA, to prevent the risk of internal laxity or sliding with transversal dislocation (Fig. 15). Adjustable ancillary instrumentation has proven to be particularly useful here. The cut can be inclined downward and outward. A preoperative radiographic construction can be used by tracing the lateral condyle axis on the frontal (AP) X-ray, its perpendicular, and the angle between this horizontal line and the mechanical tibial axis (Fig. 16). As in medial osteoarthritis, the latter is comparable to the tibial crest, which allows one to adjust the frontal cutting angle on the adjustable guide.

Finally, one should exercise caution because of the risk of overcorrection. The lateral ligament structures are much more elastic than the medial ligaments, making intraoperative judgement of no excessive tension in the ligaments as a guide to absence of joint overfilling more uncertain.

Figure 15  Lateral unicompartmental knee arthroplasty: malposition of the femoral condyle impinging with the intercondylar eminence plus tibial malposition whose inclination in varus created a tendency to slip with creation of stresses on medial formations.

Figure 16  Lateral unicompartmental knee arthroplasty: traces of the cutting lines showing that the inclination angle of the tibial cut should be downward and outward compared to the tibia’s mechanical axis so that the femoral condyle that will follow the axis of the condyle will be highly congruent with the plateau.

Operative technique

Approach
The approach is anterolateral, often slightly more extended above than the medial approaches. The capsule is incised on the lateral edge of the patellar tendon. The ilio tibial band should not be detached from the Gerdy tubercle. The Hoffa fat pad remains attached to the lateral capsule or is folded inward with the patellar tendon. It will facilitate closure. The incision extends upward between the rectus femoris and the vastus lateralis muscles.

To subluxate the patella inward, the Cabot position is used. This position “cross-legged”, with the operator’s assistant providing forced varus movement, reclines the patella inward while clearly exposing the tibial plateau. A wide-blade retractor pulls the patella inward. We never detach the anterior tibial tuberosity.

Tibial cut
The technique for the tibial cut is identical to the medial side. With the guide oriented in the frontal plane according to the preoperative radiographic measurements (Fig. 16), it is attached using a central pin driven 1 cm under the intercondylar eminence. This pin establishes the slope, which, as above (Fig. 11), is in reference to a pin tangential to the lateral plateau inserted into one of the holes of the cutting plate. Once the template has been attached in its middle by the central pin, the knee is placed in extension. The intra-articular pin is still in place, in extension and in contact with the distal surface of the lateral arthritic condyle. The assistant executes varus stress in extension. The cutting plate slides freely so that the intra-articular pin remains in contact with the distal surface of the lateral condyle,
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Figure 17 Lateral unicompartamental knee arthroplasty: adjustment guide for centering and rotation of the future condylar pad. This guide inserted between the condyle and the trial tibial plateau in extension allows drilling for two pins that will serve in the following phase to adjust the ideal rotation of the femoral implant. The essential advantage lies in being able to adjust the rotation in extension.

with the guide’s central flange brought into contact with the central pin and locked. This marks the 0 level of the height measurement for the tibial cut. The intra-articular pin is withdrawn. The 12- to 14-mm-high cutting plate (measured using the central ruler) is slipped in place. The “0 point” corresponds to the distal surface of the lateral condyle located on palpation; the 13-mm cutting height corresponds to the combined distal thickness of the prosthetic condyle (3 mm), the plateau (9 mm), plus a 1- to 2-mm laxity safety margin. As a general rule, the femoral dysplasia cannot be over-compensated or the joint line distalized in lateral arthritis, contrary to what we have described and observed in medial resurfacing UKA.

Femoral preparation
The main problem is defining the condyle rotation in the horizontal plane. For this purpose, we have developed a tool that is inserted between the femur and the trial plateau (Fig. 17). It can be used to adjust several parameters:

- medial-lateral centering on the plateau;
- rotation in relation to the plateau in the extension position, the reference position.

This paddle is attached with two pins. The knee is then placed in flexion and the paddle is replaced with a drill guide designed for drilling the holes of the groove that will be slid over the above-mentioned pin guides. This guide can be slid outward depending on the result observed in flexion. It can also be used to slightly correct rotation. However, it is important to note that the visual aspect is often misleading. Occasionally, an impression of excessive external rotation

can also be noted (Fig. 18). One must take care not to give in to the temptation to correct this position because it would risk causing excessive internal rotation of the femoral pad compared to the direction of the tibial joint line in 90° flexion. As mentioned above, this internal rotation may be a source of impingement between the anterior part of the femoral pad with the patella in flexion and the intercondylar eminence in extension.

In the following stage, after preparing the groove, the instrument dedicated to the posterior and chamfer cut is placed corresponding to the size of the different condyles. The ideal size, whose shape matches the shape of the condyle to be resurfaced, does not go beyond the edge in front, with the posterior flange, serving as the reference to the cutting thickness of the posterior condyle, applied perfectly on the posterior condyly surface (Fig. 19). From the lateral position, the guide handle makes it possible to check the component’s flexion angle. In practical terms, it is particularly crucial to prevent recurvatum. Two pins attach this guide, whose number corresponds to the size of the future prosthetic condyle. It is used to drill the central peg and make the posterior cut and the chamfer cuts.

As for the medial UKA, the trial components should be stable during flexion—extension movements. The ideal tibial PE thickness corresponds to the thickness that preserves a few millimeters of laxity in extension and mobilizes the plateau in flexion with no friction on a hard surface on the plateau in flexion. The plateau should never rise nor be ejected forward during flexion movements.

The ligaments of the lateral compartment are much more elastic than those of the medial compartment. The choice of PE thickness is therefore more delicate and overcorrection should be prevented. Unfortunately, overcorrecting the

and flexion, for squatting and kneeling, highly appreciated for daily and gardening activities as well as for housework. These are implants that patients frequently report having "forgotten."

This is nonetheless a more uncertain surgery if the technical rules and precise indications are not strictly followed.

One point is essential. A surgeon choosing to turn toward UKA should imperatively be trained in this technique. UKA is an intervention that is full of pitfalls that a technical manual, however sophisticated it may be, can never describe exhaustively. The most highly trained teams will take pride in transmitting their experience with this surgery that we personally consider to be extremely useful.

Disclosure of interest

G.D: royalties from Tornier SAS.
C.C: no conflict of interest.

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