Oxford® Cementless Partial Knee Replacement: Optimising Tibial Preparation

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Both the Oxford Cemented Partial Knee and the Oxford Cementless Partial Knee achieve very good results[1,2]. However the cementless device does have advantages: For example with the cementless tibial radiolucent lines are very rare whereas with the cemented about a third have complete radiolucencies and a third have partial[3]. Furthermore National Registry data from New Zealand and England and Wales suggests that the revision rate of the cementless at 5 years is about half that of the cemented[4]. The incidence of complications after cemented and cementless fixation is similar but the pattern is different[1]. Surgeons who are changing from cemented to cementless fixation should be aware of complications that could possibly be avoided.

The common early complications with the Oxford Cementless Partial Knee are related to the tibia. A spectrum of problems could occur including tibial plateau fracture and tibial subsidence. The observation that these complications tend to occur early in a surgeons experience with cementless and only occurs with some surgeons suggests that they are a result of surgical technique. The fundamental problem is that when the surface of the tibia is removed the tibia is weakened. If the technique is appropriate the bone will be strong enough to support the tibial component and with time , in our experience, the bone will remodel and fix to the tibial component. However, if the tibia is substantially weakened during its preparation complications may occur.

The surgical factors that may contribute to tibial complications are listed below. For a complication to occur multiple factors usually have to be present:

- A vertical tibial cut that is too deep posteriorly.
- A vertical cut that is too far medial.
- A horizontal tibial cut that is too distal or uneven, as may occur with a tibial recut.
- Multiple pin holes in the proximal tibia.
- A keel slot that extends too far posterior and damages the posterior cortex.
- A keel slot that is too deep or irregular.
- A trial reduction in which the tibial trial does not fully seat.
- Use of a heavy hammer to impact the tibial component.
- A tibial component that is not supported all around its rim by the cortex.

Technique

Positioning the Limb

To gain good access to the tibia the thigh should be supported with the hip flexed to about 30 degrees and the leg dependent. The leg should hang with the knee flexed to about 110 degrees. The knee must be free to flex fully and the thigh support must not be placed in the popliteal fossa as this will increase the risk of damage to the popliteal vessels.

Spoons and G-clamp

For a good quality tibial resection the tibia should not be recut. An appropriate depth of cut can accurately be achieved if the spoons, G-clamps and slotted resection guide are used correctly. With retractors removed a spoon of correct thickness is selected: The 1mm spoon should be placed centrally and assessed first. Ideally it should twist up to 20° in both directions. If it is too loose a 2mm spoon should be inserted. If this is too loose a 3mm should be used. We use a 1mm spoon in about 80% of cases. (Ensure that 2 and 3 spoons are available – if not they can be obtained from Zimmer Biomet). If a thicker spoon is used less tibia will be resected.

To avoid recutting the tibia, use the 4 G Clamp. For small patients the 3 G Clamp is acceptable. We would recommend that surgeons starting to use the Microplasty® instrumentation should use the 4 G-clamp in all patients as this makes the operation easier. Before locking the G-clamp the upper part of the tibial guide should be pushed laterally so that the cut out is in front of the tibial tubercle. We use a single headed pin in the central or lateral hole to hold the guide in place. (Firm pressure should be required to lock the G-clamp – if the locking feels loose use a different clamp and return it to Zimmer Biomet for servicing).

Tibial cuts

It is essential that appropriate saw blades are used (these can be obtained from Zimmer Biomet). In order to avoid a deep vertical saw cut we do the horizontal saw cut first. Prior to doing this cut we mark the position of the vertical cut. Using a diathermy (Bovie) identify the apex of the medial tibial spine and make a mark about 1mm medial to the apex. This line and the subsequent vertical cut will pass through the edge of the insertion of the ACL which will not significantly damage it. Traditionally we have done the vertical cut first. However if the horizontal cut is done first it is easier to ensure the tibia is not weakened. To do this the slotted zero shim and MCL retractor are inserted. Ensure the saw blade is guided along the MCL retractor to completely cut the medial and posterior cortex. The saw cut should extend about 5mm lateral to the site of the vertical cut (it does not matter undermining the tibial eminence). The slotted guide is removed and replaced with a standard zero guide. A thin shim is then inserted into the horizontal cut and pushed and held laterally. (If the specially designed shim is not available the oscillating saw blade or other thin instrument (≤0.89mm) such as an angel wing or steel rule can be used). The vertical cut is made just medial to the apex of the spine at the site of the mark, aiming for anterior superior iliac spine (or in the flexion plane). The shim prevents the vertical cut from going too deep.

Femoral Preparation

With the knee flexed to 90° and all retraction removed insert the femoral drill guide set to the same measurement as the selected G-clamp. If the femoral guide is very tight then remove about 1mm of cartilage from the posterior surface of the femoral condyle using a sharp chisel. It is better to remove a small amount of cartilage from the posterior femur rather than re-cut the tibia.

Remove the femoral drill guide, insert the IM rod, and reinsert the femoral drill guide. The drill guide should be positioned so that the 6mm hole is central on the condyle. Drill the holes and remove the guide. The slotted posterior femoral saw guide should be gently impacted. Ideally it should not touch the bone. If it is impacted hard it may tilt and, as a result, too little posterior bone will be removed.

Femoral Loosening is very rare but it can occur if the 6mm hole is damaged. To prevent damage ensure that when any instrument is placed in the hole all forces are directed along the hole and instruments are not toggled in the hole.

Tibial component selection

It is important to use as large a tibial component as possible and for the component to be supported by the cortex all around its rim without overhanging more than 1mm. The optimal size of tibial component is selected before the keel slot is made. A number of factors need to be considered when selecting the size and positioning the tibial template.

- A preliminary estimate is made by comparing its width to that of the excised tibial plateau. If the selected size is 3mm or more, the vertical cut should be repeated 2mm further laterally so that a size larger component can be used.
- A trial reduction is made to confirm that the bearing is not jammed against the vertical wall of the tibial component. If it is, the vertical cut is redone further laterally.
- A tibial template is inserted and positioned with its posterior margin flush with the posterior tibial cortex using the universal removal hook. This is done by inserting the template too deep and then pulling it forward with the hook until the hook hits the posterior cortex. (Prior to inserting the template it is worth comparing its length to the length of the excised tibia to confirm that its anterior portion is appropriately positioned). The hook is also used to force the tibial component laterally against the vertical cut.
- The tibial template should be flush with the medial cortex (ignore osteophytes) or overhanging 1mm. If it underhangs a larger size template should be inserted. If it overhangs by 2 mm or more a smaller size template should be inserted. If the tibial template is 3mm or more from the anterior cortex the vertical cut should be redone 2mm more laterally so a larger size component can be used.
- The tibial template is pinned in place, ideally using the posterior hole. Either note or mark where the front of the template lies so the component can be implanted in the same position.

Preparation of keel slot

The surgeon should hold the pin when using the keel cut saw to ensure that the tibial template does not move. If it does move the posterior cortex may be damaged. The keel-cut blade should be perpendicular to the tibial template. The keel-cut saw is introduced into the front of the slot and sunk to its shoulder. The blade is then lifted up and down as it is advanced posteriorly. Confirm the cut is complete by holding the pin and feeling the saw hit the front and back of the keel slot. Once the saw cuts are complete, remove the tibial template. If used with an up and down motion the keel-cut saw should remove all the bone necessary so the keel pick should not be used. Thoroughly wash the tibial plateau and keel slot and then insert the trial tibial component by hand. If the trial does not fully seat in the identical position to the template ensure there is no soft tissue obstructing it and give it a gentle tap with a small mallet. If the trial still does not fit, replace the tibial template and repeat the keel cut. If necessary the cementless tibial keel pick can be used to remove small bone fragments that are preventing the component from seating (the cementless pick should only be used with the template in place). A trial reduction should be undertaken.

Implantation of the tibial component

The tibial implant is assembled into the introducer. The knee is flexed fully and, using the toffee mallet, the component is then carefully impacted with the keel passing obliquely into the keel slot. The posterior part of the component should slide along the tibial surface and push soft tissue posteriorly out of the way. Before it is fully seated the introducer is removed. Using a small dissector, any soft tissue interposed between the implant and bone is pushed out. The AP position of the component is adjusted by impacting the front of the component until it lies where the template was originally positioned. (To aid this adjustment the side of the plastic cement removing chisel can be used as a punch). Final impaction of the component is achieved with the toffee mallet and the standard tibial impactor placed centrally over the keel. If the component does not fully seat this should be accepted (it is often 1/2mm proud). It will subside into place in time. Impaction with a heavy mallet may cause a fracture.

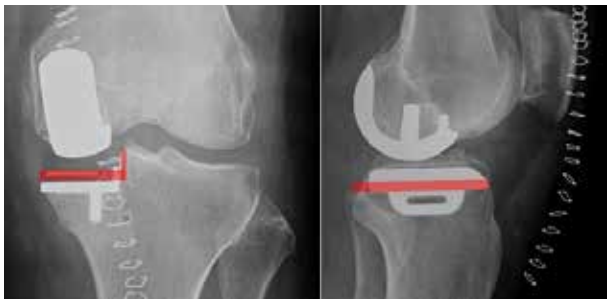

Figure 1
Post-operative radiographs of a patient that subsequently had a tibial plateau fracture showing common errors: Vertical cut too medial, Horizontal cut too distal, Tibial component not reaching the back of the tibia. The tibial component is one size too small. Its correct position is shown in red.

References

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4. The New Zealand Joint Registry Fifteen Year Report January 1999 to December 2013.

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