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Cementless

Cementless Total Knee Replacement: Guidance for Best Practices

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Cementless Total Knee Replacements

1.0 Introduction

For many surgeons, this document will be their introduction to rotating platform (RP) total knee arthroplasty (TKA) and a cementless TKA. The goal of this guide is to provide insights into both techniques.

Rotating Platform (RP) total knee implants were developed in the late 1970s with the theoretical objective to minimize the polyethylene wear and aseptic loosening that was observed in fixed bearing (FB) designs available at that time. The Low Contact Stress (LCS™) Cementless TKA was designed by Pappas and Buechel and first implanted by Dr. Buechel, in 1977.[1]

The mobility of the polyethylene insert allows increased articular conformity, thereby reducing contact-induced stresses in the polyethylene.[2] Insert mobility also significantly reduces torque transmission at the proximal tibial interface[3] which, when used with a cementless implant, theoretically increases the chance of successful osteointegration at the prosthesis-bone interface, and reduces the risk of implant loosening.

In addition to reducing contact stresses in the polyethylene, RP facilitates decoupling between the femoral-insert articulation and the tibial-insert articulation. This phenomenon converts complex rotational movements into simple linear movements; flexion-extension and anteroposterior translation at the femoral articulating interface, and internal-external rotation at the tibial articulating interface. Decoupling these movements reduces cross-shear at the insert surface which, when combined with reduced contact stresses, results in less wear.[4,5,6] Also, when compared to early FB designs, backside wear is significantly reduced by the polished tibial surface.[7]

Consequently, concerns that the added articulation between the tibial base plate and tibial insert would lead to increased backside wear appear to be unfounded in simulation and retrieval studies.[5,8]

Improved function is thought to be facilitated by the mobility of the polyethylene insert. When combined with proper surgical principles (associated with soft tissue balancing), the articulating insert allows for a more physiological movement of the knee when compared to a FB TKA, although this has not been confirmed in clinical studies.[9,10]

Regarding component fixation technology, cement is predominantly used and is considered to be the gold standard by many surgeons.[11] Dalury[12] recently published "Cementless total knee arthroplasty: current concepts review" which provides an excellent synopsis. Data from the National Joint Registry for England, Wales, Northern Ireland and the Isle of Man[13] demonstrates superior results for cemented fixation (Table 3.25 shows Cementless Revision Rate of 4.15% at 10 years vs. a Cemented Revision Rate of 3.39% at the same time point), but the majority of all TKAs are fully cemented.[13,14] However, despite the concerns about cementless fixation in TKA there has been increased utilization of this technology for several reasons. In many parts of the world, total hip arthroplasty has moved successfully toward cementless fixation. In addition, advancements in implant design, surgical techniques, soft tissue balancing and bone preparation for cementless fixation, have all served to increase confidence in adapting this technology for TKA.

To date, there are few randomized controlled trials comparing the performance of cemented versus cementless TKA. Level-1 data is rare[15,16,17] and none show any superiority of one over the other.[18]

In 2013 Hopley, et al, published data that shows that the LCS Knee demonstrated higher survivorship at 10 years relative to generalizable reports from the Swedish Knee Registry, and it continues in its original form to be the model for RP total knee systems.[19] This RP system also has a long "cementless" history using POROCOAT™ Porous Coating. A recent publication demonstrates a 97.4% cumulative survivorship for a consecutive series of 500 LCS RP Knees in which all tibias (and over half of femurs) were cementless, with a minimum follow-up of 17 years.[20]

2.0 Implant Cost

The cost difference between cemented and cementless implants is a common concern voiced by both surgeons and hospital administrators, especially in the current era of bundled care. Cementless implants often command a higher price compared to cemented implants. However, this higher cost may actually be offset when considering factors such as decreased operating room (OR) time, and the cost of cement and cement mixing systems.[21]

3.0 Patient Selection

Historically, there has been a fairly conservative approach to the use of both RP and cementless TKAs. Many surgeons restrict RP use for patients with mild and correctible deformity and reserve cementless TKAs for younger patients with good bone quality and non-inflammatory joint disease. Some authors have also put restrictions on patient BMI[21,22] As a result, the severe valgus knee typically found in an older, and predominantly female patient population,[23] presents certain challenges; factors which the surgeon must carefully consider prior to performing a cementless RP TKA.

The first factor concerns soft tissue balancing and there is certainly good evidence that RP bearing spinout is more common in the valgus knee. Diamond et al[23] reported on a series of 26 cases (spinouts) in 8373 knees (0.31%), covering the time period from 1993 to 2017. During this same period, the authors changed their surgical technique and, beginning in 2001, stopped releasing both the superficial medial and lateral collateral ligaments. This change in technique reduced spinouts to 12 in 5994 knees (0.2%). The spinouts were reduced and closed with only one revision for instability and were associated with the valgus knee ($P < .01$). The authors concluded that the etiology is flexion gap instability and that the proper focus on soft-tissue balance, that is necessary with an RP TKA, can actually reduce the incidence of revision for instability when compared to a FB TKA. Therefore, the risk of spinout should not generally be used as an argument against the use of a RP in TKA; proper soft tissue balancing is the more critical issue.

The second factor is the change in biomechanical loading from the lateral to medial compartment when bringing the valgus knee to neutral alignment. Tucker et al[24] reported on a consecutive series of 275 TKAs performed for severe valgus (≥10 degrees) with minimum follow-up of 9.5 years with only one (0.36%) revision of a cemented tibia (no revisions in the cementless tibias). All femoral components (100%) were cementless and 75% of the tibiae were cementless. However, the same author[25] reported an earlier series of tibial subsidence in the valgus knee when they initially switched from a cemented to a cementless tibia. The lessons from this learning curve are outlined in Section 4.0 Surgical Process.

There is a learning curve associated with switching from a FB to a RP TKA, and from a cemented to a cementless TKA. Therefore, it is strongly recommended that less experienced surgeons performing RP TKA restrict the procedure for mild deformities. For the cementless TKA knee, the procedure should be reserved for patients with good bone quality and non-inflammatory joint disease. Many surgeons have adapted cementless TKA as a way to slowly transition fixation selection, starting with younger patients with limited deformity and good bone quality. For many surgeons such cases could represent up to 75% approximately of their Primary TKA practice.

4.0 Surgical Process

There are two surgical instrument workflow procedures available for performing TKA with the cementless ATTUNE® Cruciate Retaining Rotating Platform (CR RP) Knee System; measured resection and gap balancing. The surgical steps for both procedures are described within the surgical technique for the system, and surgeons should become thoroughly familiar with both the instruments and surgical steps before using them in the OR. Although the term “cruciate retaining” suggests that the posterior cruciate ligament (PCL) should be retained in the ATTUNE Cruciate Retaining Knee, the Instructions For Use (IFU) clearly state that it is also possible to effectively use the system, even when sacrificing both cruciates. This is often referred to as a cruciate sacrificing (CS) technique.

Cementless Total Knee Replacements

Rotating Platform:

The authors strongly recommend that the soft tissues be appropriately balanced and assessed during implant trialing and also during final implant placement, to avoid the risk of bearing spinout.[26,27]

Cruciate Retaining:

For surgeons who retain the PCL, careful attention to the proper balancing of the PCL in RP knees is essential to avoid excessive tightness and the commensurate excessive forces applied to the posterior tibia with increasing flexion. This is particularly important in a cementless TKA where a tight PCL has the potential to result in early tibial loosening. Proper balancing of the PCL in RP knees is described by Scott, et al.[27] (Figure 1)

Cruciate Sacrificing:

For those surgeons who prefer to perform a cruciate sacrificing procedure, the authors recommend that the gap balancing instruments and technique are used to avoid the increased risk of bearing spinout.[26] The term "PCL release" can be ambiguous for many surgeons because they use it to describe their technique to completely detach the PCL from its femoral insertion and thus completely sacrifice the PCL. This is in contrast to cruciate retaining surgeons who may only detach up to 25-50% of the femoral insertion of the PCL to achieve appropriate PCL balance.

Posterior Stabilization:

For those surgeons that resect the PCL, and utilize a posterior stabilized implant, the authors strongly recommend that the soft tissues be appropriately balanced and assessed during implant trialing and during final implant placement.

Surgical Considerations Pertinent to the Cementless TKA:

Many surgeons choose to operate without a tourniquet and, with the cementless TKA, it is not imperative to have a dry surface when placing the final implants. A tourniquet is, however, considered best practice when using cement. The surgical approach to performing a cementless TKA should not differ from a cemented procedure, with one exception. This single difference is to ensure that there is adequate exposure to allow the resected bony surfaces to be protected until the definitive implants are in place. When manipulating the leg to help with exposure, careful attention should be placed on protecting the cut bony surfaces, especially when using spacer blocks to assess gaps and when accessing the posterior knee for osteophyte removal.

Bone Cut Precision for Cementless Fixation:

Figure 1: Knee Balancing
Scott, et al[27] describes PCL balancing technique for Cruciate Retaining Rotating Platform TKA's.

Depending on the surgeon's preference, either the distal femur or proximal tibia can be the first bone cut. With all cementless bone cuts it is imperative that they are as precise as possible. For cutting accuracy with the ATTUNE Knee System, all resections are made using a 1.19 mm saw blade. When the bone is hard or sclerotic, there may be a tendency for the saw blade to be deflected (skive) away from the planned resection plane, resulting in an under-resected bone. To prevent this, the surgeon should pass the saw blade over the original resected surface several times until no more bone is removed. With each blade pass, it needs to be withdrawn from the bone surface, but remain within the saw capture. Since there is normally some "play" of the blade within the saw capture the surgeon should apply gentle pressure during the subsequent saw passes and in the appropriate direction, to ensure the correct resection plane. Making both the distal femoral and proximal tibial bone cuts, the tactile feel (ease or difficulty) of passing the saw through the bone is a preliminary way to determine bone quality. Additionally, the stability of the fixation pins and the force required to remove them from the bone can provide additional information about the bone quality.

Next, it is useful to check the strength of the bony surface by trying to indent it with the index finger. If this is easy to do it would be an indication that the surgeon with less experience with cementless TKA should consider using cement, while the surgeon more experienced with cementless TKA may consider using autologous bone graft. The key point is that, after making the bone cuts, it is imperative to ensure that the bone surfaces are protected, particularly in the presence of softer bone. This is even more important in cementless TKAs than when using cement. Also, when using lamina spreaders or other devices to separate the femur and tibia, care must be taken when cleaning out loose bodies and osteophytes from the posterior aspect of the knee.

5.0 Femoral Bone Cuts

Having made the definitive distal femoral cut, it is important to ensure that it is flat. This can be performed using the flat surface of an Anterior/Posterior (A/P) cutting block. Be sure the block does not rock when placed against the distal femoral cut.

With the distal femoral cut completed, the measured resection surgical workflow continues with the remaining femoral cuts. With the gap balancing workflow the femoral cuts are performed after the tibial resection.

During the preparation of the remaining four cuts to the distal femur, the stability of the A/P Chamfer Block is paramount to achieve precise cuts. There is a tendency for the cutting block to loosen during these sequential cuts due to the vibration generated by the saw blade, and the removal of the bone support resulting from each cut (especially the chamfer cuts). To help ensure stability of the A/P Chamfer Block it is ideal to keep four pins in the block while making all of the cuts. This requires the surgeon to reposition the central pins when transitioning between the anterior and posterior chamfer cuts (see Figure 2).

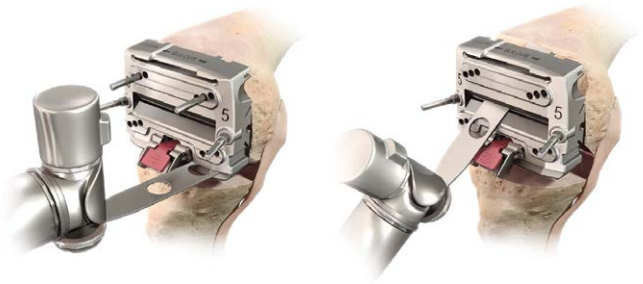

Figure 2: Correct Pinning of A/P Chamfer Block
To ensure stability of the A/P Chamfer Block it is ideal to keep four pins (2 Threaded Headed Pins obliquely, and 2 Universal or Non-Headed Pins) in the block while making the anterior and distal cuts. Remove the Universal or Non-Headed Pins and cut the remaining anterior or posterior chamfer. All resections are done using a 1.19 mm Saw Blade to maximize accuracy through the Slotted Cutting Guides.

If the pins are loosening (or backing out) while the saw is passing during any of the cuts, the surgeon should have an assistant apply additional pressure on the center of the A/P Chamfer Block to help hold it securely to the distal femoral cut surface. Also, the anterior and posterior femoral cuts should be revisited after the initial resection to avoid the effect of saw blade skiving (see Figure 3).

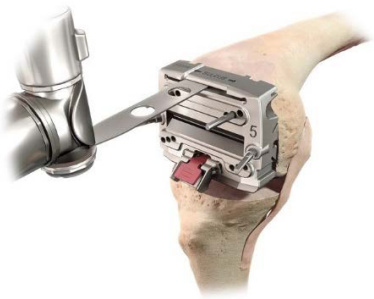

Figure 3: Recut to avoid sawblade being deflected (skive)
It is recommended to revisit the anterior and posterior femoral cuts after the initial resection to avoid the effect of saw blade skiving.

The accuracy of the A/P and chamfer femoral bone cuts can be assessed by the Femoral Cut Assessment tool provided with the INTUITION™ Cementless Instruments (see Figure 4). The Cut Assessment Tool should easily slide onto the femur. However, if force or impaction are required to insert the Cut Assessment Tool to the femur, then the femoral cuts should be revisited.

Figure 4: Use the Femoral Cut Assessment Tool to check the accuracy of the bone cuts before the Femoral Trial is introduced. Place the appropriate size Cut Assessment Tool on the medial and lateral resected surfaces and check for accuracy of the bone cuts.

The surgeon should also confirm that all finishing cuts near the trochlear and intercondylar regions are completed. Furthermore, when the trial femoral component is applied to the femur (to drill the femoral lug holes) it should go on easily and without any spring. At this stage in the procedure, when using the femoral trial, it is now time to decide whether a narrow femoral component is required to optimize the medial to lateral size of the femoral component. Achieving cortical coverage is not as crucial with the cementless femur when compared to the tibia (see Section 7.0). Consequently, regarding the femoral component fit, being just inside the femoral cortex is preferable. Being just outside the cortex may result in soft tissue irritation.

6.0 The Tibial Cut

The normal tibia has a posterior tibial slope and the ATTUNE CR RP Knee seeks to recreate that original slope. When performing a CR or CS TKA with the ATTUNE System it is recommended that the tibial slope resection be between 5 and 7 degrees, and for PS TKA with the ATTUNE System it is recommended that a tibial slope resection be between 0 and 3 degrees, with or without the use of cement. The technique may differ slightly for surgeons, depending on whether they retain or sacrifice the PCL. If the PCL is being retained, then adequate tibial slope must be achieved to help balance the PCL (as described by Scott, et al[27]), and to avoid excessive tightness and the commensurate excessive forces applied to the posterior tibia with increasing flexion. This is particularly important with a cementless tibia where early postoperative eccentric load could result in loosening. Irrespective of whether or not the PCL is retained, it is important to ensure that an adequate depth of bone is removed from the proximal tibia to 1) ensure that the tibial joint line is not raised and 2) provide an optimum surface for biologic fixation. Many surgeons, when first beginning to perform cementless TKAs, are reluctant to adequately resect the tibia because of concern about compromising the strength of the proximal tibia, however, this was not observed as a clinical issue[28]. It is important to ensure an adequate tibial resection depth as under-resecting a varus knee can leave excessively hard subchondral bone on the medial tibial plateau, resulting in a sub-optimum bony bed for cementless fixation. This may also cause the saw blade to skive (adversely affecting the flatness of the cut) and generate excessive heat which could cause thermal necrosis to the bone (see Figure 5).

Figure 5: Under-resecting a varus knee can leave subchondral bone on the medial tibial plateau, providing a sub optimum bony bed for cementless fixation, as well as causing the saw blade to skive. It is important to check tibia check, and re-cut if necessary to achieve an accurate cut.

Making a flat tibial cut is critical and therefore it is important to confirm that the tibial cut is accurate. For example, the tibial sizer should be stable when applied to the tibial surface and should not rock. The authors recommend adopting the 'Four Corner Test' as described by Witmer[29]. Figure 6 highlights this technique.

Figure 6: Four Corners Test as popularized by Leo Whiteside, M.D. Attempting to rock tibial base plate on cut surface to assess the planar accuracy of the tibial cut.

7.0 Sizing and Location of Components

When choosing the appropriate tibial component size, it is important to err on the side of "maximizing cortical coverage", even if there is a slight overhang of the tibial component. Unlike the femur, on the tibial side it is better to be 1 mm too big than 1 mm too small. Clearly, significant overhang of 2 mm or more should be avoided as it might irritate the soft tissues. A significant advantage of the ATTUNE RP Tibial Base is the ability to fine-tune the rotational alignment of the tibial component to maximize component bone coverage. This, combined with the size range, allows the ATTUNE RP Knee to achieve the highest coverage without the overhang associated with most fixed bearing designs.[30]

8.0 Spacer Blocks

With a cementless TKA, it is imperative not to force a spacer block into a tight flexion or extension gap as doing so can damage the bony surfaces, particularly with soft bone. Similarly, do not force the knee into a varus or valgus position with the spacer block in place, particularly with soft bone. Additionally, damage can also result from the over-aggressive use of laminar spreaders during a gap balancing technique or when used for exposure of the posterior knee during osteophyte removal.

9.0 Preparation of Bone Surface for Implantation

When using cement, the bone bed should be clean and dry with all superficial fat and marrow content removed using pulsed lavage. This preparation is not required for the cementless TKA. On the contrary, some surgeons that perform cementless TKAs avoid cleaning the bony surfaces and prefer to leave fat and marrow content anticipating that the osteoprogenitor cells will help induce osteointegration. It is always important to ensure that all of the bony cut surfaces are flat and free of any soft tissue during implantation of the final components. Frequently, there is residual soft tissue laterally and in the postero-lateral corner of the tibia around the popliteus which should be excised to avoid being pulled under and trapped by the tibial component during implantation. Take care not to damage the popliteus. Any soft areas of bone, which can easily be indented with the index finger, should be located. If the surgeon is going to use a cementless implant, these areas should be grafted with autologous cancellous bone chips taken from resected bone cuts. However, if the surgeon has any doubts or concerns, then a cemented TKA can be used instead. When using a bone graft a useful tip is to place the flat shaft of a chisel or osteotome on top of the graft. Then, use a hammer to gently tap on the upper surface until the grafted area blends with the rest of the flat tibial or femoral surface. On the tibial side many surgeons smear the bone slurry, that has been collected during the surgical procedure from the femoral canal, over the POROCOAT Porous Coated side of the tibial component.[31] Also, just prior to applying the tibial component, ensure there is no bone debris inside the central keel hole or the four peg holes, particularly in sclerotic bone.

10.0 Implantation of the Components

It is a recommended practice to use trials, although not all surgeons performing cementless TKA choose to do so.

The Tibial Component

When implanting the components, the authors recommend seating the tibial base plate first. At this stage the tibia will have been adequately exposed to prepare its surface. Seating the tibial base plate is best achieved by first gaining maximum knee flexion, and then using an appropriate retractor behind the tibia to

bring it forward. The distal cone of the ATTUNE Cementless RP Tibial Base has a smooth glass bead finish, allowing the surgeon to confirm alignment to the tibia before impaction. It is essential that before impaction begins, the surgeon ensures the following:

- All four pegs are aligned with the matching peg holes on the tibia, and they are clear of any bony debris
- The distance from the under-surface of the tray to the bony surface of the tibia is equal, as measured from both medial to lateral and anterior to posterior. This step requires constant re-evaluation because, as the tibia component engages the bone, any areas with hard sclerotic bone will force the tibial implant to asymmetrically descend.

As the surgeon begins the impaction process, be sure that the impactor is held firmly and flat against the tray to apply uniform pressure. The best advice is to "hit and look." This means that with each impact, a member of the surgical team visually confirms that the distance from the undersurface of the tray to the bony surface of the tibia is equal, measured from both medial to lateral and anterior to posterior. If not done properly, then the component will end up fully seated in one area only, which has the potential to affect the bone osteointegration. In general, it is advisable to use gentle impaction techniques, particularly in softer bone, to avoid a bone fracture. Continue with impaction until the implant is fully seated. This generally requires more total impactions than when implanting a cemented tibial component.

One technique, to help confirm that the tibial component is fully seated, is to use a knife blade or the tip of the electrocautery to see if there are any gaps between the tibial component and the bone. If there is a slight localized mismatch (<2 mm thick), nothing additional is usually required. If the gap is >2 mm or is over a broader area of the proximal tibia, then the surgeon can very carefully use an osteotome to elevate the component. They can then either re-impact the tibial plate, if it did not descend symmetrically, or add autologous bone graft if there is a focal defect. If the surgeon remains in doubt, a cemented component can still be used instead.

The Femoral Component

Prior to placing the femoral component on the femur, the poly insert (trial or final insert) should be placed into the tibial base. On occasion, with an obese patient, it can be difficult to engage the posterior condyles of the component onto their respective bone cuts without damaging the bony surfaces. In this situation, first impact the femoral component fully and then insert the poly insert. While it may not be common to place the components in this order, it is not particularly difficult and it can help avoid damage to the bony posterior condyles.

When positioning the femoral component, be sure the femoral lugs line up with their respective holes in the distal femur. Also, confirm that the component is not flexed. Like many modern cementless TKA systems, the ATTUNE Knee System uses divergent anterior/posterior cuts. As such, care should be taken to avoid flexion of the femoral component upon insertion. For initial placement of the femoral component, prior to impaction, it is much easier if the knee is flexed beyond 90 degrees flexion. During the femoral component impaction process, the knee should start in a high flexed position to allow for introduction and alignment of the femoral component. It should then be extended to 60-90 degrees flexion for impaction and final seating of the implant. The impaction handle should be held firmly (preferably gripping it at its base) against the femur to apply uniform pressure to both condyles. It may also help to have an assistant hold the impaction handle base to ensure uniform impaction of the femoral component. It is very important that the impaction is in-line with the femoral axis to ensure the femoral component is impacted symmetrically. As with the tibia, impaction should occur in visually monitored stages (i.e., hit and look) to ensure uniform descent of both condyles.

Usually, the cementless femoral component requires more total impactions than when implanting a cemented femoral component. This is due to the "press fit for the porous coating" on the anterior and posterior surfaces. Once it is seated on the anterior, posterior and distal surfaces, the surgeon can use the knife blade or the tip of the electrocautery device to assess if any gaps are present. The ATTUNE Cementless Knee femoral component has a 0.75 mm pressfit on the anterior and posterior surfaces. The anterior and posterior chamfer surfaces has a 0.5 mm clearance, designed to prevent the implant going into flexion. There is a peripheral rail on the chamfer surface to visually indicate that the implant is seated correctly.

11.0 Patellar Resurfacing

It is up to the surgeon to decide whether or not to resurface the patella and the choice is often dictated by peer group surgical practice. In the United States, for example, the majority of surgeons choose to resurface the patella, whereas in Europe and Asia it is a less common practice. There is strong evidence to support both practices around the world.[32,33] At this time, the ATTUNE Knee System is compatible with a cemented Medialized Dome Patella, a cemented Medialized Anatomic Patella, or the un-resurfaced native patella.

12.0 Wound Closure

There are unsubstantiated concerns that there is more blood loss in a cementless TKA. That's because the cut surfaces of the bone are not sealed by cement, which potentially allows for continued bone bleeding after the knee is closed. There is, however, no clear-cut difference in the literature to support this claim. Many surgeons have transitioned to tourniquet-free surgery which may potentially favor cementless TKAs due to concerns about cementing in a bloody bone bed. With the use of bleeding management, the postoperative bleeding is not of particular concern, and transfusion rates are substantially lower for all TKA patients (cemented and cementless). Surgeons who currently perform cemented TKAs, and do not use a drain, should not feel like they need to use one when they transition to a cementless procedure.

13.0 Postoperative Rehabilitation

There is no published evidence to show any benefit of "protected weight bearing" following a cementless TKA. For most surgeons, it is standard practice to allow full weight bearing starting from the day of surgery, with the patient using crutches or a walker, depending on their level of confidence. In fact, full weight bearing should be encouraged, if possible. The decision is often influenced by the patient's preoperative status.

Although there is no published evidence, the authors instruct their very active patients not to engage in high impact activity and avoid impact loading for a minimum of three months, to allow for completion of biologic fixation.

Despite the popularity and (almost) universal use of postoperative and, now, preoperative physiotherapy programs, there is no published evidence supporting their efficacy.[34,35,36]

There is no evidence to suggest that, during the early recovery period, a cementless TKA results in increased bleeding or pain, or increases the risk of needing a manipulation under anesthesia.

14.0 Interpreting Radiolucent Lines (RLLs) on X-Ray

Radiographic assessment of cementless TKAs requires careful patient positioning to ensure tangential views. In cementless TKA implants, if the x-rays are taken tangential to the tibial implant-bone interface, radiolucent lines on both the postoperative and subsequent x-rays will be visible. These lines are normal with cementless TKAs, and there is published evidence that they will subside over time (out to 20 years).[20,37] These lines are typically ≤1mm and tend to be in the peripheral zones 1, 4, 8 and 10 (see Figure 7 & 8).

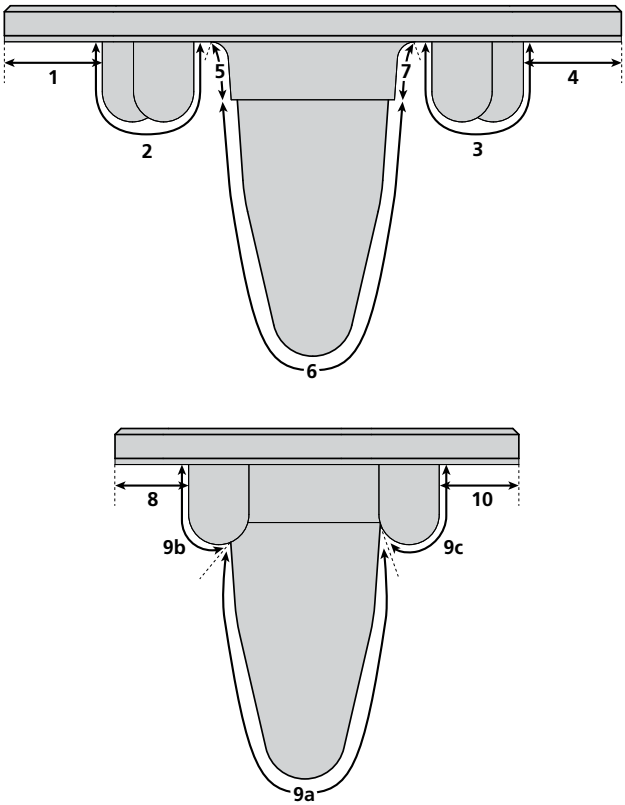

Figure 7: This is zonal radiographic analysis[38] with the ATTUNE Cementless Knee RP Tibial Base.

Figure 8: Example of faint radiolucent lines around the tibial base plate cone (zones 1and 4 on the AP and zones 8 and 10 on the lateral)

It is also quite normal to see a faint symmetrical line around the non-porous coated cone (see Figure 8). It is very important that all surgeons using a cementless implant realize that these thin lines (≤1 mm) are normal. However, many patients will experience some degree of unexplained pain following knee replacement and are tempted to incorrectly assume that such lines are the source of pain, whereas clinical experience indicates that they are in fact painless. It is important to share this information openly with the patient. If the patient was to seek a second opinion, that surgeon might reach the wrong conclusion and recommend an unnecessary revision.

15.0 Which Radiolucent Lines Should Cause Concern

Lines >1 mm do occur, but these are usually confined to a small number of zones. A RLL >1 mm that is observed in multiple, adjacent or in all zones would be unusual and could raise concerns about infection or aseptic loosening. Additionally, larger RLLs >2 mm and those which are progressive in subsequent intervals should be monitored carefully. Aseptic loosening of the tibia is very uncommon as demonstrated by the LCS RP Tibial Base with POROCOAT Porous Coating.[16] In addition, lines that progress in size and location on sequential x-rays, particularly with increasing pain, suggest infection, fibrous ingrowth, or aseptic loosening. Such findings should prompt appropriate investigations. Occasionally, there are also mild degrees of subsidence that appear, which stabilize and may not present with clinical symptoms. This would typically happen in an elderly female valgus knee. But, with the appropriate intraoperative care, it should be a rare occurrence.

Take Away Points for a Cementless Rotating Platform Total Knee Replacement

- It is normal to see RLL's ≤1mm (and isolated ≤2mm) on x-ray[16].
  Pain is common in the short term following any TKA procedure[21] and 2yr clinical outcomes have been shown to be equivalent when a cementless variant is compared to the cemented version of the same implant[16,21]
- With an RP, soft tissue balance is critical in flexion to avoid the small risk of bearing spinout.[22,26,27] If the PCL is sacrificed, we recommend a gap balanced technique.
- With PCL retention, adequate tibial slope must be achieved to help balance the PCL, as described by Scott, et al.[27] For the ATTUNE Cementless CR RP Knee, it is recommended that the slope should be between 5 and 7 degrees. It is also critical not to leave the PCL tight, to avoid the theoretical risk of early tibial loosening.
- Ensure that the cut bony surfaces are carefully protected from damage during all steps of the surgical process. Also, confirm that all bone cuts are flat by using instruments such as the Cut Assessment Tool (Figure 3) and the Four-Corners Test[29] (Figure 5).
- Final component impaction should be completed in visually monitored stages to ensure both uniform alignment during insertion and that the implant is fully seated to the bone. This is particularly important with the tibial component.

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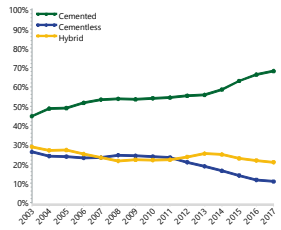
Figure KT4 Primary Total Knee Replacement by Fixation



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