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Fixed bearing unicompartmental knee prosthesis: results, complications, and technical considerations

Introduction

Unicompartmental knee replacement (UKR) is an attractive technique for managing unicompartmental arthritis of the knee since it allows quicker recovery and has lower complications rates than total knee replacement (TKR). However, questions remain over the long-term functional results and long-term survival. Whilst there are indubitably advantages of UKR over TKR, the gains are unfortunately offset by the risk of disease progression and pain from the other compartments of the joint (1, 2) There is also a risk of long-term deterioration from wear of the tibial polyethylene (PE) insert.

The experience of the senior author (GD) with UKR began in the 1980s, using the Lotus prosthesis (GUEPAR group, Howmedica®) and continued using a fixed-bearing prosthesis (Tornier® HLS UNI Evolution) since 1989. This prosthesis has a resurfacing femoral component and an all-polyethylene tibial component.

The resurfacing design replaces the worn articular surface only, with the metal bearing. There are resection designs where the distal femoral surface is removed to fit the implant. The tibia can be metal-backed, and the PE bearing mobile as well as fixed. In this chapter we shall explain the mechanical concepts behind choosing a fixed-bearing. We shall use as evidence the results of a consecutive case series and compare these to those reported in the literature. Finally, we shall present details of the technique and strategies to improve the outcomes when using a Tornier® HLS UNI Evolution prosthesis.

Fixed-bearing – the reasons for our choice

Laboratory studies have shown that point loading of polyethylene leads to increased wear (3). It follows that the greater the contact between the bearing surfaces the lower the wear rate. It is also clear that early fixed-bearing designs did have problems with PE wear. To address this Goodfellow and O'Connor, in the 1980s, designed the Oxford UKR (Biomet®). The concept behind this is that the femoral condyle can be considered part of a sphere and therefore the shape of the bearing surface can be part of a sphere. The bearing surface then has perfect congruence (4, 5). This bearing is mobile because the undersurface is flat; if it was not mobile, the congruity would impart excessive stresses at the implant bone interface. The mobile-bearing allows the femur to move without constraint by the implant and therefore normal kinematics can theoretically be achieved. It follows that the knee ligaments, including the anterior cruciate ligament must be normal and at normal tension. In theory this implant should minimize PE wear (6).

Despite the reported success of the Oxford UKR (4), with evidence to support minimal PE wear we have continued to use a fixed-bearing design. At the SOFCOT 1995 symposium (7) the outcome of more than 600 UKRs was reported. In fact, PE wear was not a major cause of failure in fixed-bearings (7). In addition, it is also technically easier to implant fixed rather than mobile-bearings. These difficulties have resulted in a significant number of early failures (8, 9). This is not encouraging to either the patient or the surgeon (10–12).

Subsequent research (13) based on the SOFCOT series found evidence that the main cause of failure with modern fixed-bearing unicompartmental implants was not PE wear but was related to errors in operating technique and patient selection (14–17). The principal technical errors were overcorrection of the alignment axis and ligament instability. Overcorrection converts varus alignment to valgus (18, 19) and also overstresses the contralateral compartment. Initially this leads to pain, and later to disease progression. This can occur rapidly post-UKR. If ligament instability is present, either pre-operatively or iatrogenically, this can cause early (20) and, sometimes, catastrophic failure (21). When a mobile-bearing prosthesis is used, both causes of failure can occur simultaneously.

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Fig. 1 – Retrieved flat tibial component (infected knee) demonstrating an early superficial wear track.

Fig. 2 – "Overstuffed" Oxford medial UKR with overcorrection.

Mobile-bearings also have a risk of dislocation (11). This risk is greatest in lateral UKR such that it has been a contraindication for the Oxford UKR (21). More recently the Oxford group have been developing a domed tibial undersurface for the bearing to reduce this risk and to match the increased mobility of the lateral compartment.

Although there is perfect congruency in a mobile-bearing which results in low wear rates, this can also occur in fixed-bearing designs. Low wear does occur with a flat tibial PE surface and a curved metal femoral surface. This seems illogical given the laboratory studies, but what actually happens is that the implant when loaded *in vivo* results in creep of the PE. The site where it occurs is patient-dependent and reflects their own kinematics. The implant therefore beds in and becomes congruent. Wear is then minimal. This is clearly seen when the implant is revised for, say infection (Fig. 1). This observation led a number of research teams to develop a slightly concave shape for the PE insert to produce a better match to the shape of the prosthetic femoral condyle (e.g., UKS Aston®). However, choosing this design causes problems with kinematics that is related to the shape and orientation of the femoral condyles, and the tibial plateaux. The condyles have an oblique orientation, which, coupled with automatic internal rotation of the tibia during flexion, means that there is then a complex change in rotation between flexion and extension. This is impossible to determine intraoperatively. This means that a congruent fixed PE bearing, which is usually inserted in flexion, is likely to create a torque at the tibial bony surface. Because it is impossible to set an ideal average position, significant sheer forces are likely to be generated at the level of the tibial implant–cement–bone interface. There are therefore only two possible options for the shape of the tibial PE insert:

- A flat bearing surface imposing no constraints on rotational alignment and where the position during rotation is not important.
- A congruent bearing surface which, to avoid constraints on the cement–bone interface caused by the change in rotation when going from flexion to extension has a flat tibial surface and a mobile-bearing.

Whilst the principle of the mobile-bearing design seems attractive, and findings published have indeed confirmed there is less tendency to wear (4), there is also a risk of dislocation (10, 11, 22). If this occurs then re-operation is necessary, with all its disadvantages for the patient. Rarely can this be corrected by a bearing exchange with a larger implant, as it is unusual to introduce too thin a mobile-bearing. More often a technical error has occurred with a significant mismatch between the flexion and extension gaps, and therefore complete revision is needed. This problem is very common with lateral mobile-bearing UKR, where flexion-extension gap balance is almost impossible. If a larger bearing is inserted, not only is there the worry of re-dislocation, but also overstuffing may lead to progression of arthritis in the contralateral compartment secondary to overload (Figs. 2 and 3). The concern with bearing dislocation means that inexperienced surgeons tend to oversize the bearing. This is the main cause of overcorrection (9, 23), although inadvertent release of the medial collateral ligament (MCL) is also well recognized. Overcorrection has been reported in a number of publications comparing fixed and mobile-bearings (10, 22). The same occurs with some unicompartmental "spacer" knees that we have had to revise (Fig. 4).

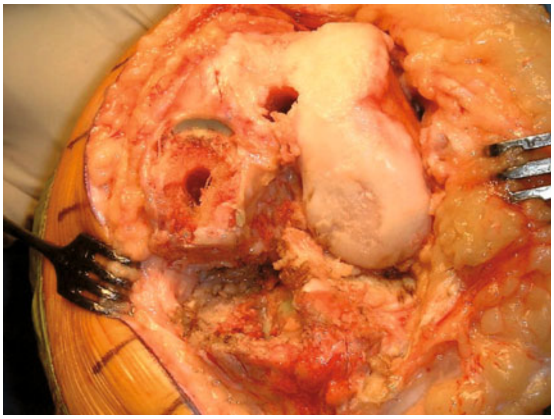


Fig. 3 – Operative view of the case corresponding to Fig. 2. Wear on the central part of the lateral condyle.

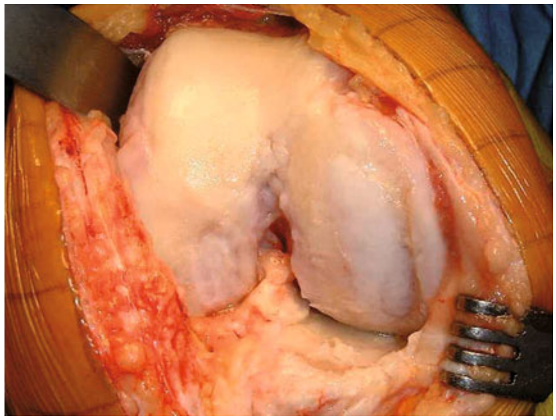


Fig. 4 – Similar wear as on Fig. 3 on the opposite compartment of a revised "spacer" UKA.

For us the advantages of wear reduction with a mobile-bearing are outweighed by the high risk of early failure due to the technical demands of the procedure (8). We prefer to consider the UKR a joint "wedge." If a fixed-bearing implant is chosen, then a flat PE bearing surface is essential. This allows the femoral condyle to find its own contact position. By allowing this, the unavoidably complex adjustment of the rotation of the tibial insert is dispensed with. Despite the initial incongruency, the signs of PE wear have not been found at up to 10 years follow-up (24).

Results of fixed-bearing UKR

A number of distinct periods can be seen in the UKR. In the 1970s and 1980s, pioneers such as Marmor in the USA and Cartier (25) in France established a number of rules for UKR such as the thickness of the PE insert should be a minimum of 6 mm (4). However, at this time the reported results show variability between series and the age of patients undergoing UKR. Papers by Laskin (16) and Insall (14, 15) brought it into disrepute, but the different series included many errors in indications and/or operating technique. Insall had overcorrected the medial UKRs, and undercorrected the lateral ones. The decision to use the same rules as applied to osteotomies explains why the results with the lateral UKR in his series were good compared to the medial ones. This point is discussed later.

More recently, Deshmukh and Scott (24) noted a distinction between failures occurring in the first 10 years, which are mainly due to errors of technique and/or indication, and failures in the second 10-year period, which are mostly related to wear and component loosening. From this some have concluded that UKR is an interim solution before going on to TKR (26).

Failures related to the design of the implants must not be considered to be the same as failures of technique or with the overall concept. Quite clearly the UKR is very vulnerable in the event of technical error. Provided that a few simple rules are followed, the results achieved with modern unicompartmental implants show them to be a satisfactory alternative to TKR, and in younger patients to upper tibial osteotomy. Many series published in the literature have reported survivorship of over 90% at 10 years (1, 5, 25, 27–31).

Personal series

At the Isakos Congress in 2005 (32), the senior author (GD) presented a series of 122 HLS UKRs that were reviewed and assessed after a follow-up period of 6–9 years. The findings are presented here as an example of outcomes achievable with a fixed-bearing UKR.

Materials and methods

This was a retrospective series of UKRs implanted by one surgeon (GD) between January 1995 and November 1997. The prosthesis used was the HLS UNI Tornier®. This is a fixed-bearing resurfacing implant with a cemented alloy (CrCo) femoral component and a full polyethylene tibial insert (Fig. 5). In eight cases, the bearing included a restraining polyethylene "Metal Ring" designed to reduce the risk of creep but without reducing the thickness of the PE insert.

The series consisted of 122 patients with an average age of 71 years (range 51–91) at the time of the operation. Of these 61 were female, and 51% were on the right side. There were no bilateral cases. Of the 122 patients only four were lost to follow-up (3%), 16 died, 10 were contacted but did not undergo clinical assessment for reasons of age or distance. Of these 10, none had been revised. Therefore, the study

Fig. 5 – HLS UNI Evolution (Tornier®).

population comprised 84 patients with an average follow-up of 7.4 years (range 6–9). They were clinically assessed and undertook an IKS score. Furthermore 74 had a full radiological assessment including pre- and post-operative long-leg radiographs.
In all 76 (90%) had primary osteoarthritis classified as Ahlback Grade II (33), of which all except nine (12%) were medial (88%). In eight cases (10%), the pathology was aseptic necrosis.

Results

On subjective evaluation there was a high rate of satisfaction with 96% satisfied or very satisfied.

Objective

The Knee Score went from 39 pre-operatively to 86 at the time of review, with 94% of patients experiencing either no pain or occasional mild pain. We must point out that the intentional post-operative residual deformity (varus for medial and valgus for lateral UKAs,) automatically reduced the knee score by an average of 10 points.
The functional score went from 62 pre-operatively to 77 at the time of review. The advanced age of the patients at the time of review needs to be taken into account here: 18% were IKS category C for an average age of 78 years (range 68–97). The most noteworthy points included a high average angle of flexion, from 128° pre-operatively to 133° (90–150°) at the time of review.

Radiological

For the medial UKRs, the mechanical femorotibial angle (mFTA) did not change staying at 173° pre-operatively and at the time of review, with a mechanical femoral angle (mFA) of 92° and a mechanical tibial angle (mTA) of 83°. For the lateral UKAs, the mFTA did not vary significantly at 184°. The mFA was 92° and the mTA 92.5°. Radiolucent lines were reported in 22% of cases, but only beneath the tibial plateau in medial UKAs. These lucencies did not change over time. One case showed signs of polyethylene wear with loss of height of the bearing surface.

Complications

There were only four cases of distal deep vein thrombosis, which were successfully treated with anticoagulants (5%). There were no cases of stiffness requiring mobilization under anesthetic.

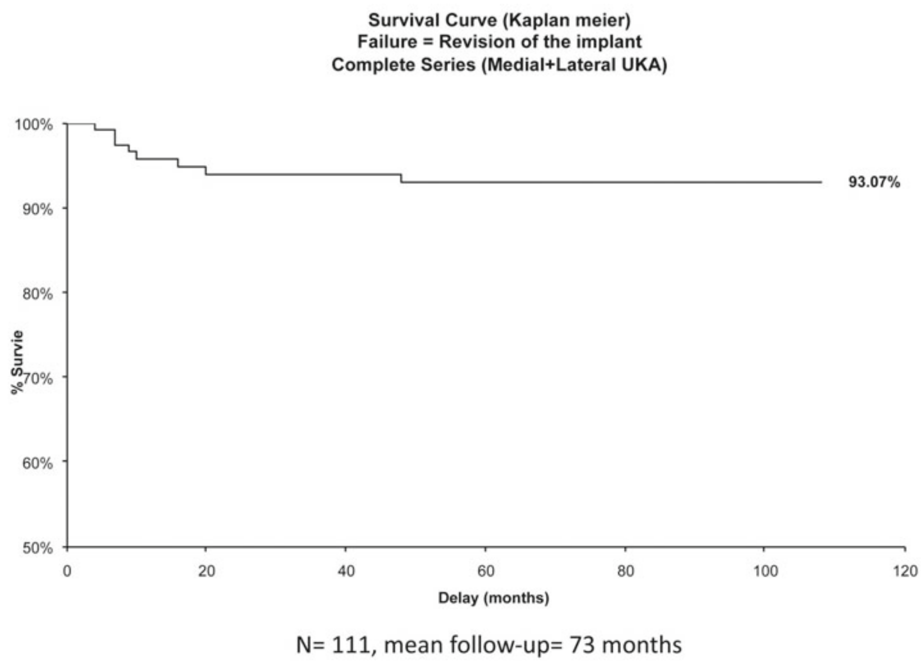


Table I – Survival curve. overall series.

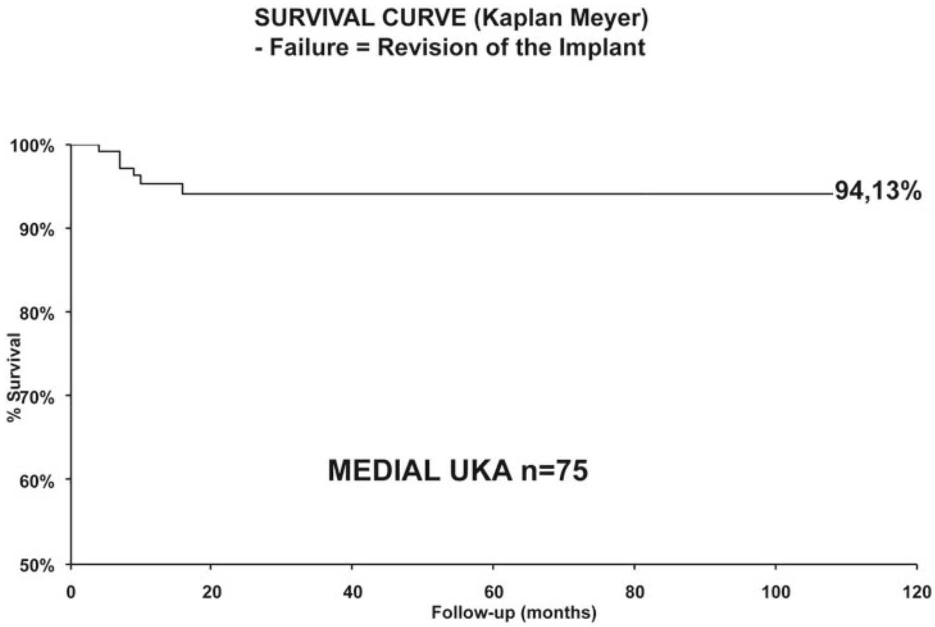


Table II – Survival curve medial HLS UNI evolution at 9-year maximal follow-up.

Eight patients (6.5%) required removal of the prosthesis. Two were deep-seated secondary infections (1.6%), one after cholecystitis a year from operation, and the other after a severe lung infection 2 years post-operatively. Two cases of tibial loosening (1.6%) (*v.i.*) underwent revision to a TKR. There was one case of oversizing of the components in a small female patient. A No. 1 (the smallest) femoral component distalized the joint line and the size 1 tibial component had a posterior overhang, which caused posterior pain. This was also revised to a TKR as well as a further three patients with unexplained pain. Two with unexplained pain had undergone lateral UKR, with revision only improving but not abolishing the pain.

Overall the Kaplan–Meier survival analysis was 93% for the full series (Table 1) and 94% for the series of 75 medial UKRs (Table 2).

Discussion

From this series important observations can be made:

– In medial UKR a residual varus of 5–7° does not adversely affect the outcome. This finding corroborates the results we published in 2004 (13). Only residual varus superior to 10° have a risk of wear on the PE tibial insert. Others have reported similar findings (1, 28). The residual varus reflects the anatomical or structural varus of the individual patient prior to the onset of medial tibiofemoral osteoarthritis. The UKR acts as a wedge and replaces the wear created by the osteoarthritis, but not the structural varus. Contrary to osteotomies there is no pre-determined correction angle that is ideal for all patients. The global deformity depends on the structural deformity of the bone and on the degree of wear. Therefore, a patient with 6° bone deformity and wear equivalent to an angle of 4° has a total deformity of 10°. The proportion of the angular deformity due to the bony morphology, and unrelated to wear, can never be corrected by a UKR. This was the reason for the tibial component loosening in our series. The patient was overweight and had a femoral bony varus >10° from femoral bowing. Obviously this was impossible to correct using a UKR (Fig. 6).

– The tibial radiolucent lines showed significant correlation with excessive tibial bony resection (p = 0.009) (Fig.7). This excessive resection also

Fig. 6 – Femoral "bowing". fMA 80°. Incompatible with UKRs.

Fig. 7 – Femorotibial incongruency due to an excessive orthogonal tibial cut.

Fig. 8 – Excessive medial tilting of the tibial plateau without penalty at 7 year follow-up.

contributed to excessive varus tilting of the plateau ($p = 0.047$). This correlation was not significant for excessive tilting alone (Fig. 8) ($p = 0.62$), nor with the post-operative mFTA angle, even when this was accentuated ($p = 0.65$). It was noted that in some 25% of cases, the excessive tibial resection was due to distalization of the femoral replacement. This led to lowering of the prosthetic joint line. Lowering the tibial bony cut, to make room for the tibial insert, then compensated this for. This is a risk with femoral resurfacing UKR, and is important to avoid.

With medial UKRs, the average mFA was 91° pre-operatively, only increasing to 92° on average at follow-up. This was not the case with lateral UKRs where resurfacing lead to a good correction. The wear or dysplasia of the lateral condyle was almost fully corrected, with the mFA went changing from an average of 94 to 91°. As a result of these findings we can make a number of technical recommendations on the different choices of equipment and material. There are important rules to stick to for medial UKRs, and in lateral UKRs it is essential to use resurfacing rather than cutting designs on the femoral condyle. These technical aspects will now be addressed.

Unicompartmental knee replacement – the technique

It is important to make a distinction between medial and lateral unicompartmental arthroplasties as they do not present the same problems and thus require different techniques. However, the objectives are the same for both.

Objectives in unicompartmental replacement

Two factors need to be taken into account.

UKR and ligament balance

There is no intrinsic stability built into unicompartmental knee prosthesis. Everything depends on the ligaments being intact, whether it is the

Fig. 9 – Early failure due to ACL preoperative insufficiency. Pre- and post-operative anterior drawer is present.

Fig.10 – Failure of a lateral UKA due to medial collateral laxity.

cruciates (20, 21) or the ligaments on the convex side of the deformity. Thus, as we reported more than 20 years ago (20), no defect of the central pivot (in particular of the ACL) can ever be stabilized by a unicompartmental "wedge" (Fig. 9). In the coronal plane, cases with laxity on the convex side e.g., distension of medial soft tissues in genu valgum (Fig. 10) or a lateral translation in genu varum are contraindications for UKR (Fig. 11). The pre-operative radiographic assessment with frontal and lateral views, both weight-bearing and stress X-rays, screen for these problems.

Care should be taken when excising the medial meniscus to leave the rim, especially in its mid-portion as it is confluent with the deep MCL. This can be inadvertently divided leading to excessive medial opening. If after preparation the tibial component measures much larger than anticipated, this has probably happened. Repair of the divided deep fibres of the MCL can be tried, or, more usually, immediate conversion to a TKR.

UKA and bone alignment

One of the keys to the success of the operation is a proper understanding of the alignment correction. This will also set any limits to indications for UKR. In TKR, the aim is to achieve the best possible correction of the defect in the structural bony alignment as this reduces the risk of loosening and wear. However in UKR, the implant can only, and must only, be positioned on the concave side of the deformity. This role as a "joint wedge" must do nothing more than offset any wear. The goal therefore is only to restore the *patient's original structural alignment* (Fig. 12) to the degree of residual varus or valgus that depends on the original alignment of bone extremities. There is no ideal or average pre-determined value.

The classical idea of "undercorrection" is a misnomer. The purpose of the operation is not to undercorrect for the sake of undercorrecting, but to restore the patient's original structural alignment as accurately as possible (34). The axial alignment is varus for medial UKAs and valgus for lateral UKAs. There are occasionally patients with no structural bony deformity who therefore have a final alignment of 180°. In this scenario, this would not be overcorrection. Conversely, a post-operative mFTA of 178° in a patient whose structural alignment was originally 172° (before wear) is a case of overcorrection by 6°. This would occur by significant overstuffing of the medial femorotibial joint space

Fig. 11 – Frontal weight-bearing X-ray demonstrating a lateral tibial translation. Contra-indication to a UKA.

Fig. 12 – Bilateral UKA. Frontal X-rays illustrating the ideal alignment.

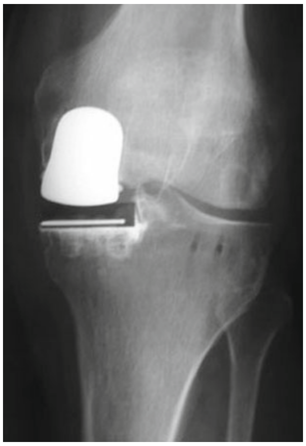


Fig. 13 – Overstuffed knee with contralateral involvement despite an overall neutral alignment.

(Fig. 13). To avoid this type of error, the ligaments on the concave side should never be released. These ligaments are the sole reference to the original pre-arthritic joint intra-operatively, and help to decide on the thickness of the bearing. The purpose of the operation is to achieve proper balance of the ligaments without excessive tension (or even with 2 or 3 mm residual laxity as a safety margin). This reference ensures proper, i.e., not excessive, correction for wear, and is termed the "standard" correction in relation to the patient's own anatomy. This is why stress X-rays correcting the varus (Fig. 14) or valgus are useful for checking that the joint space narrowing will not be overcorrected. The two components of the prosthesis, femoral and tibial, are positioned to replace lost articular surface and act as a composite wedge. It therefore should be stressed that:

- Proper ligament balancing resulting in just filling the worn surface is the only way to effectively avoid progression of arthritis into the opposite compartment. It guides the surgeon to the choice of PE thickness.
- Correction of alignment measured on the post-operative long-leg film must, in theory, match the structural mFTA of the patient; as it was before wear occurred (35).

As a consequence of this:

- By combining data from the pre-operative long-leg film and stress X-rays, the target value of the provisional post-operative mFTA can be measured. This can be used to predict the post-operative residual alignment discrepancy. This then shows whether it is within the range tolerated by a unicompartmental prosthesis. For instance in medial UKAs the residual varus should be no greater than 7°. The X-rays can also be used to screen for bony deformities away from the joint. An example of this is femoral bowing (Fig. 6). With an mFA of 80° this obviously cannot be corrected from within the joint.
- The restoration of the joint line in UKA depends on the thickness of the femoral component, notably in extension, along with the amount of wear on the distal femoral surface. Using a resurfacing component in the presence of subchondral bone loss will elevate the joint line, and increases the thickness of the tibial component. Resurfacing when there is residual articular cartilage lowers the joint line. As said earlier this means that the tibial cut must be lowered to allow space for the tibial component. Raising or lowering the joint line has no effect on the overall axial alignment, as this has not been changed. However, our series shows a significant correlation between tibial radiolucent lines and lowering the tibial cut secondary to "distalization" of the femoral component from residual articular cartilage (Fig. 7). This effect was only found in medial UKRs. We recommend great care in preparing the femoral implant bed when using a resurfacing component. The alternative is to choose a resection UKR in cases where the pre-operative mFA is equal to or greater than 90°. This, however, is never the case on the lateral side where the resurfacing UKR technique works very well.

In conclusion two important objectives must be stressed:

- Re-establish the patient's original anatomy by only correcting the loss of joint space by wear, and do not correct any bony deformity.
- Restore the true tibiofemoral joint line. It is easy to define the true joint line as it is at the level of the meniscal bed.

Until recently we considered avoiding overstuffing as of primary importance and restoration of the joint

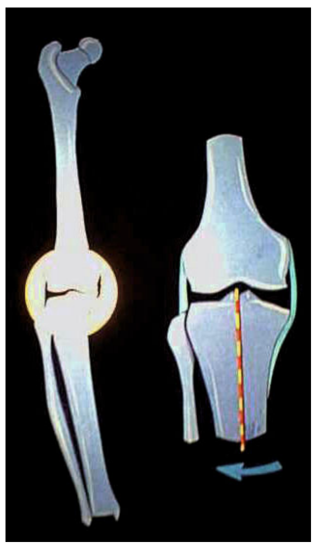


Fig. 14 –Schematic representation of the correction of medial wear.

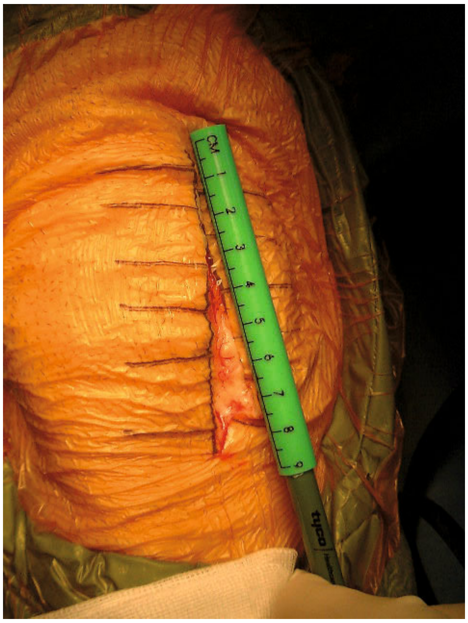


Fig. 15 – Minimally invasive approach.

line as secondary. However, following analysis of our series we realize that the latter is equally important. This has led to the view that the choice of implant (resurfacing or resection) is determined by the pre-operative radiological measurements of the mFA.

Medial UKR – the technique

Approach

Recently the minimal access approach has become standard throughout the international orthopedic community. This is not just a fashion but is eminently suited to UKR. The approach is medial parapatellar extending to the upper border of the patella (Fig. 15). If more space is needed, the muscle fibres of the vastus medialis can be divided under the skin flap (36), but not between the vastus and the rectus femoris where there is a much greater risk of damaging the quadriceps tendon. The distal end of the incision is the medial edge of the tibial tubercle. After excising Hoffa's fat pad, the patella can usually be displaced laterally leading to adequate exposure of the medial compartment. The cruciate ligaments and the lateral tibiofemoral and patellofemoral joints surfaces can then be inspected to confirm suitability for UKR.

Tibial preparation

With the HLS technique the tibial cut is performed first. The same choice is made for most other implants. There are two objectives:

(1) *To define the plane of the tibial cut according to the patient's anatomy*: To define the plane both frontally, which is in varus, and sagittally, where the slope is posterior, the joint space has to be measured in relation to the mechanical tibial axis as seen on pre-operative correction X-rays or weight-bearing long-leg film (Fig. 16). The HLS UNI (Tornier®) instrument set has an adjustable alignment guide fitted with a goniometer that can be used to set the varus plane of the upper tibia (Fig. 17). The instrument has pre-settings from 0° to 5°.

The cutting block is placed on the front of the knee, with the patella displaced. It has three holes for guide pins. These pins will subsequently be used

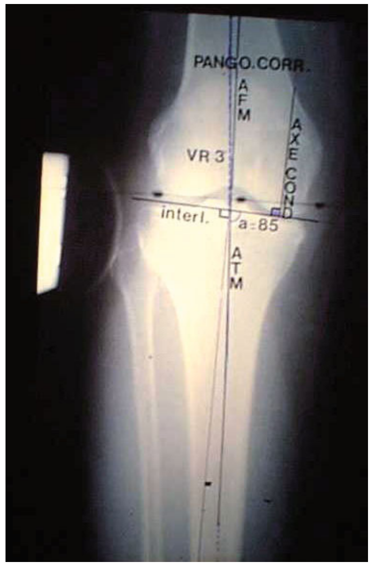


Fig. 16 – Stress X-ray allowing to design the orientation of the tibial cut.

Fig. 17 – HLS UNI Evolution (Tornier®). Tibial cutting guide with compass allowing to restitute the frontal joint line direction.

to guide the blade during tibial resection. One pin is placed in one of the most medial holes then inserted in the joint space with the knee in flexion. This pin determines the patient's tibial slope. Next a central pin is inserted to set the position of the guide to match the slope. This central fixation pin will then be used as a reference for the depth of the cut (thickness of tibial resection) (Fig. 18).

(2) *To set the level of the tibial resection*: The technique we recommend uses the pin in the joint to set the level of tibial resection. The pin which has already been inserted in the joint space to set the slope is left in position. The knee is then placed in extension and slight valgus. The central cursor is positioned up against the central pin. This is the reference point and is the distal surface of the patient's medial condyle (Fig. 19).

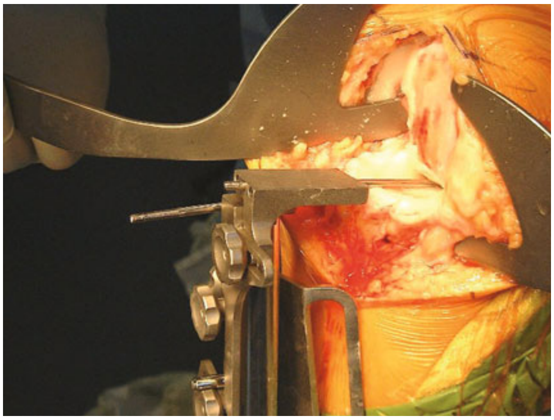


Fig. 18 – Slope is determined by the pin introduced tangentially to the tibial plateau.

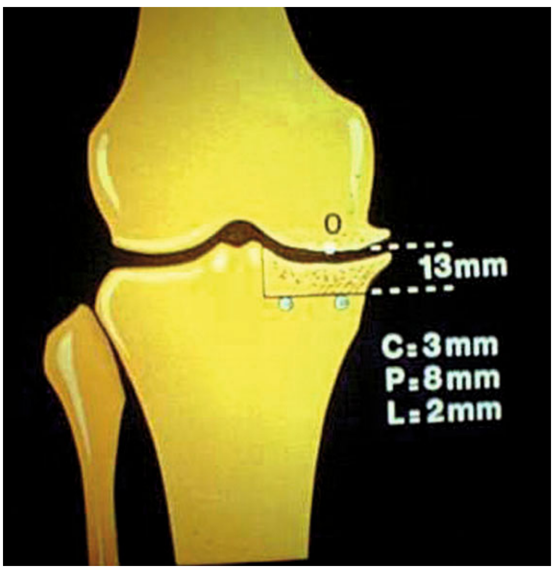


Fig. 19 – Schematic representation of the evaluation of the tibial cut with reference to the distal femur.

The knee is then moved back into flexion and the pin inside the joint is removed. The cutting plate is then lowered 14 mm as shown on the central gauge display. The height of 14 mm is the sum of the distal thickness of the femoral component (3 mm) plus the space required for the thickness of the tibial insert selected (usually 9 mm), adding a further 1 or 2 mm laxity for "safety." The total thickness is thus (with a 2 mm laxity margin) 3 + 9 + 2 = 14 mm.

The advantage of this method is that the cuts can always be altered without any risk of overfilling the joint space. Controlled ligament balance without any excess tension, and without ligament release avoids overstuffing. The disadvantage, however, is that the level of the tibial resection changes as a function of the position of the femoral component. In theory this is not a problem, but as our series showed very clearly, if there is still residual cartilage (as may occur in aseptic osteonecrosis of the femoral condyle) then there is the risk of distalizing the femoral component leading to an excessively low level for the tibial resection. This, in turn, can affect the load-bearing capacity, by reducing the surface area for the tibial component as well as loading the weaker cancellous metaphyseal bone. This, as noted earlier, increases the risk of radiolucent lines, and also of tibial collapse (37–39). Our series showed a significant correlation between the incidence of radiolucent lines and the level of the tibial cut which, in turn, correlated with distalization of the femoral component.

Our analysis of cases of medial compartment osteoarthritis has shown that the mFA is often greater than 90°. The average mF angle in our series was 91° (Table 3). In such cases wear is, in effect, minimal. If the resection only removes a few millimeters of the distal femoral cartilage then the post-operative mF angle, using a resurfacing design, is very likely to reach 93° or even more. In these circumstances, and to avoid overstuffing the medial femorotibial space, the only option for the surgeon is to over-resect the tibial plateau, with all the risks described above. When there is no exposed subchondral bone caused by wear, we recommend careful "sanding" of the femoral implant site to avoid distalization of the femoral component (Fig. 20). This preparation must be done with the knee in flexion before the level of the tibial cut is set using the pin in the joint. Of course these cases are perfect candidates for a resection unicompartmental design. However, in cases where there has been wear, producing a natural bed for the condylar component (Fig. 21), resurfacing is the best choice, and measurement of the tibial cut, using the pin, stands as the ideal option.

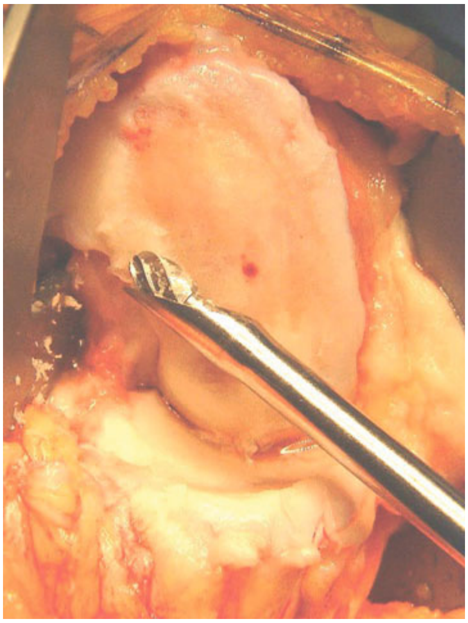


Fig. 20 – Preparation of the femoral component layer with high speed shaver.

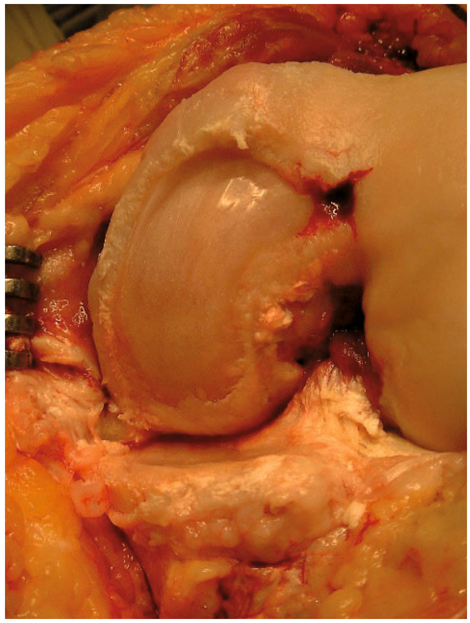
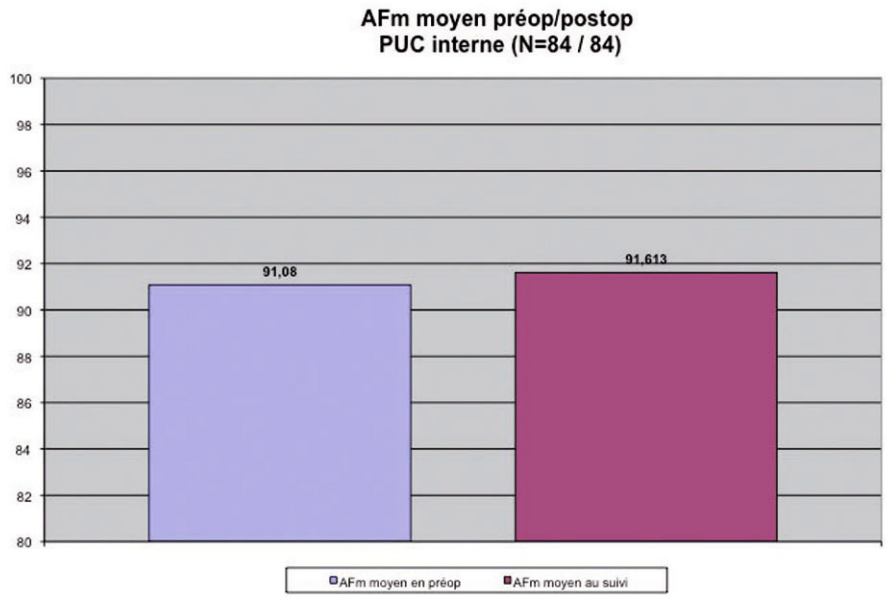


Fig. 21 – Typical aspect of the femoral wear corresponding to a perfect indication of resurfacing femoral component.

Table III



Femoral preparation

In addition to the distal (or extensor) surface preparation as stated in the previous paragraph, the femoral condyle requires a posterior cut. In osteoarthritis suitable for UKR, there is never wear on the posterior part of the femoral condyle. Chamfer cuts also need to be performed.

The preparation is done with dedicated instruments designed to fit the curve of the condyle and its anteroposterior dimensions. The HLS UNI (Tornier®) system has a range of four sizes that can be aligned anteriorly with the anterior-most point of contact of the tibial plateau on the patient's condyle. This point is located before the tibial cut is made and is marked using a diathermy. Before defining this point it is important to define the orientation of the femoral component. The component must be centered on the condyle in extension and not impinge on the tibial spines. The extension surface should lie in parallel with the frontal plane alignment of the tibial plateau, which is in slight varus. The femoral component should also be

Fig. 22 – Perfect post-operative frontal positioning of the UKA.

rotated to run along the femoral condyle's extensor surface (Fig. 22). Any impingement between the anterior part of the femoral implant in extension and the tibial spines, or, in flexion, any significant contact with the medial facet of the patella, must be avoided. Both of these problems can be avoided by proper adjustment of the position of the femoral implant and checking by rotating the tibia during flexion and extension. This is why the HLS UNI instrument set has a femoral guide that is placed between the tibial trial insert and the distal condyle in extension (Fig. 23). The instrument is of key importance as it sets the three fundamental parameters: coronal orientation, centering and rotation of the femoral component (It is even more crucial for lateral UKRs where there is a greater risk of rotation errors). The cutting block has two holes for pins, and once it is in place, can be used to set the position. The knee is placed in flexion. The cutting block is removed and replaced with a special guide that can be used to make "postage stamp" perforations of the area for implanting the anti-rotation fins of the future definitive femoral implant (Fig. 24). At this stage, slight adjustment can be made to correct centering and rotation, but caution is required. The surgeon must not be misled by any excessive obliquity of the patient's condyle. If the alignment was set in relation to the patient's condyle, the future femoral implant could be positioned with excessive internal rotation, causing impingement on the tibial spines when the knee is in extension, or with the patellar facet with the knee in flexion; precisely the problems we are trying to avoid.

There are four sizes for the posterior cutting block and chamfer covering the range needed to fit the anteroposterior dimensions of the patient's

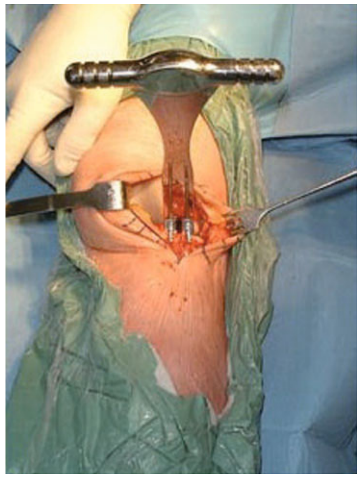


Fig. 23 – HLS UNI Evolution Femoral guide assessing the ideal disposition of the future femoral component (rotational, mediolateral, and frontal positioning).

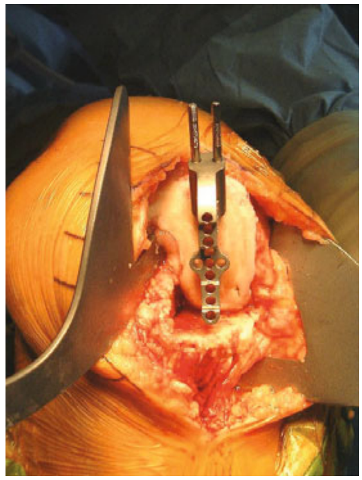


Fig. 24 – HLS UNI Evolution Femoral instrument used to make "postage stamp" for the fins.

Fig. 25 – HLS UNI Evolution Femoral instrument used to assess the coronal size.

condyle. Three basic principles must be followed (Fig. 25). There must be:

– Lateral alignment between the handle and the sagittal axis of the femur. It is essential to avoid any recurvatum.

– Perfect posterior contact between the posterior flange of the jig and the surface of the posterior condyle. Any mismatch causes inadequate resection. This results in excessive compression in flexion causing instability and the risk of tibial component lift-off.
– Smooth transition between prosthesis and trochlear articular cartilage so as to avoid impingement with the patella.

In reality there is little problem in choosing the curvature and size of the prosthesis. Once the cutting block is set in place with one or two pins, the posterior and chamfer cuts can be undertaken.

Trialling before cementation

It is essential to understand that any instability of the trial pieces cannot be compensated for by cementation. Moving the knee from flexion to extension and back without any movement of the components between implant and bone is crucial. The contact of the trial tibial bearing with the tibial cut must be exact. The tibial bearing must be stable in flexion, without any lift-off or anterior expulsion. The femoral component should not rotate in the sagittal plane in flexion (i.e., the anterior lip lifting away from the condyle). This will not occur if the posterior condylar cut is correctly aligned (Fig. 25). This imparts stability to the femoral insert and avoids any posterior protrusion of the implant's posterior condyle. By using the pin to achieve proper alignment with the patient's tibial slope (Fig. 18), there is no excessive posterior compression on the implant in flexion. If this is not avoided then it inevitably leads to early loosening and/or pain. Provided that these principles are followed, then the implants will be set in place perfectly and that lead to reliable results. Cementation does not impart primary stability but ensures reduced stress transfer between the bone and the implant. It is important to avoid using massive cement pegs to secure the prosthesis, particularly at the tibial level. By not having a keel, the risk of medial tibial plateau fracture is minimized.

Closure is performed in layers over a suction drain. The patient is able to move and put weight on the joint immediately.

Lateral UKR – the technique

The main principles are the same as for medial UKR, but a number of specific points require closer attention.

The main problems concern:

– The correction of any anomaly in the mFTA, with a greater risk of overfilling the joint space and therefore of overcorrection (Fig. 26) due to the greater structural laxity of the lateral ligament complex.
– The bone cuts which can lead to an excessively oblique angle in varus for the tibial cut and defective rotation of the condylar component (Fig. 27).

The most logical choice and most appropriate implant is a resurfacing model since the usual cause of the deformity is femoral dysplasia.

Approach

In the 1990s, Dejour recommended access by tibial tubercle osteotomy. However, our preferred technique is an anterolateral, mini-invasive approach,

Fig. 26 – Contralateral progression of arthritis due to a slight hyper correction in a lateral UKA.

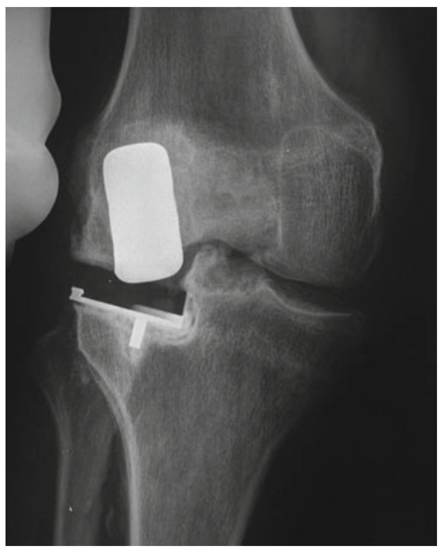


Fig. 27 – Tibial and femoral malpositioning of a lateral UKR ending to dislocation.

Fig. 28 – Cabot's leg position to improve lateral exposure and preparation.

extending the incision proximally if necessary to the junction of the fibres of the vastus lateralis. Better exposure is gained by partial resection of the Hoffa's fat pad and by positioning the knee in the Cabot, cross-legged, or figure-four position (Fig. 28).

Tibial preparation

The knee is positioned in flexion, with the patella displaced medially using a Homan-type retractor. The cutting block is placed on the extramedullary alignment rod facing the joint line. The caliper must be angled slightly downwards and 2–3° outwards to avoid a varus oblique cut. A varus cut might produce a tendency for the tibial component to slip laterally and to a medial laxity (Fig. 29). As on the medial side, a pin is placed on the femorotibial joint line, at a tangent to the lateral plateau, which can then be used to determine the slope. The same pin provides a reference point in relation to the distal condyle for setting the depth of the tibial cut.

Unlike the medial side, where there are fears of overstuffing caused by residual cartilage, this risk does not occur on the lateral side. This is because the main problem encountered is lateral condylar hypoplasia with excessive femoral valgus. In our series, the average pre-operative mF angle was 94°, and the post-operative angle was 91° (Table 4). This finding suggests that on the lateral side preference should be given to a resurfacing rather than a resection UKR.

Femoral preparation

Femoral preparation is done using the same method as for medial UKR. The problem specific on the lateral side often comes from excessive internal rotation of the lateral condyle in relation to the medial condyle. When setting rotation, choosing the long axis of the condyle with the knee flexed for alignment has an unfortunate tendency to medialize the anterior part of the femoral implant, and this causes to two complications:

Fig. 29 – Excessive tibial varus of the tibial component of a lateral UKR.

– Impingement of the lateral articular facet of the patella in flexion (40).
– A risk of impingement of the anterior part of the femoral component and the tibial spines when in extension (Fig. 29).

Therefore on the lateral side, we like to use the HLS UNI instrument set, which offers the same facility as for the medial side for adjusting the centering, the coronal positioning and rotation, but doing this in extension (Fig. 23). When moving back to flexion, no attempt must ever be made to correct any impression of excessive external rotation of the cutting block (Figs. 30, 31). Early on we learnt that to make this "correction" in flexion leads to malalignment in extension. Although it looks wrong it is important not to correct it. Cartier emphasizes the fact that the lateral osteophyte of the condyle is often the only supporting element of the anterior part femoral component and that every effort must be made to conserve it. The rest of the preparation is done using the same method and instruments as for the medial side.

At the end of the procedure, before cementing, the parts must be perfectly stable, as is in the medial side.

Conclusion

Provided that the operating technique is carried out with strict compliance to the protocol, the fixed-bearing unicompartmental prosthesis is, in our opinion, a simple and elegant solution

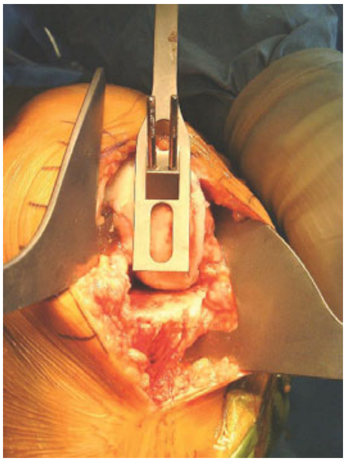


Fig. 30 – Rotation of the femoral guide in flexion in the lateral condyle.

Fig. 31 – Curious aspect of the fin preparation in case of a lateral UKR. This is nevertheless the correct rotation to avoid an impingement between the anterior part of the future femoral prosthetic condyle and the tibial spine.

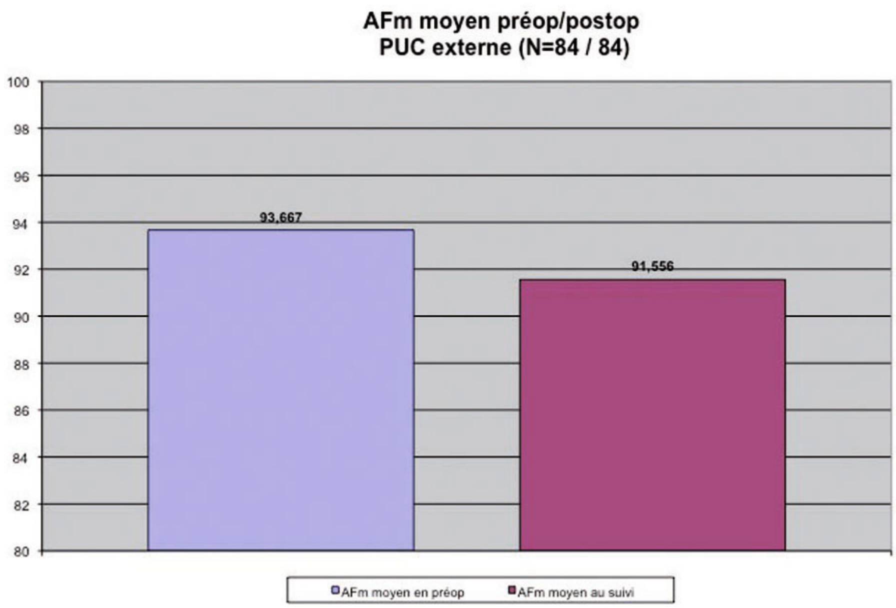


Table IV

for treating isolated unicompartmental medial or lateral tibiofemoral osteoarthritis. Studies have confirmed that the rules that we have established lead to reproducible results with at least a 10-year good clinical, functional, and radiological outcome. The great advantages over TKR are a more normal feeling knee, lower complication rates, better range of motion including the ability to squat and kneel.

There is a risk of PE wear becoming apparent between 10 and 20 years post-implantation as our follow-up time increases. However, our ideal population group is over 80 years old where this will not be a problem. In younger patients, we maintain that revision of an all-polyethylene UKR, which has avoided massive tibial resection and large tibial and/or femoral pegs, leads to a revision procedure of comparable difficulty to a primary TKR. We can recommend the Tornier® HLS UNI Evolution with its resection femoral component and all polyethylene tibial component for patients who have symptomatic isolated unicompartmental tibiofemoral osteoarthritis with intact ligaments.

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