

European Central Marketing  
Waterton Industrial Estate  
Bridgend  
South Wales  
CF31 3XA  
+44 [0] 1656 655221  
+44 [0] 1656 645454

Responsible Manufacturer  
Biomet UK Ltd  
Waterton Industrial Estate  
Bridgend  
South Wales  
CF31 3XA  
+44 [0] 1656 655221  
+44 [0] 1656 645454

[www.biomet.com](http://www.biomet.com)

[www.oxfordpartialknee.net](http://www.oxfordpartialknee.net)

**BIOMET®**

**One Surgeon. One Patient.**





## **Oxford Partial Knee**

Surgical Technique



#### **Disclaimer**

This surgical technique document was prepared by Biomet UK Ltd with the help of and represents the opinions and surgical practices of Mr Christopher Dodd, Mr John Goodfellow, Professor David Murray and Professor John O'Connor of the Nuffield Orthopaedic Centre, Oxford, United Kingdom.

Biomet does not practice medicine and does not recommend any particular orthopaedic implant or surgical technique for use on a specific patient. The surgeon who performs any implant procedure is responsible for determining and utilising the appropriate techniques for implanting prosthesis in each individual patient.

Biomet is not responsible for selection of the appropriate orthopaedic implant or surgical technique, nor does it advocate a particular technique to be utilised on an individual patient.

This publication and all content, artwork, photographs, names, logos and marks contained in it are protected by copyright, trademarks and other intellectual property rights owned by or licensed to Biomet or its affiliates. This brochure must not be used, copied or reproduced in whole or in part for any purposes other than marketing by Biomet or its authorised representatives. Use for other purposes is prohibited.

Oxford is a registered trademark of Biomet UK Ltd.

Stablecut is a registered trademark of Synvasive Technology Inc.

# Oxford Partial Knee Surgical Technique

## Contents

The Oxford Partial Knee System	2
Femoral Components	2
Tibial Components	3
Meniscal Bearings	3
Choice of Patient	4
The Place for Partial Knee Replacement	6
The Learning Curve	6
Preoperative Planning	7
X-ray Template	8
The Operation	10
Positioning the Limb	10
Incision	10
Excision of Osteophytes	11
Tibial Plateau Resection	12
The Femoral Drill Holes	16
Femoral Saw Cut	19
First Milling of the Condyle	20
Equalising the 90° and 20° Flexion Gaps	22
Confirming Equality of the 90° and 20° Flexion Gaps	23
Preventing Impingement	24
Final Preparation of the Tibial Plateau	25
Trial Reduction	27
Cementing the Components	28
Key to Instruments	30
Appendix	33
Postoperative Treatment	33
Postoperative Radiographic Assessment	33
Radiographic Technique	33
Radiographic Criteria	34
Follow up Radiographs	36
References	37
Ordering Information	38

## The Oxford Partial Knee System

The Oxford Knee is the evolution of the original meniscal arthroplasty, which was first used in 1976<sup>1</sup>. It continues to offer the advantage of a large area of contact throughout the entire range of movement, which assures minimal polyethylene wear<sup>2,3</sup>. Since 1982, the Oxford Partial Knee (Phase 1 and 2) was mainly used to treat **anteromedial osteoarthritis**<sup>4</sup>. If performed early in this disease process, the operation can arrest the progress of arthritis in the other compartments of the joint and provide long term relief of symptoms<sup>5,18</sup>.

The Phase 3 implant is based on its clinically successful predecessors which achieved 98% survival at 10 years<sup>5,6</sup> and 93% at 15 years in an independent series<sup>13</sup> with an average wear rate of 0.03mm per year<sup>2,3</sup>.

The Phase 3 provides the following advantages:

- **5 sizes of femoral component for improved fit and reduced bone removal**
- **anatomically shaped tibial components for optimal tibial coverage**
- **re-designed meniscal bearings to minimise impingement**
- **a reproducible technique using a minimally invasive approach, which offers quicker recovery and lower morbidity**

## Femoral Components

The femoral components are made of cast cobalt chromium molybdenum alloy for strength, wear resistance and biocompatibility. The design is based upon the Phase 2 but is available in 5 sizes to provide a better fit. The sizes are parametric and have the following radii of curvature:

Extra small	20mm
Small	22mm
Medium	24mm
Large	26mm
Extra Large	28mm

The articulating surface of the femoral component is spherical and polished to a very high tolerance. The appropriate size of femoral component is chosen preoperatively by overlaying templates on a lateral radiograph of the knee.



## Tibial Components

The tibial components, also of cast cobalt chromium molybdenum alloy, are available in six sizes handed right and left. Their shapes are based on that of the successful AGC Total Knee System<sup>7</sup>. They provide greater tibial bone coverage and avoid component overhang anteriomedially, which sometimes caused postoperative pain in the Phase 2 design. The tibial keel has been altered slightly for easier implantation.



## Meniscal Bearings

The bearings are of direct compression moulded ultra high molecular weight polyethylene, sterilised in inert argon gas. The bearings have been redesigned to reduce the risk of impingement and rotation which can lead to dislocation. There are 5 sizes of bearing to match the radii of curvature of the 5 sizes of femoral component. For each size there is a range of 7 thicknesses from 3mm to 9mm. The 3mm bearings are only to be used as a 'fail safe' device with the four larger femoral components. With the extra-small femoral component, the 3mm bearing is the implant of choice.



## Choice of Patient

**There are well defined circumstances in which the Oxford medial arthroplasty is appropriate and certain criteria must be fulfilled for success. In principle, the soft tissue components of the joint and the articular surfaces of the lateral compartment must all be intact. The operation is most suitable for the treatment of anteromedial osteoarthritis<sup>4</sup>.**

Both cruciate ligaments must be intact. The posterior cruciate is seldom diseased in osteoarthritic knees but the anterior cruciate is often damaged and is sometimes absent. Since the implant is completely unrestrained in the anteroposterior plane, the stability of the prosthesis depends on an intact cruciate mechanism. Stability cannot be restored if the anterior cruciate ligament is badly damaged or absent and this deficiency is a contraindication to the procedure.

It is however appropriate to proceed if the ligament is superficially damaged, denuded of synovium or split. Posterior tibial bone loss (on the lateral radiograph), strongly suggests damage to the cruciate mechanism and, therefore, that the joint is inappropriate<sup>8</sup> for this procedure.

The lateral compartment should be well preserved, with an intact meniscus and full thickness of articular cartilage. This is best demonstrated by the presence of a full thickness 'joint space' visible on an AP radiograph taken with the joint 20° flexed and stressed into valgus<sup>9</sup>. Superficial fibrillation, marginal osteophytes and even localised areas of erosion of the cartilage on the medial margin of the lateral condyle are frequently seen at surgery and are not contra-indications to medial compartment arthroplasty.

The intra-articular deformity caused by the bone and cartilage loss must be passively correctable to neutral and not beyond. A good way to confirm this is to take stressed radiographs<sup>9</sup>.

The degree of deformity is not so important as its ability to be passively corrected by the application of a valgus force. Varus deformity of more than 15° can seldom be passively corrected to neutral and, therefore, this figure represents the outer limit. Soft tissue release should never be performed. If the medial collateral ligament has shortened and passive correction of the varus is impossible, the arthritic process has progressed beyond the stage suitable for this procedure.

Flexion deformity should be less than 15°. Partial arthroplasty has only a limited ability to improve flexion deformity. If the pre-operative deformity is excessive, it should not be employed.

The knee must be able to flex to at least 110° under anaesthetic to allow access for preparation of the femoral condyle.

Patellofemoral arthritis is not a contra-indication. Extensive fibrillation and full thickness erosions are commonly seen on the medial patellar facet and the medial flange of the patellar groove of the femur, but realignment of the limb by partial knee replacement unloads these damaged areas of the patellofemoral joint. No correlation has been found between the success of the operation and the state of the patellofemoral joint. In more than 500 cases reported by Murray et al<sup>5</sup> and Price et al<sup>6</sup>, no knee was revised because of patellofemoral problems.

Several other contraindications to partial knee replacement which have been proposed have been found unnecessary. Neither the patient's age<sup>10</sup>, weight<sup>3</sup> nor activity level<sup>11</sup> are contra-indications nor the presence of chondrocalcinosis<sup>12</sup>.

Partial Knee arthroplasty is contraindicated in all forms of inflammatory arthritis. The pathological changes of early rheumatoid arthritis can be confused with those of medial compartment osteoarthritis.

The high success rates reported<sup>5,6</sup> were achieved in patients with anteromedial osteoarthritis and they may not be achieved with other diagnoses. The Oxford implant has also been used successfully in the treatment of primary avascular necrosis, and in a few patients, combined with replacement of an absent anterior cruciate for secondary osteoarthritis<sup>14,15</sup>.

The Oxford Knee is not designed for use in the lateral compartment. The ligaments of the lateral compartment are more elastic than those of the medial and a 10% rate of early dislocation of the bearing is reported. Access through a small incision is more difficult laterally than medially. A considered opinion on the subject of lateral compartment arthroplasty using the Oxford Knee Phase 2 is given in the paper by Gunther et al is recommended that the fixed bearing, (Vanguard M), partial knee replacement is used instead<sup>16</sup>.

The final decision, whether or not to perform partial knee arthroplasty, is made when the knee has been opened and directly inspected.

## The Place for Partial Knee Replacement

In cases of osteoarthritis, partial knee replacement competes with upper tibial osteotomy at one end of the disease spectrum and with total condylar joint replacement at the other.

It has the advantages over tibial osteotomy of providing more certain relief of pain, quicker recovery, and better long term survival, in appropriate cases.

It has the advantage over total replacement of providing more physiological function, better range of movement and quicker recovery. Nevertheless, patients who require knee replacement and who do not fulfil the above criteria are better treated by total knee arthroplasty.

Using the criteria given above, about one in four osteoarthritic knees requiring replacement are suitable for Oxford medial partial arthroplasty<sup>19</sup>.

## The Learning Curve

This Surgical Technique should be used in association with the Instructional DVD of the operation (available from Biomet UK Healthcare Ltd). As with other surgical procedures, errors of technique are more likely when the method is being learned. To reduce these to a minimum, surgeons are strongly recommended to attend an Instructional Course on the Oxford Partial Knee before performing any operation.

## Preoperative Planning

The trays containing the tibial instruments and trial components are used with all sizes of femur (Figure 1).

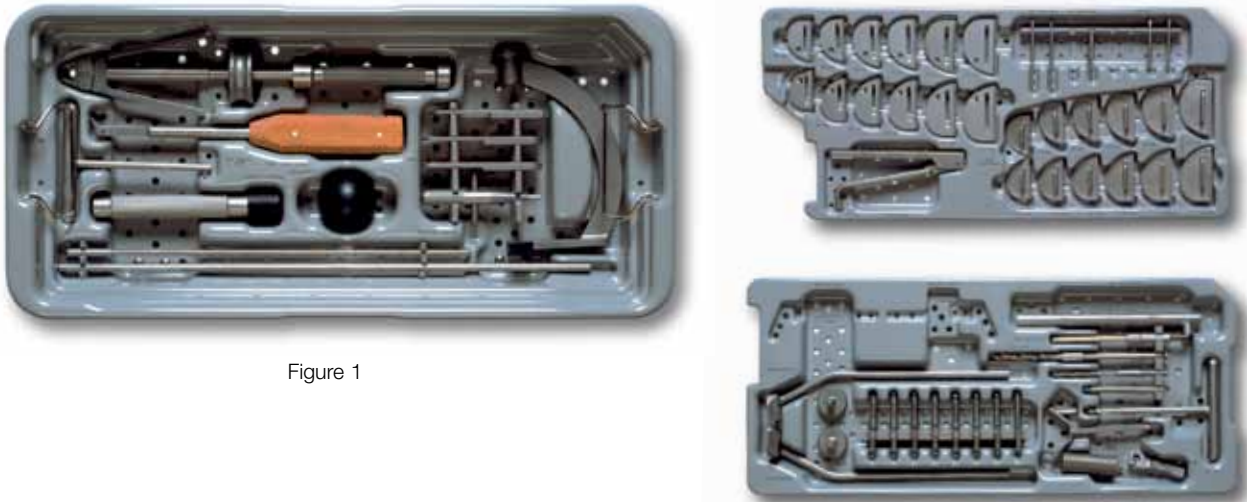


Figure 1

The five sizes of femoral component have different radii of curvature. For each femoral size there is a matching set of meniscal bearings in seven thicknesses, from 3mm to 9mm. There is a separate tray of femoral instruments and trial implants for each femoral size (Figure 2). The trays are colour coded and each contains instruments and trial components specific for one size of femoral component.



• Femoral size extra small



• Femoral size small



• Femoral size medium



• Femoral size large



• Femoral size extra large

Figure 2

# X-ray Template



## OXFORD UNICOMPARTMENTAL KNEE PHASE 3

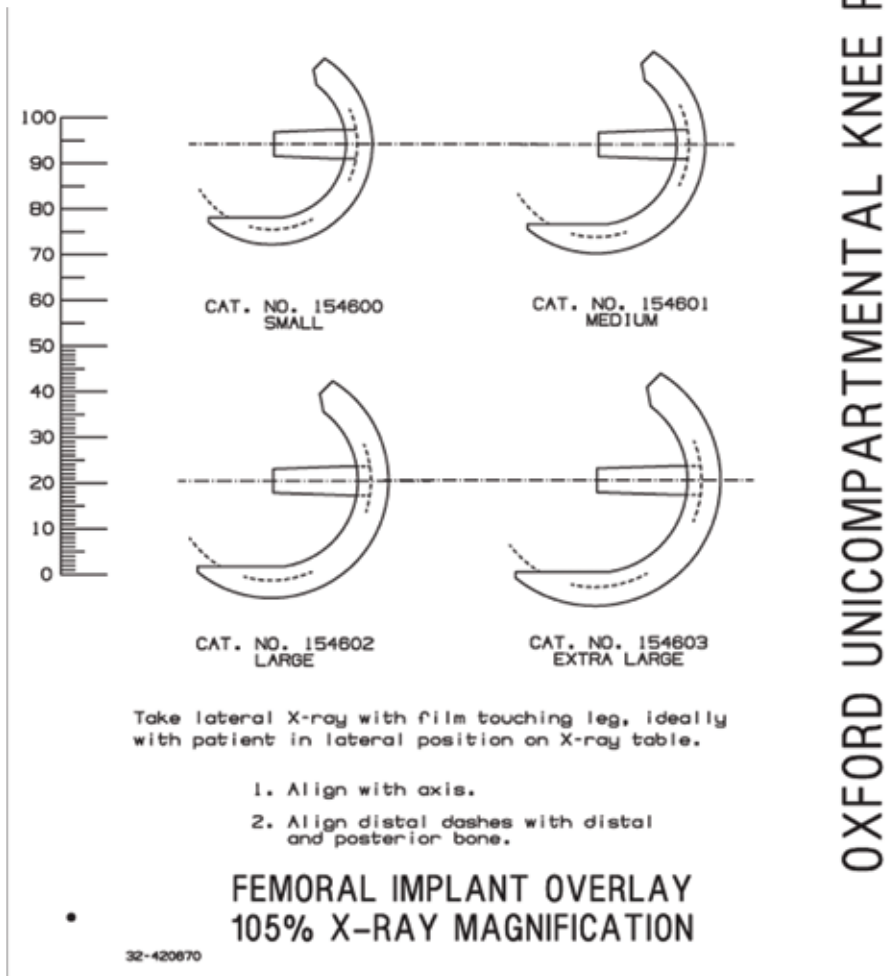


Figure 3

The size of femoral component should be chosen preoperatively using the X-ray template (Figure 3). A true lateral radiograph is required. It should be made with the film cassette touching the lateral side of the knee with the X-ray source 1m from the medial side of the knee. This gives a magnification of approximately 5%. If films are taken in this way, the template marked 105% should be used. Digital images should be printed at 100% for templating.

The outlines on the template are applied to the X-ray image of the medial femoral condyle. The line along the central peg of the implant should be parallel with the long axis of the femoral shaft. The outer surface of the diagrammatic component should lie about 3mm outside the radiographic bone image, both distally, in the region of the peg, and posteriorly to allow for the thickness of articular cartilage. The ideal component is one that overhangs the bone posteriorly so it will be flush with the remaining articular cartilage (Figure 4).

A medium size femoral component is appropriate for most patients. It was, in fact, the only size used in the Phase 1 and 2 implants.

However, in small women, it is better to employ the small size and, in large men, the large size. The extra-large and extra-small are rarely used. If there is doubt between small/medium, or large/medium it is recommended to use the medium. Similarly, if there is doubt between the extra-small and the small, or between the extra-large and the large, use the small or the large.

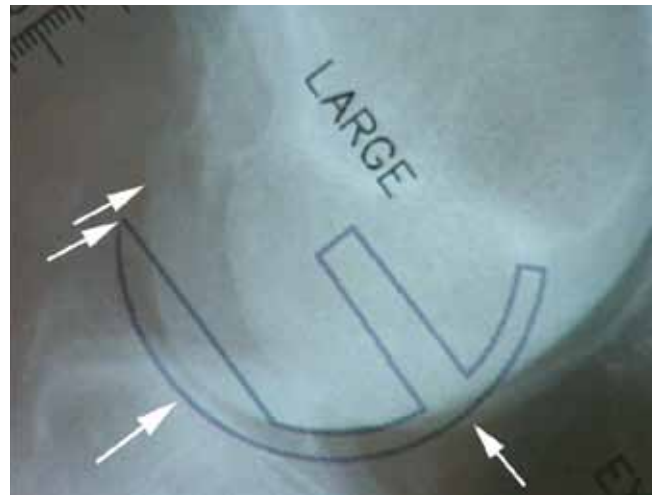


Figure 4

## The Operation

### Positioning the Limb

A thigh tourniquet is applied and the leg is placed on a thigh support with the hip flexed to about 30° and abducted, and the leg dependent. The knee must be free to flex to at least 120° (Figure 5). The thigh support must not impinge in the popliteal fossa.

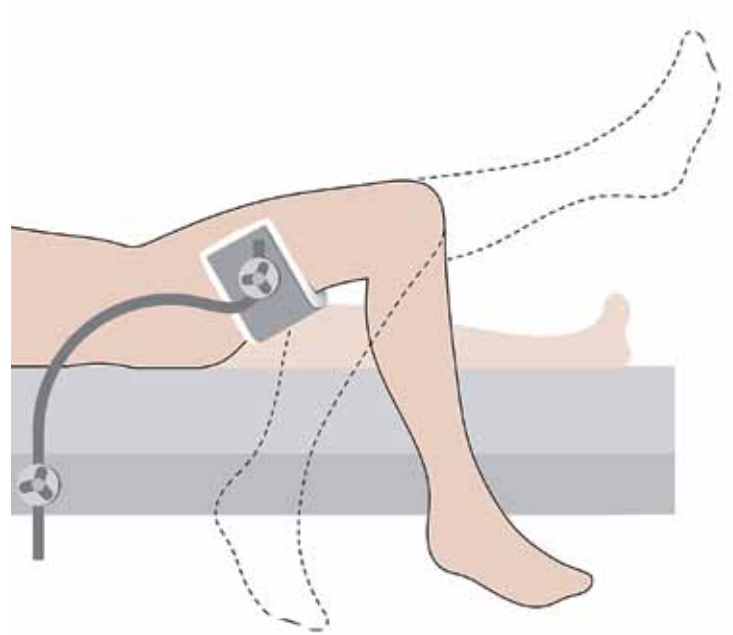


Figure 5

### Incision

With the knee flexed to 90°, a paramedial skin incision is made from the medial margin of the patella to a point 3cm distal to the joint line just medial to the tibial tubercle (Figure 6). The incision is deepened through the joint capsule. At its upper end, the capsular incision is extended proximally for 1 to 2cm into the vastus medialis.

Part of the retropatellar fat pad is excised and the anterior tibia is exposed. Self-retaining retractors are inserted into the synovial cavity.

The anterior cruciate ligament can now be inspected to ascertain that it is intact. Note that absence of a functioning ACL is a contra-indication and the operation should be abandoned in favour of a total knee replacement.

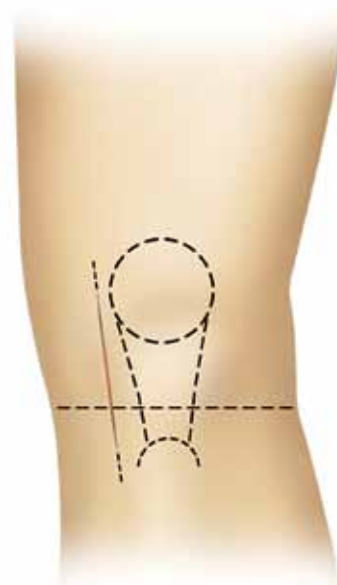


Figure 6

## Excision of Osteophytes

Large osteophytes must be removed from the medial margin of the medial femoral condyle and from both margins of the intercondylar notch (Figure 7). The assistant extends and flexes the knee, moving the incision up and down, so that the various osteophytes come into view.

Large patellar osteophytes should be removed to improve access.



Figure 7

A narrow chisel (6mm) is needed to remove the osteophytes from **beneath the medial collateral ligament** (Figure 8) and from the **posterolateral margin of the medial condyle** (to make room to insert the saw blade into the intercondylar notch at the next step). When removing osteophytes from the postero-lateral margin of the medial condyle, the chisel should be directed towards the femoral head.



Figure 8

## Tibial Plateau Resection

The front of the tibia is exposed in the lower part of the wound from the tibial tubercle to the rim of the plateau. Large osteophytes are removed from the anterior tibia as they interfere with seating of the tibial saw guide. As much as possible of the medial meniscus is excised.

**Do not 'release' any of the fibres of the medial collateral ligament.**

The tibial saw guide is applied with its shaft parallel with the long axis of the tibia in both planes (Figures 9 & 10). This will make the horizontal tibial saw cut slope backwards and downwards 7°. The guide should remain in the saggital (flexion) plane when the knee is flexed and extended.

The upper end of the guide is manipulated so that its face lies against the exposed bone. It should be pushed laterally so that the recess accommodates the patellar tendon laterally (Figure 9), and in a thin patient, the skin.

The level of resection is estimated and varies with the depth of the tibial erosion. Normally, the saw cut should pass 2 or 3mm below the deepest part of the erosion (Figure 12). If the erosion is deep, the saw cut should pass through its base. It is better to be conservative with the first cut as the tibia can be easily re-cut if too little bone has been removed. Having decided the level, the guide is fixed to the bone with a nail passed through the lower set of holes in its head. One nail should have a head and the other not.

A stylus is now available which references off intact posterior cartilage. The stylus must be placed on the retained cartilage and not the meniscus. This is best done under direct vision with the joint slightly distracted with a lamina spreader.



Figure 9



Figure 10



Figure 10a

A reciprocating saw with a stiff narrow blade is used to make the vertical tibial saw cut. The blade is pushed into the intercondylar notch and must lie against the lateral margin of the medial femoral condyle (from which the osteophytes were removed). The saw cut should be medial to the origin of the ACL avoiding damage to its fibres. The blade is pointed towards the head of the femur (Figure 11), the position of which is demonstrated by the assistant who palpates half way between the pubic tubercle and the anterior superior iliac spine.

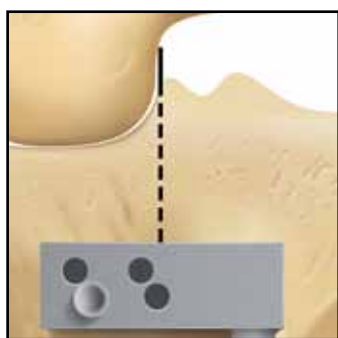


Figure 11a

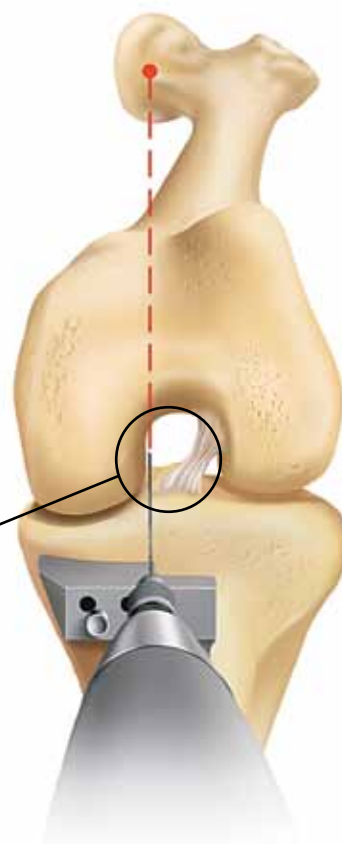


Figure 11

The saw must reach to the back of the tibial plateau and a little beyond. The saw cuts vertically down until it rests on the upper surface of the saw guide (Figure 12). The handle of the saw must not be raised as a deep cut posteriorly will weaken the posterior cortex.



Figure 12

Before making the horizontal cut, a retractor is inserted between the tibia and the medial collateral ligament to protect the deep fibres of the ligament from damage.



Figure 13

A 12mm wide oscillating saw blade is used to excise the plateau (Figures 13 & 14). It is recommended that the Synvasive Stablecut blades are used. It has to be ensured that the blade goes right to the back of the joint. When the plateau is loose, it is levered up with a broad osteotome and removed. Soft tissue attachments posteriorly may need to be cut with a knife. The posterior horn of the medial meniscus can now be removed.

The excised plateau will show the typical lesion of anteromedial osteoarthritis; eroded cartilage and bone in its mid- and anterior parts and preserved cartilage posteriorly (Figure 15). Osteophytes around the edge of the plateau remain attached to it when it is removed.



Figure 14

The excised plateau is used, with the tibial templates, to choose the size of the tibial implant by laying templates of the **opposite side** on its **cut surface**. The ideal size is one that has the correct width.



Figure 15

The thickness of bone removed from the tibia must be enough to accommodate the tibial template, and a bearing at least 4mm thick. (In a very small patient it is acceptable to use a 3mm bearing.) To check that sufficient bone has been excised, insert the tibial template and a 4mm feeler gauge (Figure 16). **Note that whenever a feeler gauge is used to measure a gap, the retractors are removed.** If they are left in, they have the effect of tightening the soft tissues which artificially diminishes the gap.

If the 4mm gauge cannot be inserted, or feels tight, then more bone needs to be excised from the tibia.

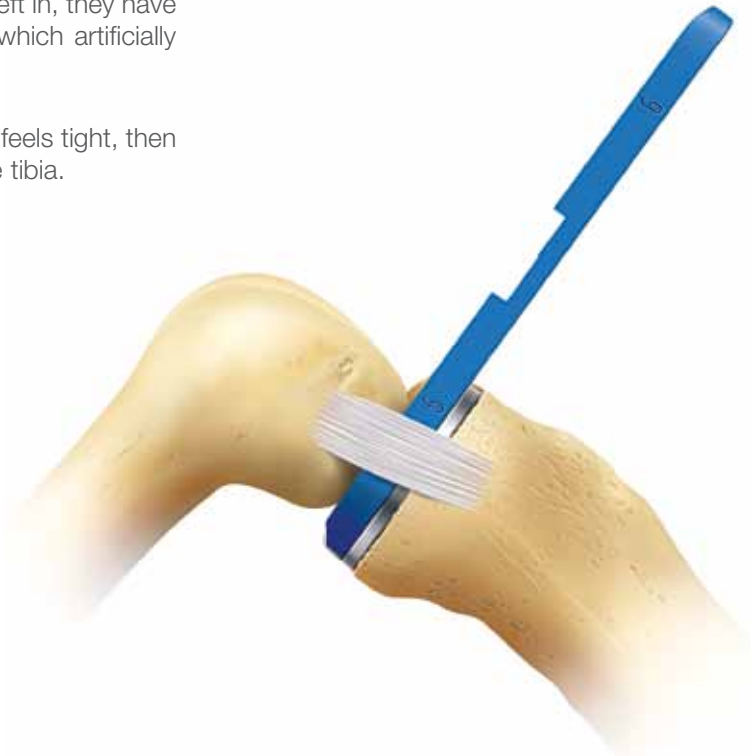


Figure 16

To excise more bone, the **headed nail** and the tibial saw guide are removed. The guide is then replaced, with the headless nail passing through one of the upper holes. The headed nail is then replaced adjacent to it (in its original bone hole). This displaces the saw guide 3mm distally (Figure 17). A further layer of bone is removed and the gap is rechecked, with the tibial template in place, to ensure that the 4mm feeler gauge can now be easily inserted.



Figure 17

## The Femoral Drill Holes

With the knee in about 45° flexion, a hole is made into the intramedullary canal of the femur with the 5mm awl (Figure 18).



Figure 18

The hole must be situated 1cm anterior to the anteromedial corner of the intercondylar notch (Figure 19). It should be directed towards the anterior superior iliac spine.

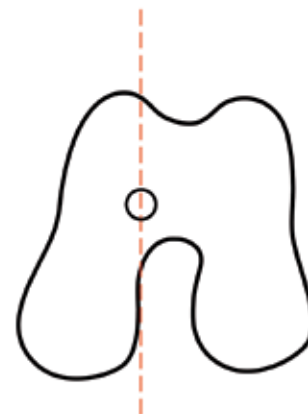


Figure 19

Insert the intramedullary rod until the rod pusher is stopped against the bone (Figure 20).



Figure 20

The knee is then flexed to 90°. This must be done with care as the medial border of the patella abuts against the rod which now acts as a retractor.

Replace the tibial template, insert the femoral drill guide and place a feeler gauge, 1mm thinner than the flexion gap between them (Figure 21). **The feeler gauge must be touching the vertical wall of the tibial template.**

**The 6mm drill hole should lie near the centre line of the femoral condyle, i.e. in its central third,** but not necessarily ON the centre line. If it is not in the middle third, the position of the instruments should be checked. A common problem is that the feeler gauge is not touching the vertical wall. To facilitate this, osteophytes and some cartilage can be removed from the postero-medial aspect of the the femoral condyle. Occasionally, the position of the tibial plateau is wrong and the site of the vertical tibial saw cut should be revised.

**The handle of the femoral drill guide should be aligned parallel with the long axis of the tibia (Figure 20) and its anterior face must touch the femoral condyle (Figure 22).**



Figure 21

By adjusting the degree of flexion of the knee, **the upper surface of the drill guide is made to lie parallel with the IM rod when viewed from the side (Figure 22).**

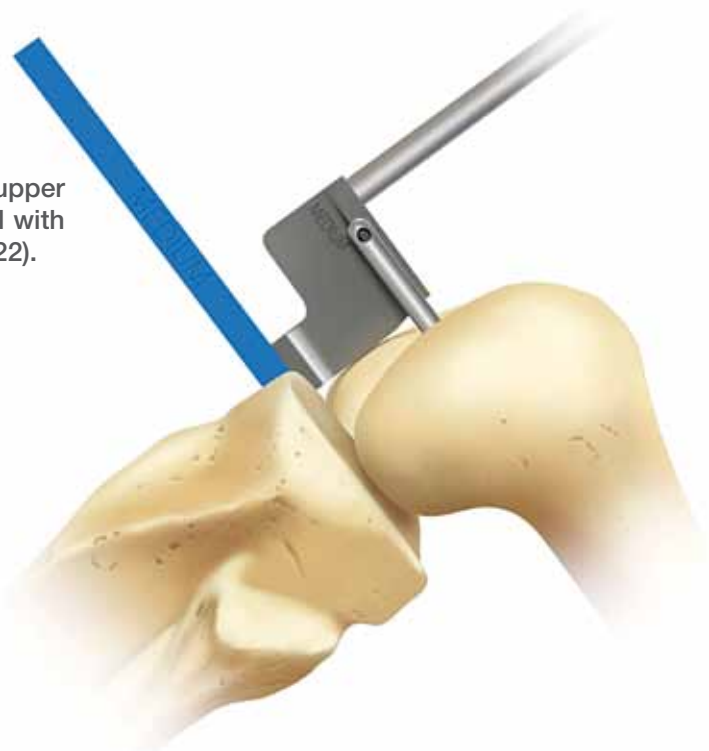


Figure 22

By internally and externally rotating the tibia, the **lateral surface of the 7° fin on the side of the drill guide is made to lie parallel with the intramedullary rod** when viewed from above (Figure 23).

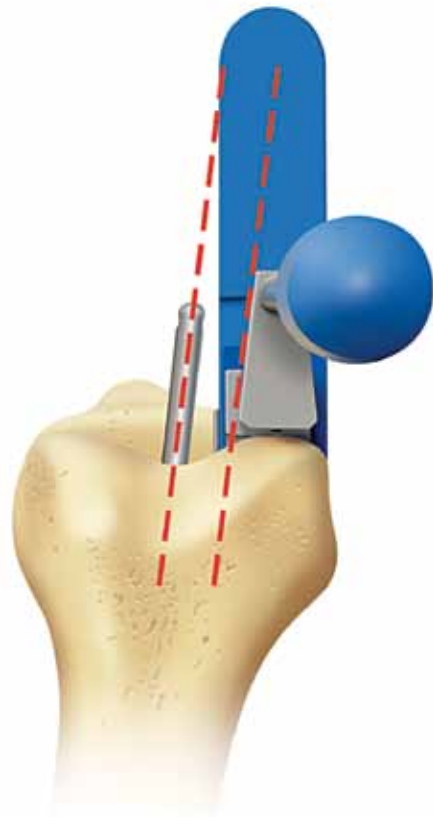


Figure 23

When all these 6 requirements are fulfilled, the 4mm drill is passed through the upper hole in the guide, drilled into the bone up to its stop and left in place. All alignments are confirmed. The 6mm drill is then drilled through the lower hole in the guide up to its collar (Figure 24).

Both drills and all instruments are removed. The intramedullary rod can be removed with the universal removal hook. It is possible to use the extra medullary guide instead of the intramedullary rod. If this is done, the patella must be retracted laterally so that it does not impinge on the drill guide.

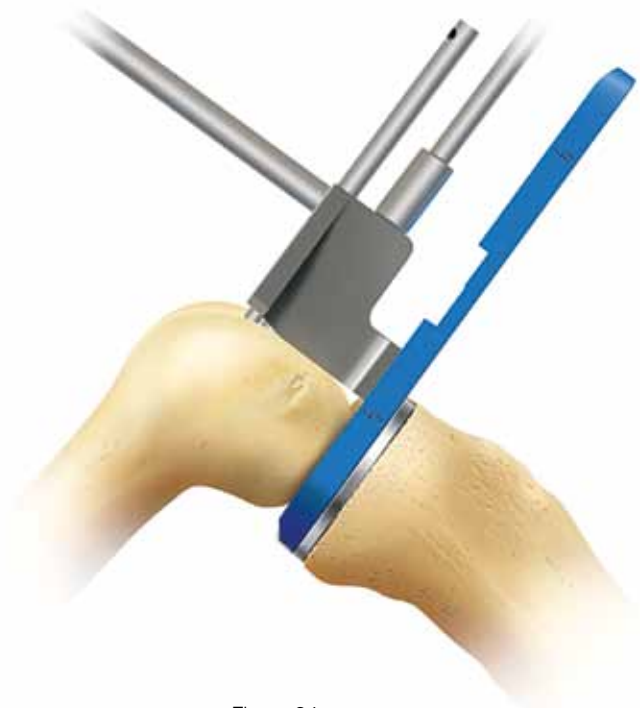


Figure 24

## Femoral Saw Cut

The femoral saw block is inserted into the drilled holes and tapped home (Figure 25).



Figure 25

Using the 12mm broad sagittal saw, the posterior facet of the femoral condyle is carefully excised, guiding the blade against the underside of the saw block, (Figure 26). Care must be taken to cut parallel to the guide and to avoid damage to the medial collateral and anterior cruciate ligaments. Both slotted and unslotted guides are available. If the unslotted guide is used, the accuracy of the cut should be confirmed by placing a chisel along the guide and cut bone.

The saw guide is removed with the slap hammer extractor ensuring that it is withdrawn in line with the femoral drill holes, so as to not damage them.



Figure 26

There is now good access to the back of the joint and any remnants of the medial meniscus should be completely removed. The posterior horn of the meniscus should be completely excised and a small cuff of meniscus left medially, to protect the medial collateral ligament from the components.

## First Milling of the Condyle

### Measurement with Feeler Gauges and Spigots

The numbers marked on the feeler gauges and the meniscal bearings represent their least thickness in millimetres.

The scale of numbers of the spigots is in 1mm steps, in inverse ratio to the thickness of their flanges.

The spigots are used as described below:

- First milling

The 0 spigot is always used first. It is designed to remove sufficient bone to allow the femoral component to seat. It establishes a “zero” from which succeeding measurements are made.

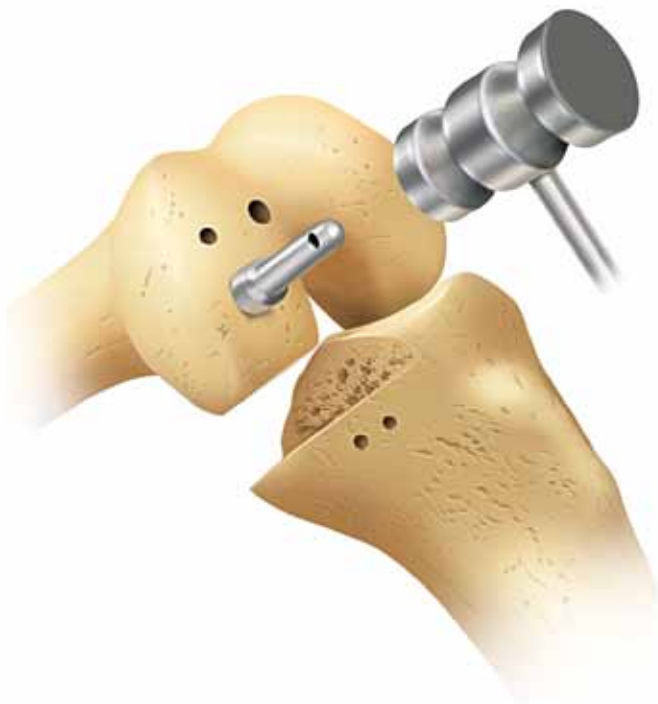
- Second milling

The spigots (numbered 1 to 7) allow bone to be removed in measured quantities (in mm) from the level of the first mill-cut. The number 3 spigot removes 3mm, the number 4, 4mm etc.

- Subsequent milling

If the last spigot used was a number 3, a number 4 spigot will remove a further 1mm of bone (i.e. a total of 4mm since the first milling). If the last spigot used was a number 4, a number 5 spigot is required to remove 1mm of bone (i.e. a total thickness of 5 mm since the first milling).

The spigot number represents, therefore, the **total** thickness of bone it removes from the level of the first (0) mill-cut.



Insert the 0 spigot (the one with the thickest flange) into the large drill hole and tap it home until its flange abuts against the bone (Figure 27).

Figure 27

By extending the knee to about 60°, and retracting the soft tissues, the spherical mill can be manoeuvred onto the spigot (Figure 28) and into the wound so that its teeth touch the bone (Figure 29). To avoid trapping soft tissues, do not start the mill until it is touching bone.



Figure 28

When milling, push firmly in the direction of the axis of the spigot taking care not to tilt the tool. Mill until the cutter will not advance further, and the spigot can be seen, in the window, to have reached its endstop.



Figure 29

**If in doubt continue to mill; the mill cannot continue beyond the amount permitted by the collar of the selected spigot.**

Remove the mill and the spigot and trim off the bone protruding from the posterior corners of the condyle which lie outside the periphery of the cutting teeth, (Figure 30). These corners should be removed tangentially to the milled surface and not parallel to the posterior surface. Also remove the small collar of bone that lies beneath the flange of the spigot and escaped milling.



Figure 30

## Equalising the 90° and 20° Flexion Gaps

With the leg in 90° of flexion, insert the tibial template and apply the femoral trial component to the milled condyle, tapping it home with the femoral impactor, which should be aligned at 45° to the femoral axis. All retractors must be removed when the gaps are measured.

a) The **90° flexion gap** is now carefully measured with the feeler gauges (Figure 31). The tibial preparation has already ensured that the gap is wide enough to accept at least the 4 mm gauge. The gauge thickness is correct when natural tension in the ligaments is achieved. Under these circumstances the feeler gauge will slide in and out easily but will not tilt.

b) **The gauge is removed.** It is important to remove the feeler gauge before extending the knee because, at this stage, the extension gap is always narrower than the flexion gap. **If it is left in place, the gauge may stretch or avulse the ligaments as the knee extends.**

c) The **20° flexion gap** is measured next (Figure 32) with the knee in 20° of flexion not full extension. Note that in full extension, the posterior capsule is tight and its influence gives a false under-measurement. The 20° flexion gap is usually less than 4mm, so either the thin plastic or metal feeler gauges are used to measure it. If the 1mm gauge cannot be inserted, the gap is 0mm.



Figure 31

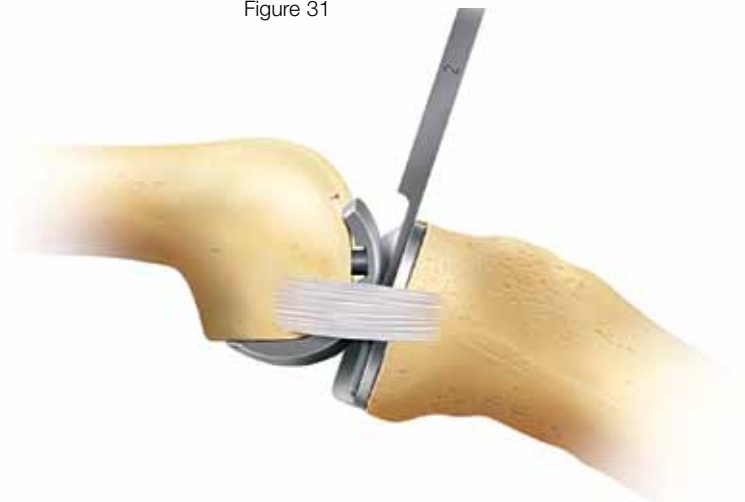


Figure 32

The formula for balancing the 90° and 20° flexion gaps is:

$$\mathbf{90^\circ \text{ flexion gap (mm) - 20^\circ \text{ flexion gap (mm) = thickness of bone to be milled from the femur (mm) = spigot number to be used.}}$$

For instance, if the 90° flexion gap measured 5mm and the 20° flexion gap 2mm, then the amount of bone to be milled is 3mm. To achieve this, insert a number 3 spigot and mill until the cutter will advance no further.

After each milling, it is necessary to remove the bone left at the posterior corners of the condyle (Figure 30). Also, if a collar of bone is left under the flange of the spigot, it should be removed. The reference for the spigot will not be lost as its tip continues to reference off the bottom of the drill hole.

## Confirming Equality of the 90° and 20° Flexion Gaps

With the tibial template and the femoral trial component in place, re-measure the gaps. They will usually be found to be the same (Figures 33 & 34).

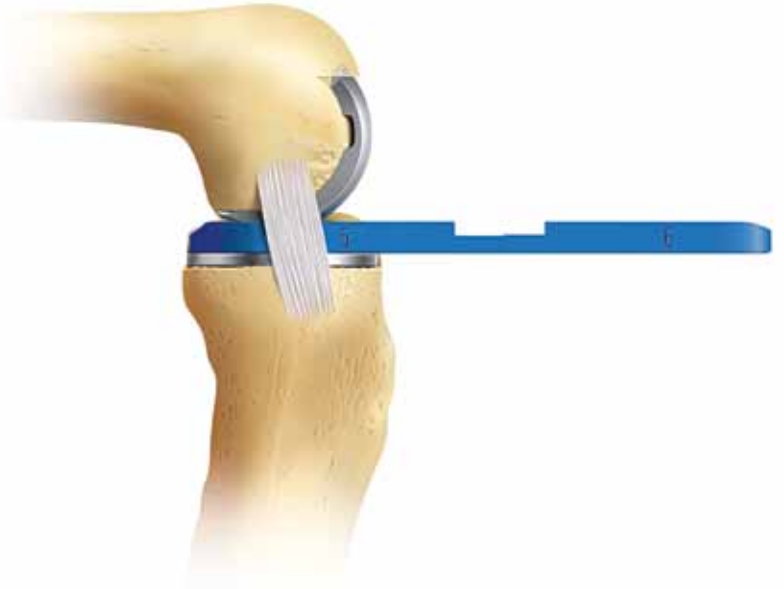


Figure 33

If the 20° flexion gap is still smaller than the 90° flexion gap, remove more bone with the mill. This can be done, 1mm at a time, by using the sequence of spigots. In the example above, a further 1mm of bone could be removed by using a number 4 spigot. Do not hammer the spigot in if the collar of bone around the hole has been removed, as this will destroy the reference at the bottom of the hole.

Usually the gaps are balanced with a 3 or 4 spigot.



Figure 34

## Preventing Impingement

Final preparation of the femur requires trimming of the femoral condyle anteriorly and posteriorly to reduce the risk of impingement of bone against the bearing in full extension and full flexion.

Anteriorly, a chisel is used to remove about 5mm of bone to provide at least 3mm clearance for the front of the bearing in full extension (Figure 35).

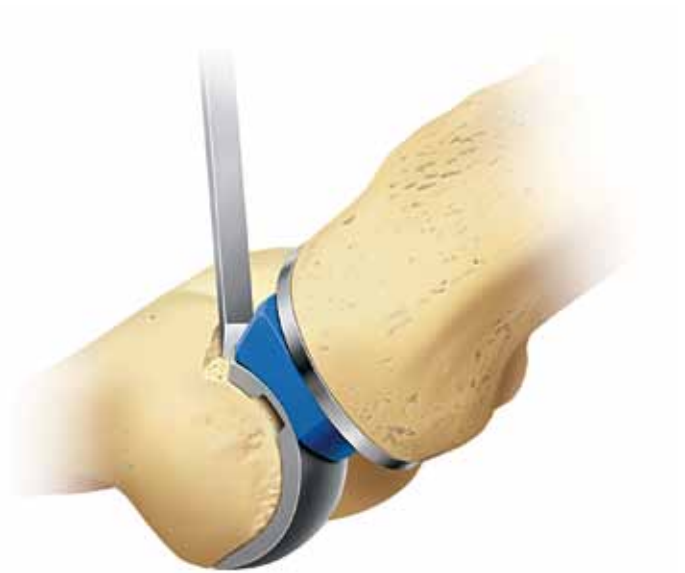


Figure 35

The femoral trimming guide is applied to direct the posterior osteophyte chisel (Figure 36) so that it detaches all the osteophytes. The guide and osteophytes are removed, and a finger is inserted to confirm that the clearance is complete. A slotted guide is available which facilitates positioning of the chisel.



Figure 36

## Final Preparation of the Tibial Plateau

The tibial plateau is examined to ensure that there are no large marginal osteophytes medially. If there are, they should be removed taking care not to damage the MCL.

The tibial template is inserted and located with its posterior margin flush with the posterior tibial cortex. The universal removal hook, passed over the posterior margin of the component and the tibia facilitates this. The sizing of the tibial component is checked and altered if necessary. **Medially and posteriorly** the edge of the component should be aligned with the cortex or should overhang by up to 2mm. A correctly sized and positioned component usually does not reach to the anterior cortex.

The template is fixed with the tibial template nail (Figure 37). Cuts 1cm deep are made with a reciprocating saw blade along both sides of the slot in the tibial template. A third, oblique saw cut in the slot facilitates removal of eburnated bone. Take care that the cuts are no deeper than 1cm.



Figure 37

After removing the template, the groove is excavated to the correct depth by scooping out the bone with the blade of the tibial groove gouge, taking care not to damage the anterior and posterior cortices (Figure 38). The safest way to prepare the back of the groove is to feel the posterior cortex with the gouge and then move it forward 5mm before pushing it down into the bone and drawing it forward to empty the slot.



Figure 38

The tibial trial component is inserted and tapped home with the tibial impactor (Figure 39).

Ensure that it is flush to the bone and that its posterior margin extends to the back of the tibia. Note where the anterior edge of the implant lies relative to the tibia so that the definitive component is in the same place.

During impaction of the tibial implant, only a light hammer should be used, to avoid the risk of plateau fracture. If the component does not seat fully it should be removed and the keel slot cleaned out again.



Figure 39

## Trial Reduction

Insert the tibial and femoral trial components ensuring that they are fully seated by tapping them home with the appropriate impactors (Figures 40 & 41). The femoral impactor should be used at 45° to the femoral axis.



Figure 40

Insert a trial meniscal bearing of the chosen thickness (Figure 42).

It is only at this stage that a trial bearing is used. Previously, feeler gauges have been used to measure the gaps because they do not stretch the ligaments. The meniscal bearings have a 3mm high posterior lip which, after multiple insertions, may stretch the ligaments.



Figure 41

With the bearing in place, the knee is manipulated through a full range of movements to demonstrate stability of the joint, security of the bearing and absence of impingement. The thickness of the bearing should be such as to restore the ligaments to their natural tension so that, when a valgus force is applied to the knee, the artificial joint surfaces distract a millimetre or two. This test should be done with the knee in 20° of flexion. In full extension the bearing will be firmly gripped because of the tight posterior capsule.



Figure 42

## Cementing the Components

The femoral and tibial surfaces are roughened by multiple small drill holes made with the cement key drill (Figure 43). It is particularly important to make holes in areas of eburnated bone on the femur and tibia and in the posterior surface of the femur. The bone surfaces are cleaned with pulse lavage.

The components are fixed with two separate mixes of cement.

### 1. The tibial component

A small amount of cement is placed on the tibial bone surface and flattened to produce a thin layer. The component is inserted and pressed down, first posteriorly and then anteriorly, so that excess cement is squeezed out at the front. The tibial impactor is used (with a small hammer) to complete the insertion. A dissector is passed around the margin of the component to ensure no soft tissue has been trapped under it. If there is soft tissue it must be pulled out.

Excess cement is removed with a small curette from the margins of the component. The femoral trial component is then inserted and, with the knee flexed 45°, the appropriate feeler gauge is inserted to pressurise the cement. **During setting, the leg is held in 45° flexion and is compressed.** Do not fully extend the leg as pressure in this position may tilt the tibial component anteriorly.

When the cement has set, remove the feeler gauge and the trial femoral component and look carefully for extruded cement, which should be removed. The flat plastic probe is made to slide along the tibial articular surface, feeling for cement at the edges, particularly posteriorly.

### 2. The femoral component

From the second mix, cement is pushed into the large femoral drill-hole and the concave surface of the femoral component is filled with cement. The loaded component is applied to the condyle and impacted with the punch held at 45° to the long axis of the femur. Excess cement is removed from the margins with a small curette and, with the knee flexed 45°, the appropriate feeler gauge is inserted to pressurise the cement. **During setting, the leg is compressed in 45° flexion as above.**



Figure 43



Figure 44

When the cement has set the feeler gauge is removed. The medial and lateral margins of the component are cleared of any extruded cement. The posterior margin of the implant can be palpated with a curved dissector, and can sometimes be seen reflected in the tibial plateau.

As the components may not have seated down fully the trial bearings are inserted again to select the ideal bearing thickness.

The reconstruction is completed by snapping the chosen bearing into place (Figures 44 & 45).

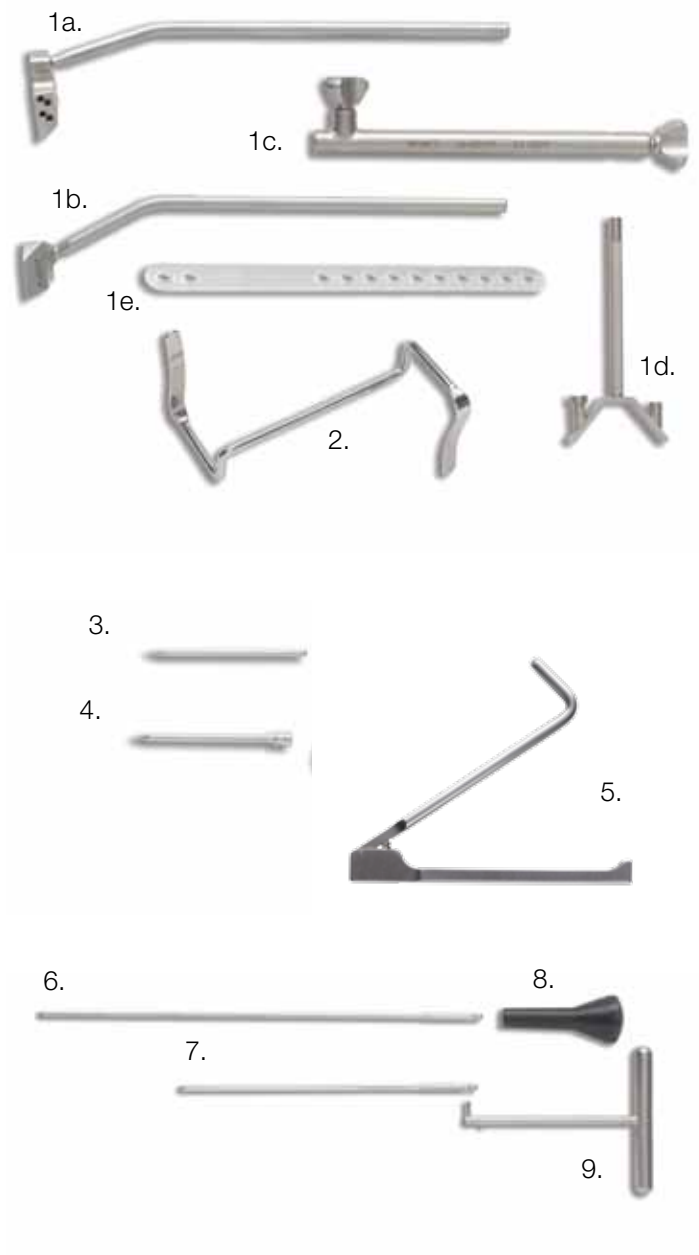
Closure of the wound follows.



Figure 45

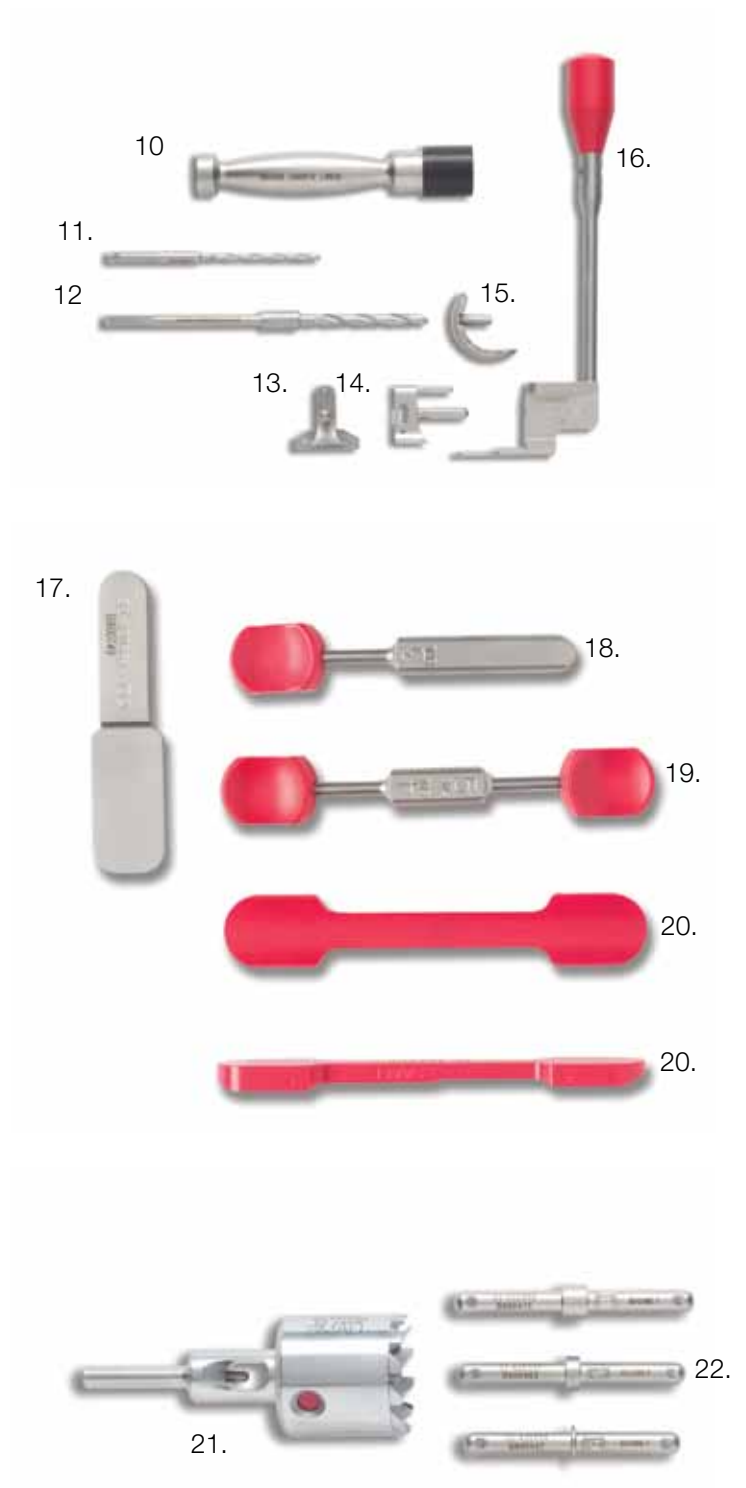
## Key to Instruments

1. Tibial saw guide assembly,
  - a) upper shaft (right)
  - b) upper shaft (left)
  - c) lower shaft
  - d) ankle yoke
  - e) ankle strap
2. Medial collateral ligament retractor
3. Headless nail
4. Headed nail
5. Nail puller
6. Intramedullary alignment rod (300mm long)
7. Intramedullary alignment rod (200mm long)
8. Rod pusher
9. Universal removal hook



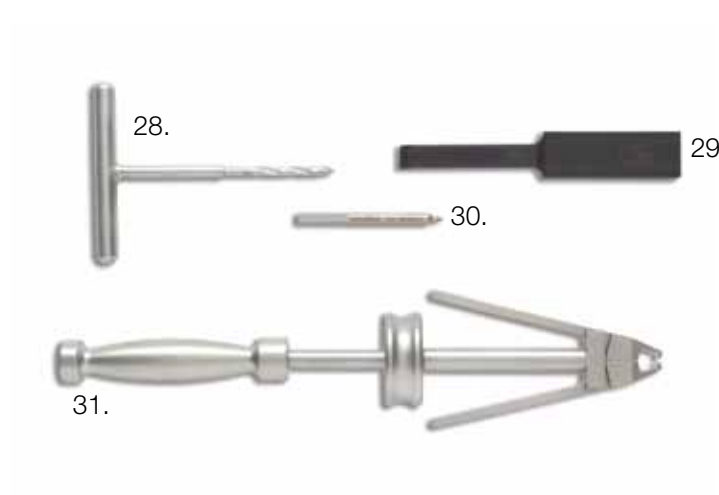
## Key to Instruments

- 10. Femoral impactor
- 11. Drill (4mm diameter)
- 12. Drill (6mm diameter)
- 13. Slotted femoral saw guide
- 14. Femoral saw guide
- 15. Trial femoral component
- 16. Femoral drill guide
- 17. Metal feeler gauges (1, 2 & 3mm thick)
- 18. Trial bearing (3mm thick)
- 19. Trial bearings (4 to 9mm thick)
- 20. Feeler gauges (2 to 9mm thick)
- 21. Spherical mill
- 22. Spigots (numbers 0 to 7)



## Key to Instruments

- 23. Tibial impactor
- 24. Trial tibial components
- 25. Tibial templates
- 26. Tibial template nail
- 27. Tibial groove gouge
- 28. Awl (5mm diameter)
- 29. Plastic probe
- 30. Cement key drill
- 31. Slap-hammer extractor
- 32. Posterior osteophyte chisel
- 33. Femoral trimming guide
- 34. Slotted femoral trimming guide



## Appendix

### Postoperative Treatment

Because the quadriceps mechanism is hardly damaged, recovery of knee function is usually rapid and easy. Early walking with a light knee splint and crutches or sticks is encouraged and patients are allowed to regain knee flexion at their own speed. Forcing flexion of the knee during the first postoperative week often causes pain and is unnecessary since movements are almost always recovered spontaneously.

### Postoperative Radiographic Assessment

Good postoperative radiographs are necessary as a baseline for comparison with later films and to allow 'quality control' of the surgical technique.

For these purposes, the standard methods of aligning the X-ray beam are not sufficiently accurate, nor repeatable enough. To assess the positions of the two metal components, the X-ray beam must be centred on one component and aligned with it in two planes. The resulting projection of the other component can then be used to deduce their relative positions<sup>17</sup>.

### Radiographic Technique

#### Anterior Projection

In the anteroposterior projection, the patient lies supine on the X-ray table and the leg and the X-ray beam are manipulated under fluoroscopic control until the tibial component appears exactly end-on in silhouette, and the radiograph is then taken (Figure 46). In this projection, the alignment of the beam with the flat orthogonal surfaces (horizontal tray and vertical lateral wall and keel) allows great accuracy and reproducibility.

#### Lateral Projection

In the lateral projection, the patient lies supine on the couch with the knee flexed 20°-30°. The fluoroscope is rotated through 90° so that the X-ray beam is parallel to the floor and centred on the femoral component (Figure 47). The tibial implant is not so useful in this projection as it offers no vertical surface and its horizontal surface is obscured by its lateral wall. Therefore the lateral projection is not as precise or as reproducible as the anteroposterior projection. Radiographs taken this way can be repeated at any time interval in the knowledge that (at least the anteroposterior films) the projections of the tibial component are always the same. Therefore small changes in the relationships of the components to one another and to the bones can be detected. Furthermore, because the X-ray beam is parallel to the tibial plateau, the state of its bone/implant interface is always reliably imaged. Without properly aligned postoperative films for comparison, later radiographs are difficult, or impossible, to interpret.

Figures 46 and 47 show the components ideally implanted. These x-ray pictures satisfy all the criteria, given on pages 34 and 35.



Figure 46



Figure 47

## Radiographic Criteria

If the steps of the operation have all been followed as described in this manual, the postoperative appearances will be as shown in the diagrams on the next page (Figure 48).

### Position and Size of Components

#### Femoral Component (Relative to the Femur)

		Acceptable limits
<b>A/A</b>	Varus/valgus angle	<10° varus— <10° valgus
<b>B/B</b>	Flexion/extension angle	<10° flexion— <5° extension
<b>C/C</b>	Medial/ lateral placement	Central
<b>D</b>	Posterior fit	Flush or <4mm overhang

#### Tibial Component (Relative to the Tibia)

<b>E/E</b>	Varus/valgus angle	<5° varus— <5° valgus
<b>F/F</b>	Posteroinferior tilt	7° +or- 5°
<b>G</b>	Medial fit	Flush or <2mm overhang
<b>H</b>	Posterior fit	Flush or <2mm overhang
<b>J</b>	Anterior fit	Flush or <5mm short
<b>K</b>	Lateral fit	Flush - No gap

#### Meniscal Bearing (Relative to the Tibial Component)

<b>L</b>	X-ray marker central, and parallel with the tibial component	
----------	--	--

### Bone Interfaces

<b>M</b>	Posterior femoral	Parallel surfaces: Cement OK
<b>N</b>	Tibial	Parallel surfaces: Cement OK

### Other

<b>O</b>	Posterior osteophytes	None visible
<b>P</b>	Depth of tibial saw cuts	Minimal ingress of cement
<b>Q</b>	Intact posterior cortex	No extruded cement posteriorly
<b>R</b>	No anterior impingement	Adequate bone removed; no cement

# Radiographic Criteria

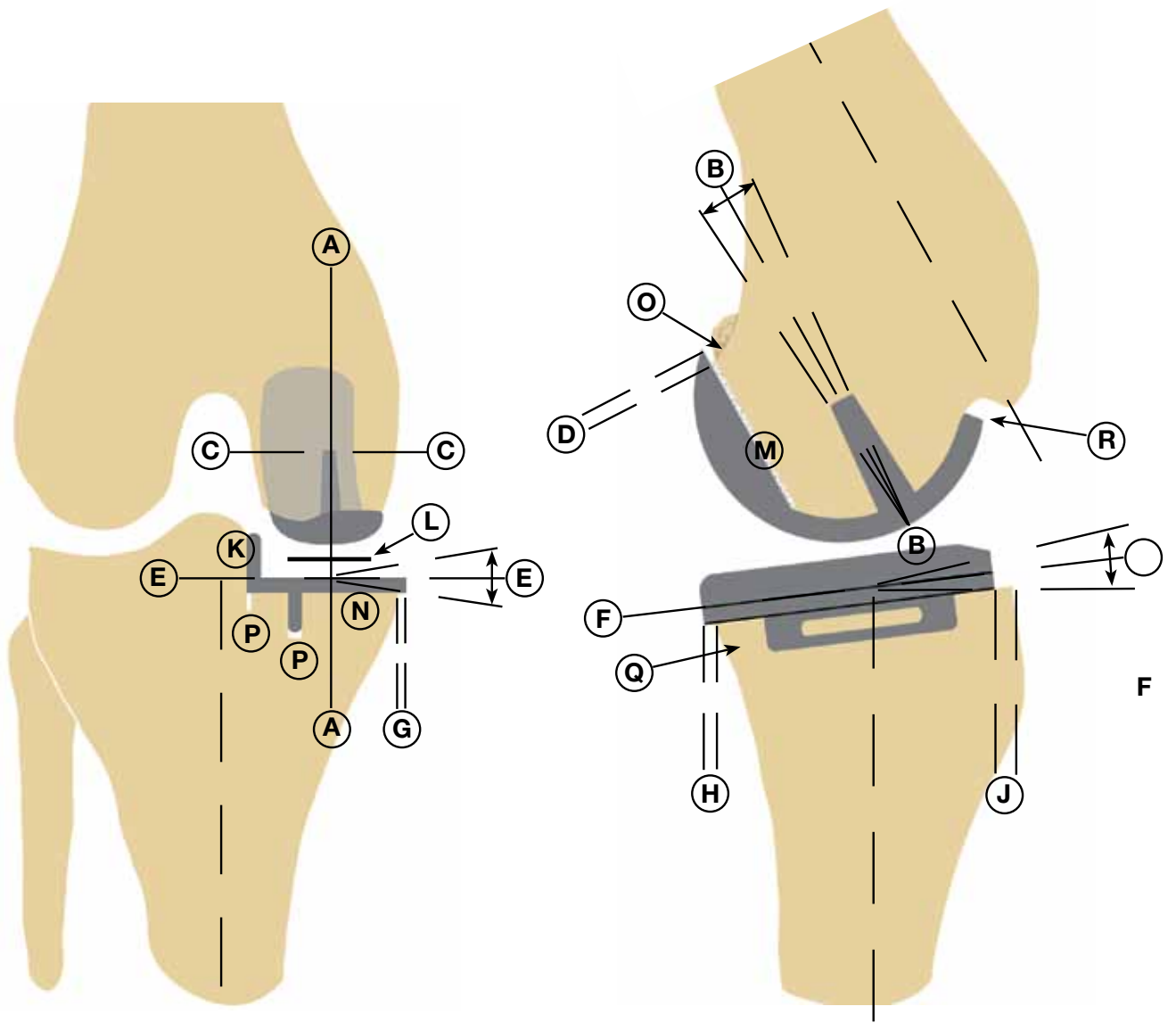


Figure 48

## Follow-up Radiographs

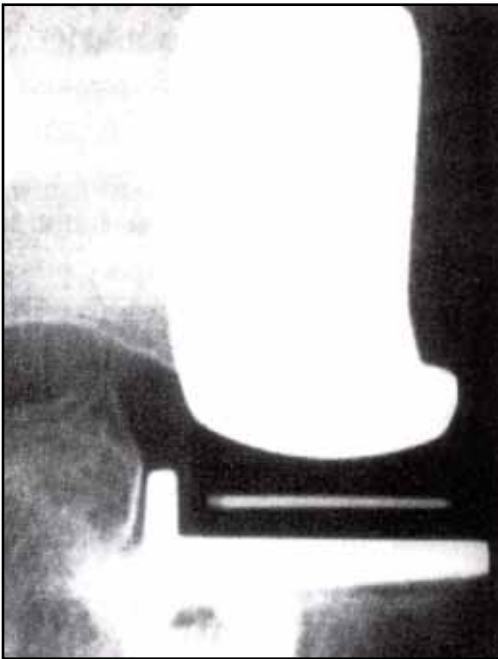
All later radiographs should be taken in the same way as the immediate postoperative films to allow comparison. Fluoroscopically centered films are particularly appropriate for demonstrating the state of the interface beneath the tibial plateau.

This interface changes gradually during the first year after implantation and, thereafter, remains unaltered. The typical appearances, at one year and at ten years, are shown in Figures 49 & 50. A thin **radiolucent line** (ca 1mm) is almost always seen, defined on its deep surface by a thin **radiodense line**. Histologically, the radiolucent line represents a layer of fibrocartilage, its collagen organised parallel with the plateau; the radiodense line represents a new 'subchondral bone plate'. The trabeculae, which were cut at the operation, attach to this plate and support it. The collagen fibres of the cartilage layer insert into its upper surface<sup>17</sup>.

The appearances under the femoral component are the same but are not so easily demonstrated because of the non-planar form of the femoral interface.

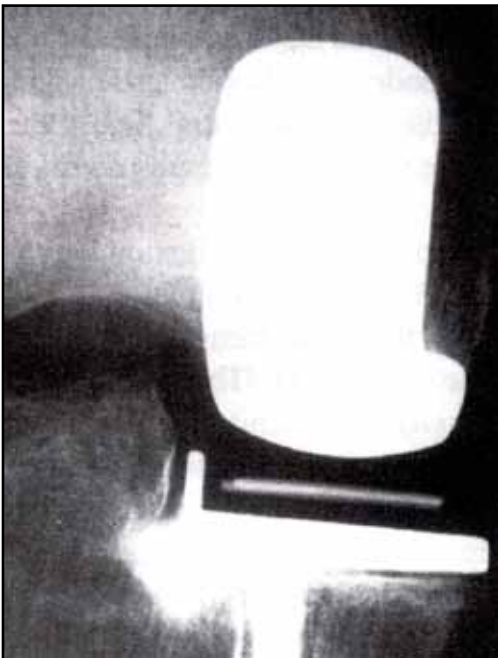
The radiographic changes which occur during the first postoperative year result from healing of the cut bone and its remodelling to sustain the new pattern of compressive load applied to it by the rigid implant.

Mature interfaces of this type have proved stable for as long as 15 years in 95% of cases<sup>13</sup>. It is, therefore, important not to ascribe clinical symptoms to these 'normal' appearances or to interpret them as evidence of loosening of the implants.



*One year Post-op*

Figure 49



*Ten years Post-op*

Figure 50

## References

1. **Goodfellow JW, O'Connor JJ.** The Mechanics of the Knee and Prosthesis Design. *J Bone Joint Surg [Br]* 1978; 60-B; 3; 358-369
2. **Argenson J-N, O'Connor JJ.** Polyethylene Wear in Meniscal Knee Replacement. A One to Nine-Year Retrieval Analysis of the Oxford Knee. *J Bone Joint Surg [Br]* 1992; 74-B; 2; 228-32
3. **Psychoyios V, Crawford RW, O'Connor JJ, Murray DW.** Wear of congruent meniscal bearings in unicompartmental knee arthroplasty - A retrieval study of 16 specimen. *J Bone Joint Surg [Br]* 1998; 80-B; 6; 976-982
4. **White SH, Goodfellow JW, O'Connor JJ.** Anteromedial Osteoarthritis of the Knee. *J Bone Joint Surg [Br]* 1991; 73-B; 4; 582-586.
5. **Murray DW, O'Connor JJ, Goodfellow JW.** The Oxford medial unicompartmental arthroplasty, a ten year survival study. *J Bone Joint Surg [Br]* 1998; 80-B; 6; 983-989
6. **Price A, Svärd UCG, Murray DW, Goodfellow JW.** Ten year survival results of Oxford mobile bearing unicompartmental knee arthroplasty in young patients. *I.S.T.A Chicago*, 1999.
7. **Incavo et al.** Tibial Plateau Coverage in Total Knee Arthroplasty. *Clin Orthop* 1994; 299; 81-85.
8. **Keys GW, Carr AJ, Miller RK, Goodfellow JW.** The Radiographic Classification of Medial Gonarthrosis. Correlation with Operative Methods in 200 Knees. *Acta Orthop Scand* 1992; 63; 5; 497-501.
9. **Gibson P, Goodfellow JW.** Stress Radiography in Degenerative Arthritis of the Knee. *J Bone Joint Surg [Br]* 1986; 68-B; 4; 608-9
10. **Price AJ, Dodd CAF, Svärd UCG & Murray DW.** "Oxford unicompartmental arthroplasty in patients younger than 60 years of age. *J Bone Joint Surg [Br]* 2005; 87-B; 11; 1488-92
11. **Pandit HG, Price AJ, Rees JC, Beard DJ, Gill HS, Dodd CAF, Murray DW.** Is unicompartmental knee arthroplasty contraindicated in young active patients *J Bone Joint Surg [Br]* 2004; 86-B; Suppl 1; 12
12. **Woods D, Wallas D, Woods C, McLardy-Smith P, Carr AJ, Murray DW, Martin J, Gunther T.** Chondrocalcinosis and medial unicompartmental knee arthroplasty. *The Knee* 1995; 2; 117-19
13. **Svärd UCG, Price AJ.** Oxford medial unicompartmental knee arthroplasty – A survival analysis of an independent series. *J Bone Joint Surg [Br]* 2001; 83-B; 2; 191-194.
14. **Langdown A, Pandit H, Price AJ, Dodd CAF, Murrey DW, Svärd UCG, Gibbons CLMH.** Oxford medial unicompartmental arthroplasty for focal spontaneous osteoarthritis of the knee. *Acta Orthop* 2005; 76; 688-92
15. **Pandit H, Beard DJ, Jenkins C, Kimstra Y, Thomas NP, Dodd CAF, Murray DW.** Combined anterior cruciate reconstruction and Oxford unicompartmental knee arthroplasty. *J Bone Joint Surg [Br]* 2006; 88-B; 7; 887-892
16. **Gunther TV, Murray DW, Miller R, Wallace DA, Carr AJ, O'Connor JJ, McLardy Smith P, Goodfellow JW.** Lateral unicompartmental arthroplasty with the Oxford meniscal knee. *The Knee* 1996; 3; 33-39
17. **Tibrewal SB, Grant KA, Goodfellow JW.** The Radiolucent Line beneath the Tibial Components of the Oxford Meniscal Knee. *J Bone Joint Surg [Br]* 1984; 66-B; 4; 523-8
18. **Weale AE, Murray DW, Crawford RW, Psychoyios V, Bonomo A, Howell G, O'Connor JJ, Goodfellow JW.** Does Arthritis Progress in the Retained Compartments after 'Oxford' Medial Unicompartmental Arthroplasty? *J Bone Joint Surg [Br]* 1999; 81-B; 5; 783-789
19. **Carr AJ, Keys GW, Miller RK, O'Connor JJ, Goodfellow JW.** Medial Unicompartmental Arthroplasty; A Survival Study of the Oxford Meniscal Knee. *Clin Orthop* 1993; 295; 205-213

## Ordering Information

### Implants

#### Femoral Components

Extra Small	Small	Medium	Large	Extra Large
159530	154600	154601	154602	154603

#### Tibial Components (Alpha)

Code	Size	Code	Size
159531	Size AA LM	159532	Size AA RM
154718	Size A LM	154719	Size A RM
154720	Size B LM	154721	Size B RM
154722	Size C LM	154723	Size C RM
154724	Size D LM	154725	Size D RM
154726	Size E LM	154727	Size E RM
154775	Size F LM	154776	Size F RM

#### Tibial Components (Numeric)

Code	Size	Code	Size
154605	38 x 26 LM	154606	38 x 26 RM
154607	41 x 26 LM	154608	47 x 26 RM
154609	44 x 28 LM	154610	44 x 28 RM
154611	47 x 30 LM	154612	47 x 30 RM
154613	50 x 32 LM	154614	50 x 32 RM
154615	53 x 34 LM	154616	53 x 34 RM

#### Meniscal Bearing Components

Extra Small		Small		Medium		Large		Extra Large	
Code	Thickness	Code	Thickness	Code	Thickness	Code	Thickness	Code	Thickness
159533	3	154618	3	154626	3	154634	3	154642	3
159534	4	154619	4	154627	4	154635	4	154643	4
159535	5	154620	5	154628	5	154636	5	154644	5
159536	6	154621	6	154629	6	154637	6	154645	6
159537	7	154622	7	154630	7	154638	7	154646	7
159538	8	154623	8	154631	8	154639	8	154647	8
159539	9	154624	9	154632	9	154640	9	154648	9

### Instrument Sets

#### Femoral

Extra Small	Small	Medium	Large	Extra Large
32-421069	32-420696	32-420697	32-420698	32-420699

#### Tibial (Common to all sizes of femoral components)

Numerical Sizes	Alpha Sizes
32-420700	32-420951

## Meniscal Bearing Components - Anatomic

Small LEFT		Medium LEFT		Large LEFT		Extra Large LEFT	
Code	Thickness	Code	Thickness	Code	Thickness	Code	Thickness
159540	3	159547	3	159554	3	159561	3
159541	4	159548	4	159555	4	159562	4
159542	5	159549	5	159556	5	159563	5
159543	6	159550	6	159557	6	159564	6
159544	7	159551	7	159558	7	159565	7
159545	8	159552	8	159559	8	159566	8
159546	9	159553	9	159560	9	159567	9

Small RIGHT		Medium RIGHT		Large RIGHT		Extra Large RIGHT	
Code	Thickness	Code	Thickness	Code	Thickness	Code	Thickness
159568	3	159575	3	159582	3	159589	3
159569	4	159576	4	159583	4	159590	4
159570	5	159577	5	159584	5	159591	5
159571	6	159578	6	159585	6	159592	6
159572	7	159579	7	159586	7	159593	7
159573	8	159580	8	159587	8	159594	8
159574	9	159581	9	159588	9	159595	9

## Meniscal Bearing Components - Anatomic Extra Small

Extra Small RIGHT		Extra Small RIGHT	
Code	Thickness	Code	Thickness
159790	3	160790	3
159791	4	160791	4
159792	5	160792	5
159793	6	160793	6
159794	7	160794	7
159795	8	160795	8
159796	9	160796	9



