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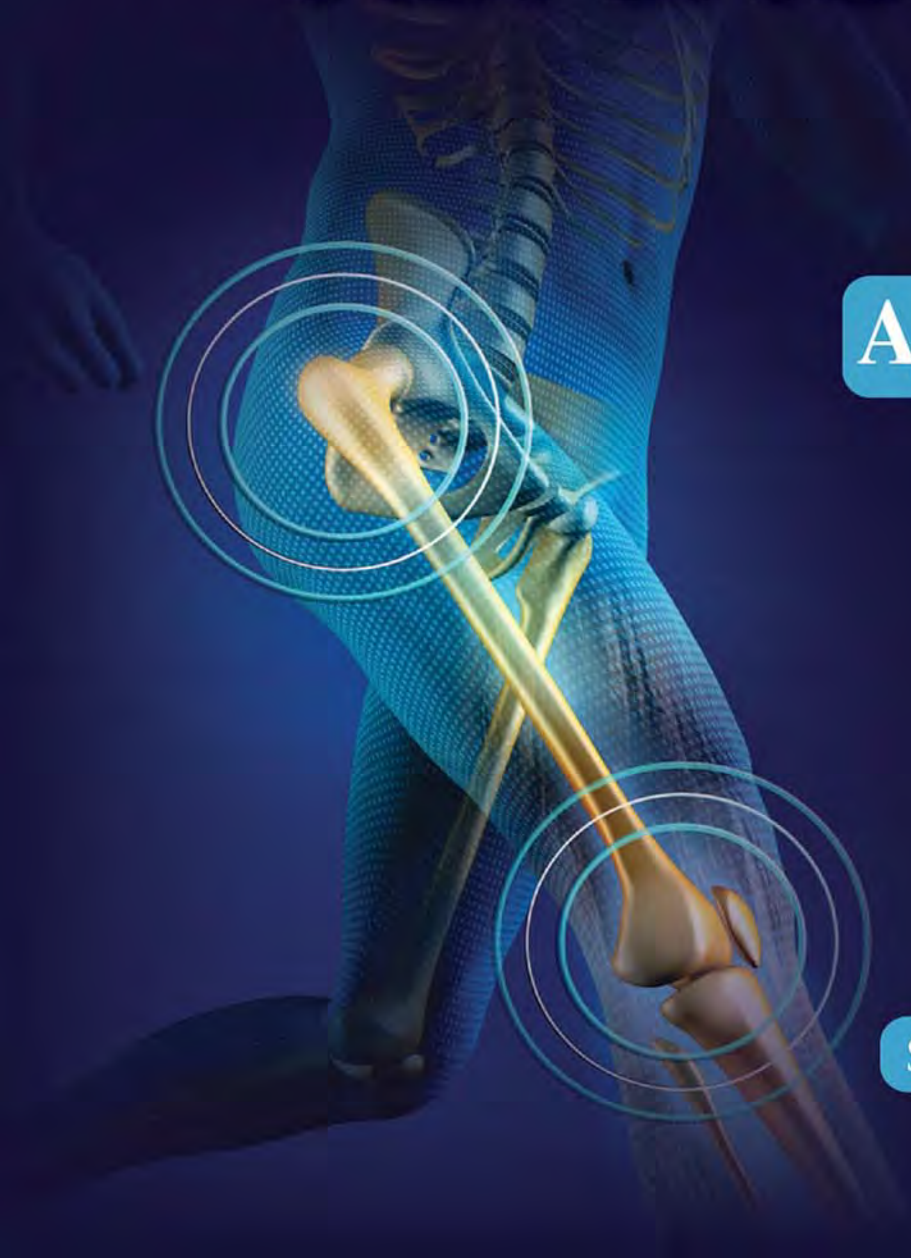
A Practical Operative Guide for TOTAL KNEE & HIP REPLACEMENT



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SECOND EDITION

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Difficult Situations and Important Points

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- Knee Implants
- Summary of TKR (Steps in Sequence)
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Total Knee Replacement (TKR) in Difficult Situations

Assess the difficult situations like:

1. FFD >30°
2. Stiff knee (i.e. knee flexion <30°)
3. Large medial or lateral defect (i.e. severe varus >25° or valgus deformity >15°)
4. Post HTO

Plan the surgery properly including templating, keeping many options ready for building up the defect (bone cement, screws and bone cement, bone graft, metallic wedges), tibial tubercle osteotomy, quadriceptoplasty, quadriceps snip, multiple puncture (pie-crusting) in quadriceps tendon (in stiff knee and revision TKR), multiple puncture in iliotibial (IT) band (in fixed valgus deformity), posterior release in femur (in FFD), medialization of tibial tray and possibility of offset stem tibial tray (in post HTO), Extension rod with tibial tray or femoral component. In cases of FFD >30°, pre-operative correction of FFD up to 30° or at least 40° must be achieved by vigorous physiotherapy, passive stretching by use of knee brace, traction or serial casting under anesthesia. Postoperative, significant (>15°) flexion contractures can cause persistent pain and altered gait mechanics. In cases of stiff knee (flexion <30°), patient must be informed that regaining flexion will be slow and require considerable time and effort by the patient and the physiotherapist. Even then flexion up to 90° may not be gained in some cases.

Build up the residual defect by:

1. *Bone cement*: If the defect is <5 mm.
2. *Screws and bone cement*: If the defect is between 5 and 10 mm, make two drill holes in defect with 2.5 mm drill bit. The direction of the tip of drill bit is about 10° towards the tibial axis. Measure the depth with depth gauge to determine the length of the screws (usually 18 mm, 20 mm, 22 mm, 24 mm or 26 mm screw length). Tap it with 3.5 mm tap if hard bone. Pass two 3.5 mm cortical screws till they come just below the level of defect **(Fig. 3.1)**. Check the level by putting the trial tibial tray. There is 1–2 mm clearance between head of screws and the tibial

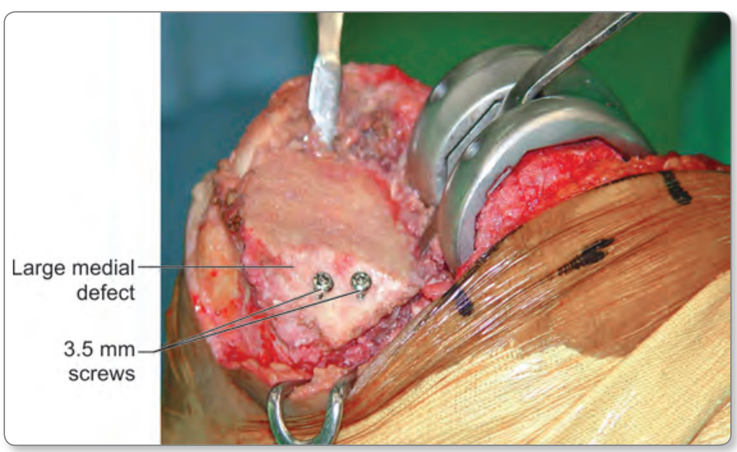


Fig. 3.1 3.5 mm two cortical screws to support the tibial tray and to hold the cement

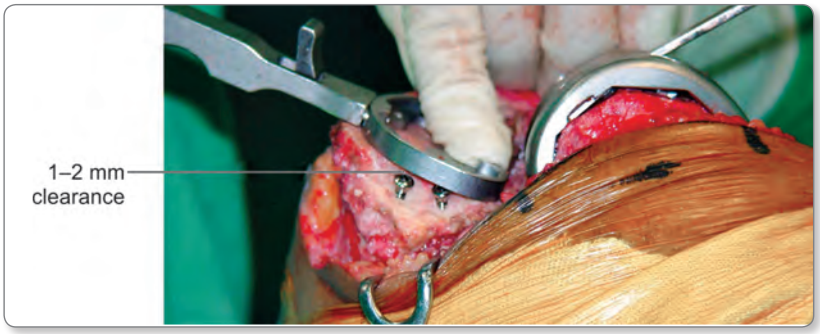


Fig. 3.2 Checking the level of screws in defect by trial tibial tray

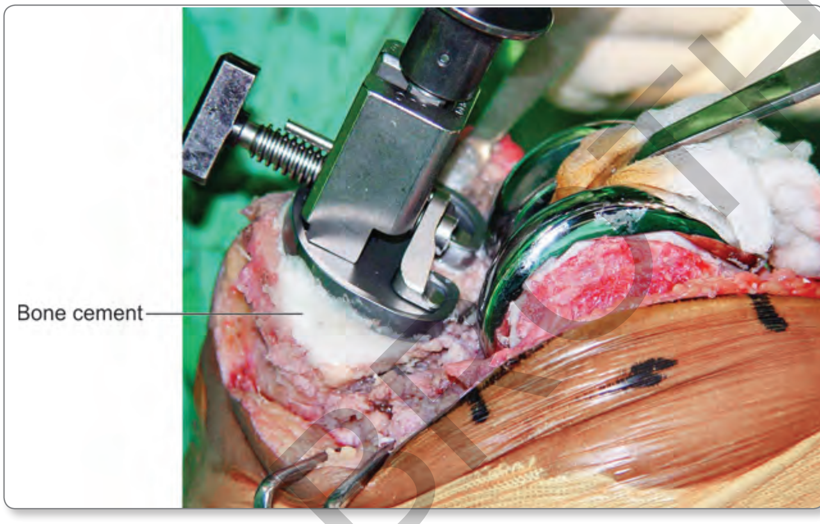
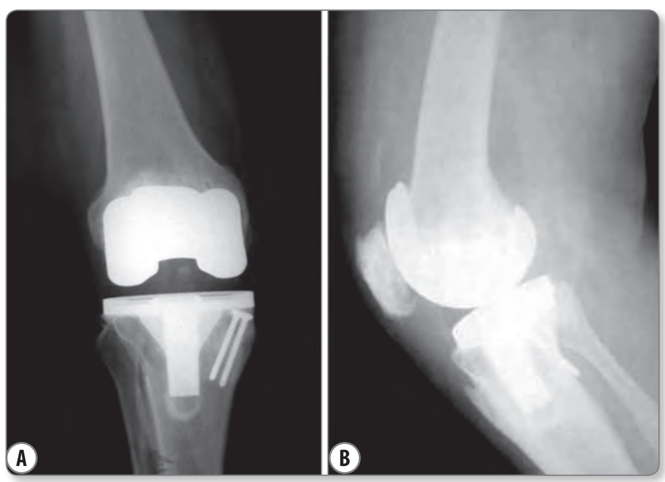


Fig. 3.3 After cementing

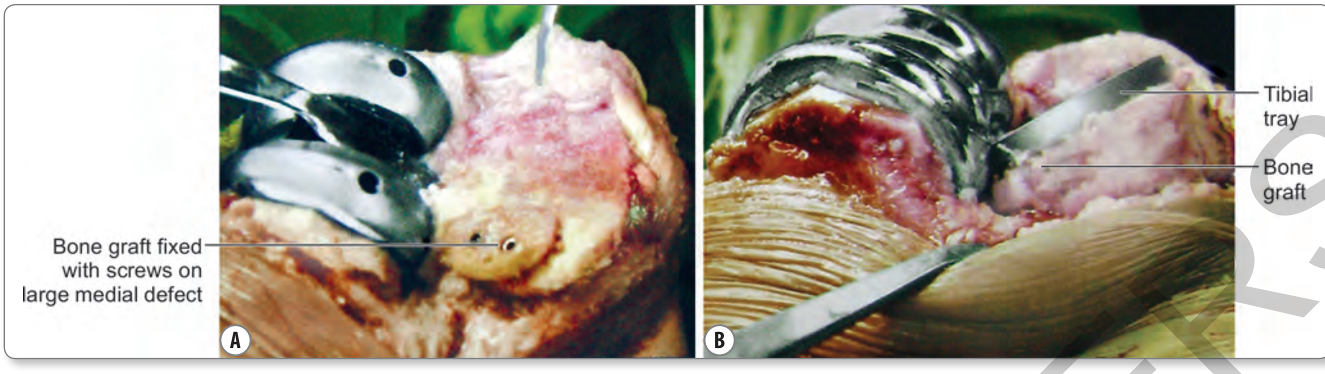
tray for bone cement **(Fig. 3.2)**. It will support the tibial tray and hold the cement **(Figs 3.3 and 3.4)**.

3. *Bone graft*: If the defect is >10 mm and patient is younger (<60 years): The bone removed from either posterior part of medial condyle, distal femur, upper tibia or box cut is used as bone graft. The defect of tibial condyle is made box-shaped by backward movement of saw or by high speed drill or microdrive plus for better holding of graft and making the area vascular. The graft is temporarily fixed with one K-wire. Drill through the graft by 2.5 mm drill bit. The direction of the tip of drill bit is about 10° towards the tibial axis. Measure the depth with depth gauge to determine the length of the screws (usually 24 to 30 mm screw length). Countersink, tap with 3.5 mm tap and fix the bone graft by two 3.5 mm cortical screws **(Figs 3.5 and 3.6)**.

In addition, if the tibial defect after resection is less than 50% of the tibial condyle, the peg bone graft without screws may be used. It is usually taken from the intercondylar bone of the femur which is being removed during box cut or resected tibia. Make a hole in the tibial defect by reciprocating saw, burr and/or drill (high speed drill or microdrive plus). Shape the graft in such a manner that it will firmly fit into the hole created in the defect of tibial plateau. Temporarily fix the graft



Figs 3.4A and B (A) AP view X-ray; (B) Lateral view X-ray



Figs 3.5A and B (A) Bone graft fixed with two 3.5 mm cortical screws on grafted bone; (B) After implantation of tibial tray

transversely with two K-wires taking care not to pass the K-wires in the area of tibial preparation **(Fig. 3.7)**. Re-apply the tibial cutting block and level the graft with saw to resected tibia. If required, augmentation with one or two cortical screws of 3.5 mm may be done. Tibial preparation is done. First fix the tibial tray with bone cement. While cement is setting, remove the K-wires and press the bone cement with fingers near the defect. Hold and pressurize the tibial tray in position till the cement sets.

For central bone defect, do impaction bone grafting.

4. *Metallic wedge*: If the defect is >10 mm and elderly patient (>60 years) **(Fig. 3.8A)**.

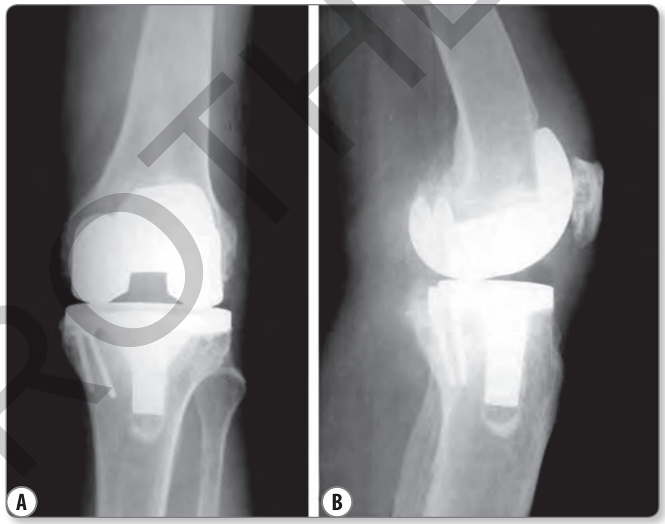
Modular plus tibial wedges are used with modular plus tibial tray and 2 enclosed screws **(Figs 3.8C to F)**. The wedges are 10° and 20° hemi and 10° and 15° full in all sizes of tibial tray. There are 10 mm and 15 mm thickness step wedge in all sizes of tibial tray. There is one wedge cutting guide for 10° and 20° hemi wedge and one step cutting guide for 10 mm and 15 mm step **(Fig. 3.8B)**. There are four full wedge cutting guides—10° LL/RM, 10° LM/RL and 15° LL/RM, 15° LM/RL (See details of technique in revision TKR).

Femoral Augmentations

There are posterior augmentation (4 mm and 8 mm) and distal augmentation for right and left (4 mm, 8 mm, 12 mm, 16 mm) (See details of technique in revision TKR).

Posterior Release from Femur

After all bone cuts, lift the femur by bone hook and release posteriorly with curve osteotome and gauze piece by elevating the capsule from the distal femur or proximal tibia in a subperiosteal plane (to avoid injury to popliteal artery or tibial nerve) in case of FFD **(Fig. 3.9)**. Large osteophytes on the posterior aspect of the femur are being removed by using curette.



Figs 3.6A and B AP view and lateral view X-ray with bone graft fixed with screws

Extension Rod

In case of large tibial defects **(Figs 3.11 to 3.19)**, old fracture of tibial condyle **(Figs 3.20 and 3.21)**, upper shaft of tibia **(Figs 3.22 to 3.27)** or non-union HTO, extension rod is applied to avoid stress over the condyle of tibia. For application of extension rod with tibial tray, keep the trial tibial tray and punch guide in position after tibial preparation. Remove the drill bushing. Pass the 8 mm drill in tibial canal and ream the tibial canal with gradually increasing diameter reamer till snugly fitting upto the planned length of rod **(Fig. 3.10A)** and then one size higher i.e. for 14 mm rod, ream to 15 mm (Sizes of reamers are 10 mm, 11 mm, 12 mm, 13 mm, 14 mm, 15 mm, 16 mm, 17 mm, 18 mm). Do the trial reduction after application of trial extension rod in Trial tibial tray with peg (For trial reduction with extension rod, the trial tibial tray is separate i.e. with peg). Apply the extension rod of appropriate length and diameter on tibial tray **(Fig. 3.10B)**. For applying the extension rod, hold the appropriate tibial tray with tibial holding clamp. Remove the plastic plug from the lower

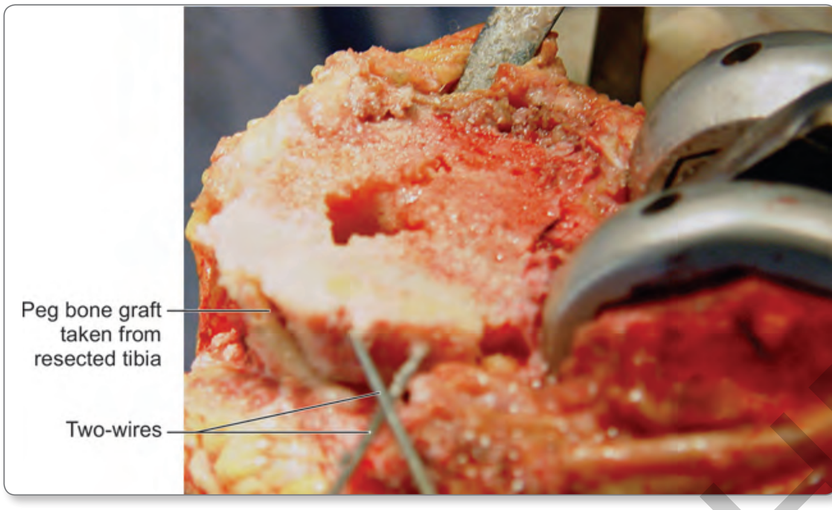
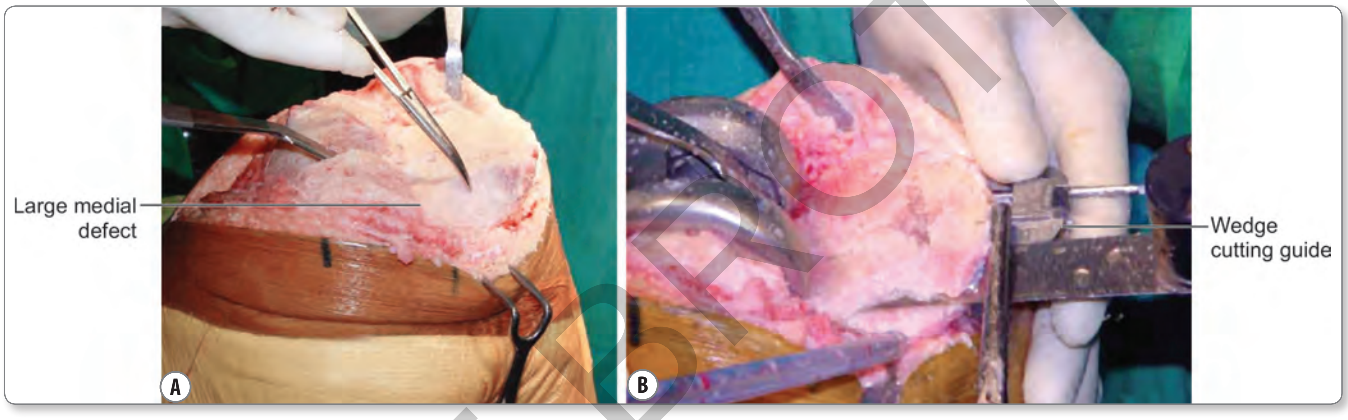
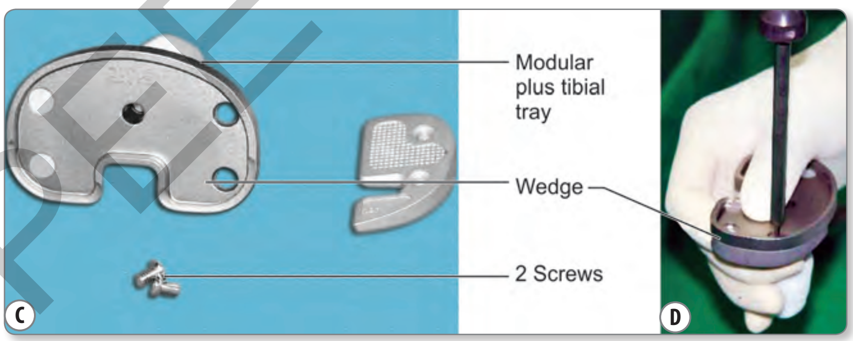


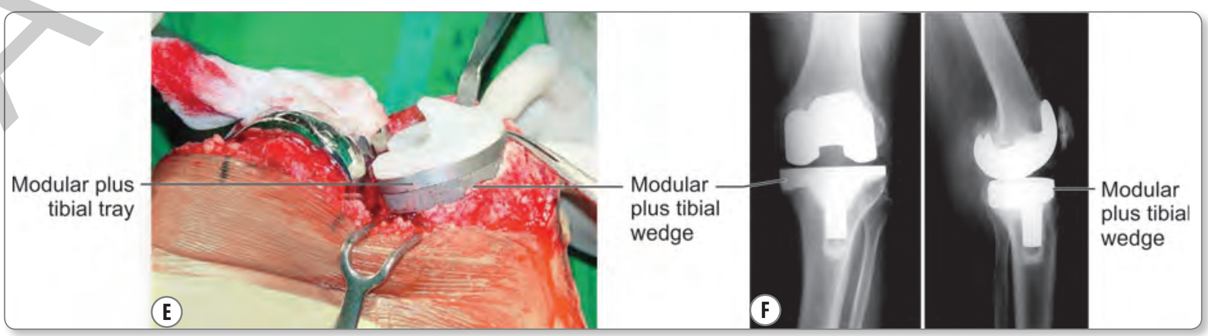
Fig. 3.7 Two K-wires temporarily fixing the graft and passing away from the area of tibial preparation



Figs 3.8A and B (A) Large defect >10 mm; (B) Cutting wedge



Figs 3.8C and D (C) Modular plus tibial tray, wedge and 2 screws; (D) Fitting of wedge with modular plus tibial tray



Figs 3.8E and F (E) Modular plus tibial tray with wedge; (F) AP and lateral view X-ray with wedge

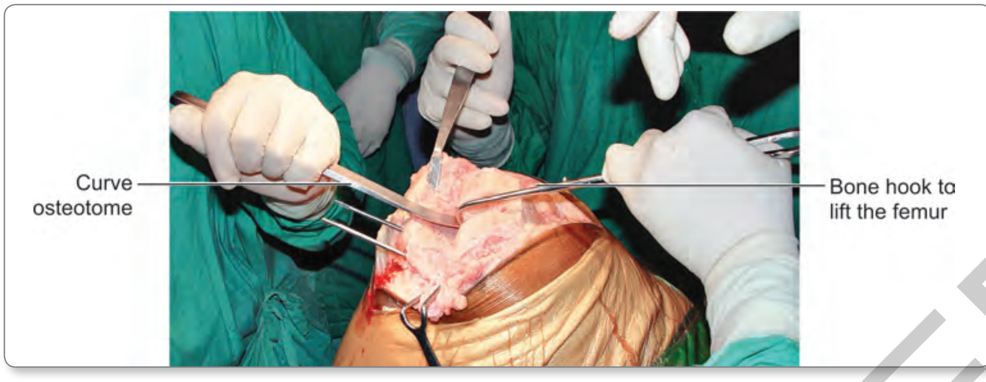
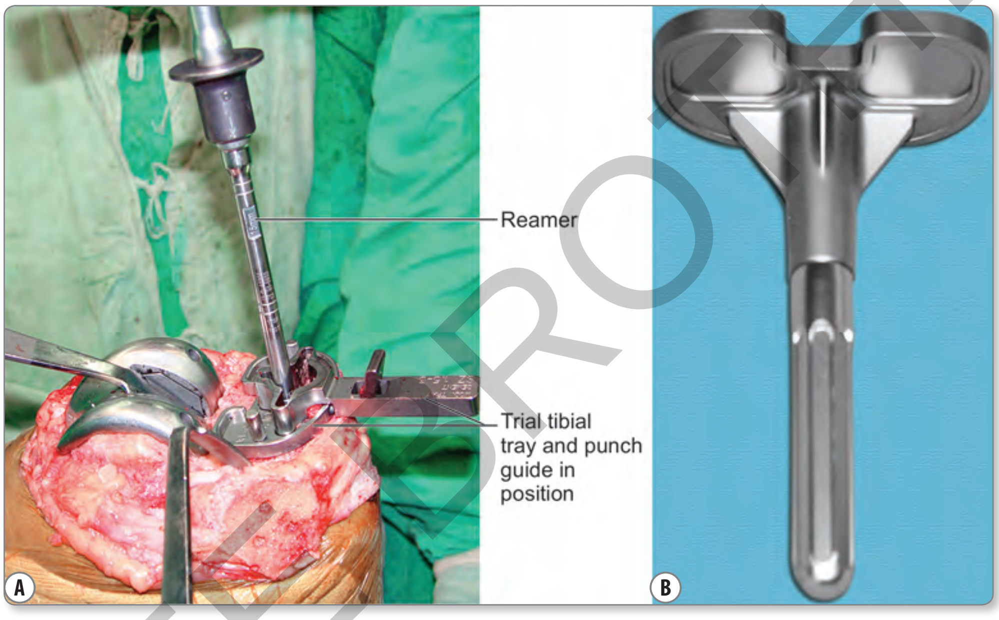
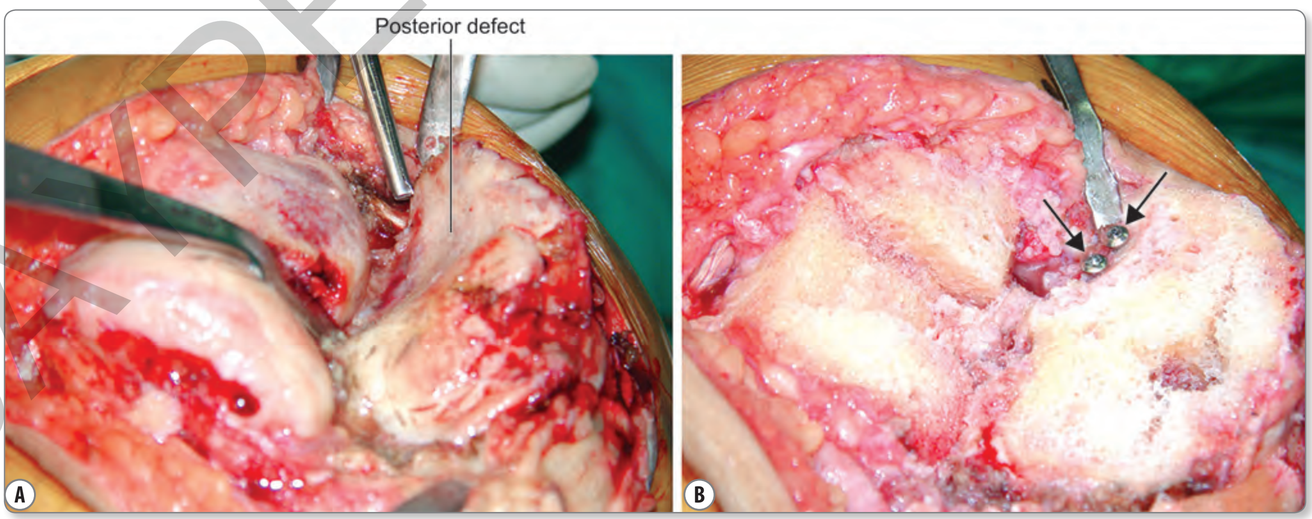


Fig. 3.9 Posterior release of femur



Figs 3.10A and B (A) Reaming upto planned length of rod; (B) Tibial tray fitted with extension rod (Fluted rod)



Figs 3.11A and B (A) Large posterior defect of tibia; (B) Built up by 3.5 mm two screws

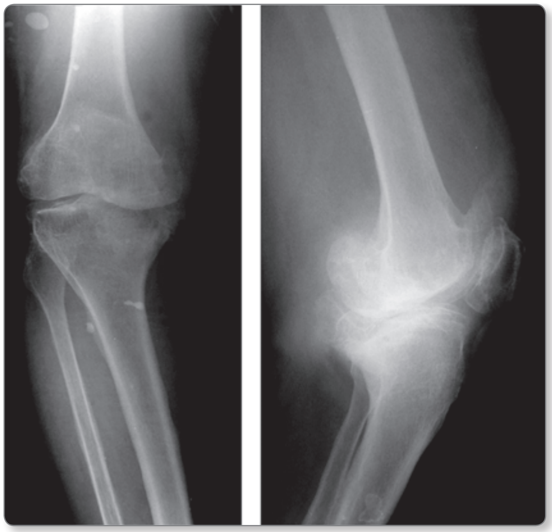


Fig. 3.12 AP and lateral view X-rays showing large posterior defect

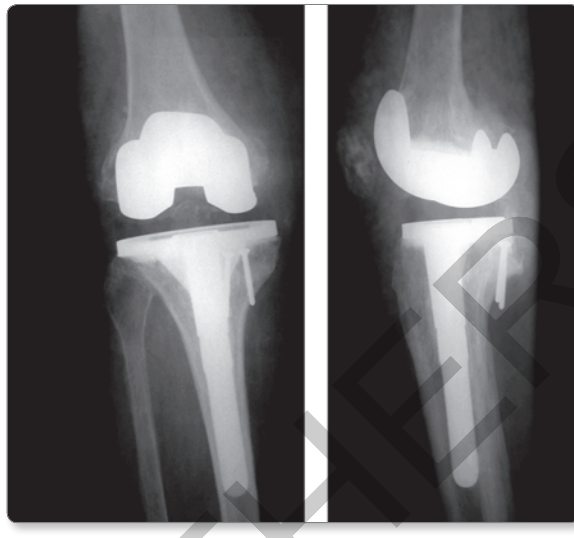


Fig.3.13 In addition to built up by screws, extension rod is applied to avoid stress

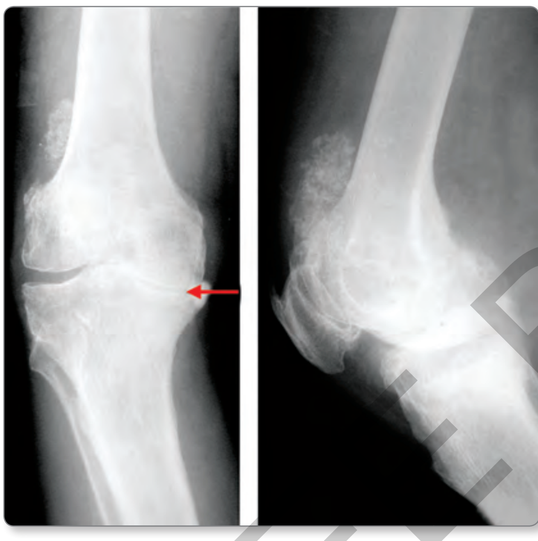
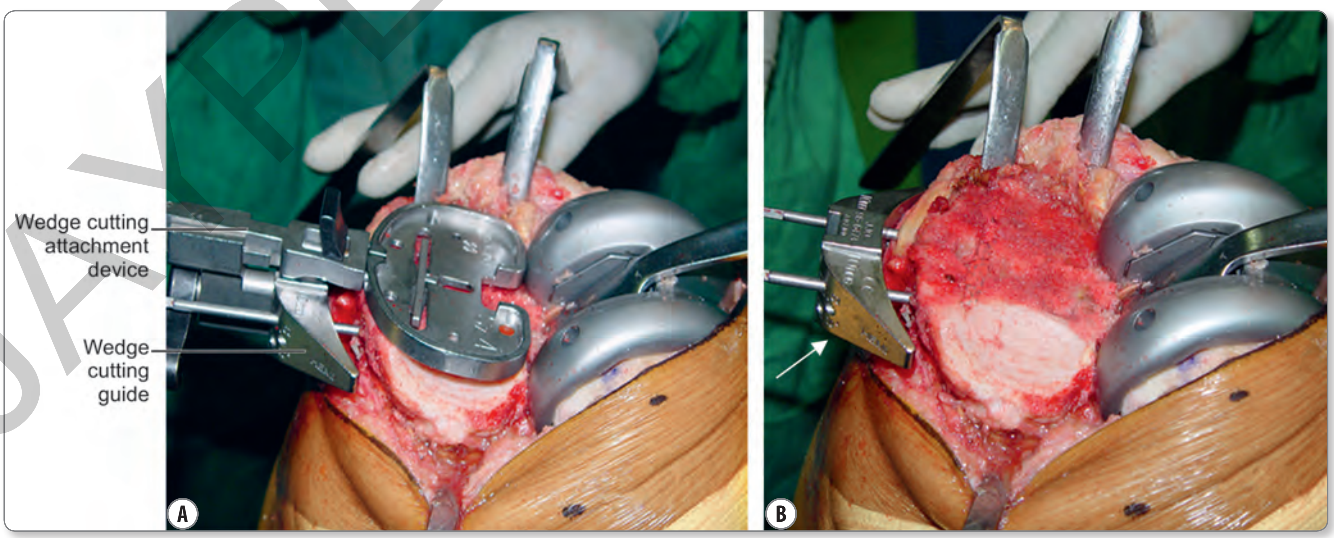


Fig. 3.14 Large medial defect

Fig. 3.15 Greater than 10 mm residual medial defect in elderly



Figs 3.16A and B Positioning of wedge cutting guide

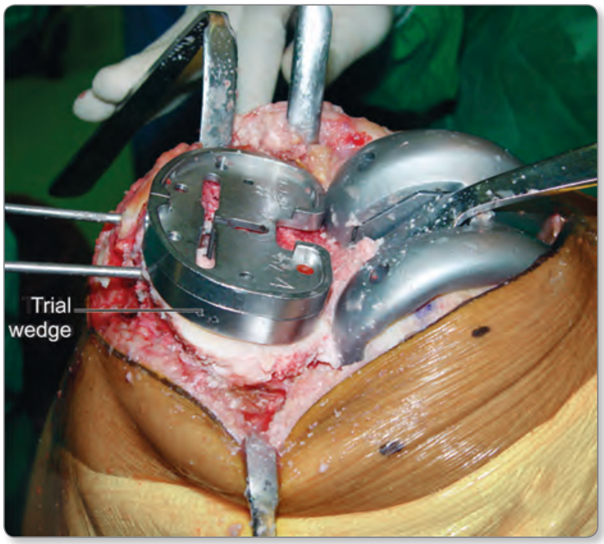


Fig. 3.17 Trial wedge attached with trail tibial tray

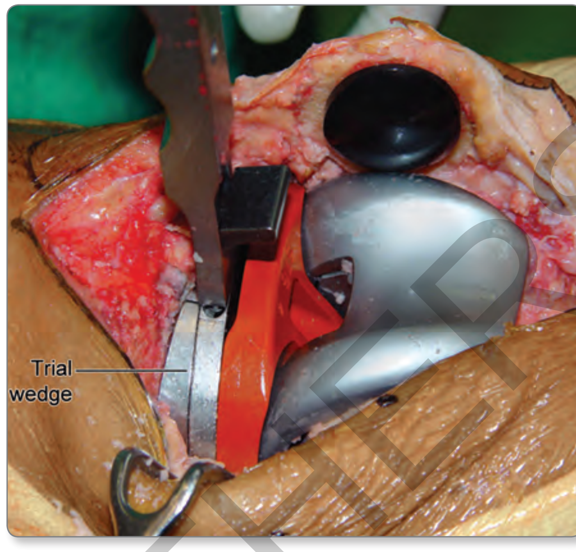
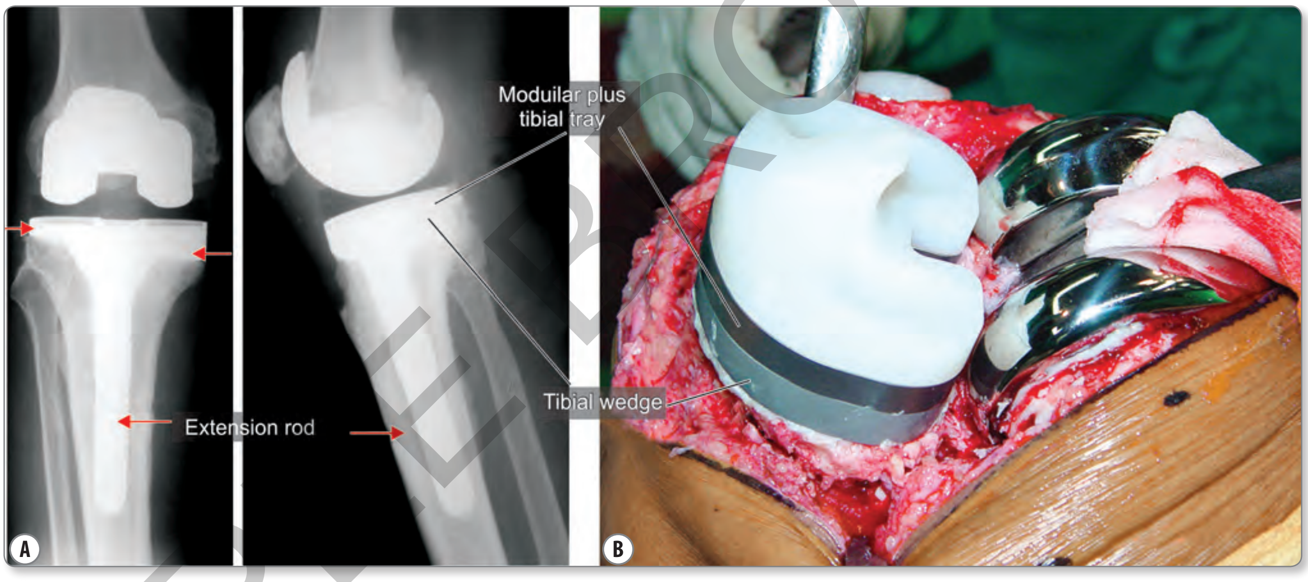


Fig. 3.18 After trial reduction



Figs 3.19A and B Modular plus tibial wedge and extension rod fitted with modular plus tibial tray

end of the tibial tray. Extension rod is held with press fit rod wrench and completely tightened with the tibial tray. Similarly ream the femoral canal for femoral rod according to the requirement. Reamers for tibial and femoral rods are same with different marking of tibial rod length and femoral rod length. (Fluted tibial IM rods are available in 3 lengths – 75 mm, 115 mm, 150 mm and diameter 10mm, 12mm, 14mm, 16 mm, 18 mm. Fluted Femoral IM rods in 2 lengths—125 mm, 175 mm and diameter 10 mm, 12 mm, 14 mm, 16 mm, 18 mm with 50 and 70 valgus angles, Bolts for fixing IM rod with femoral component—0 mm and 2 mm offset).

It is always a wise decision to use extension rod whenever building up large defects.

Cemented Tibial and Femoral Stem Extension

Recommended in severe osteoporosis **(Figs 3.28 to 3.30)** and whenever building up the large defects **(Figs 3.31A to C)**.

Cemented tibial stems are available in two sizes and two diameters—30 mm, 60 mm length and 13 mm, 15 mm diameters each. Canal preparation is done in the similar way as for fluted rods by same reamer up to desired length and

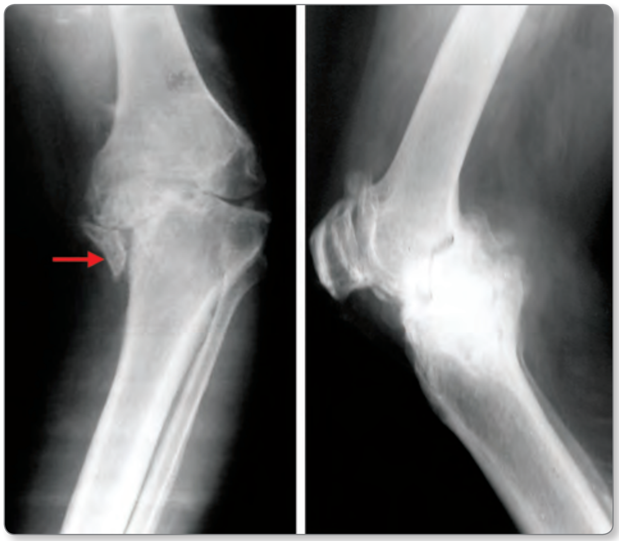


Fig. 3.20 Old fractured medial condyle tibia—AP and lateral view

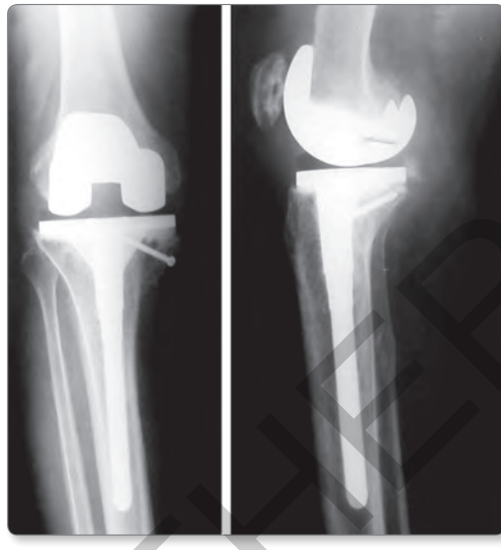


Fig. 3.21 Fixation of fractured of medial condyle with screw and application of extension rod with tibial tray to avoid stress over the fractured medial condyle (AP and Lateral view)

Fig. 3.22 Stress fracture upper tibia with arthritis

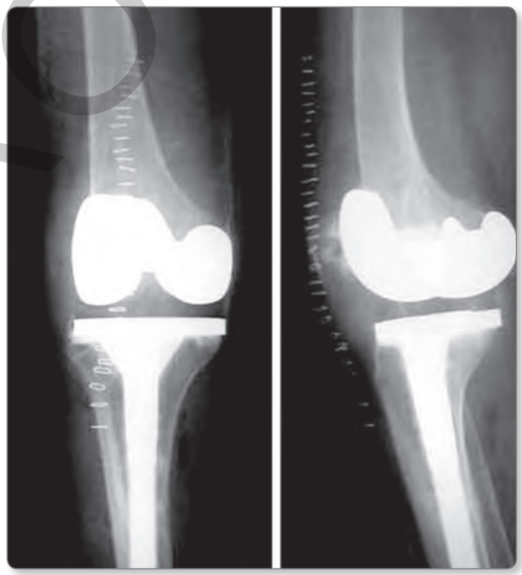


Fig. 3.23 Extension rod with tibial tray to avoid stress over fractured tibia (AP and lateral views)

diameter with trial tibial tray and punch guide in place. Trial reduction is done with trial tibial tray fitted with extension rod. CMW1 bone cement is applied on the selected size tibial tray and stem and applied over the prepared tibia.

Cemented femoral stems (smooth, non-fluted modular stems) are available in two sizes (90 mm and 130 mm lengths), two diameters (13 mm and 15 mm), two angles (5° and 7°) and three stem positions (0 mm, + 2 mm and –2 mm). Femoral canal preparation is done with appropriate diameter femoral stem reamer and desired depth according to marking on the reamer. Stem positioning and trial assembly is done as mentioned in revision TKR ahead. Trial reduction is done with appropriate trial femoral component and stem assembly. Assemble the selected size femoral component and femoral stem. CMW1 bone cement is applied on the femoral component and stem and applied over the distal femur.

Available cemented femoral stems are:

1. 5° and 7° angles each
2. 13 mm and 15 mm +2 mm left/–2 mm right
3. 13 mm and 15 mm +2 mm right/–2 mm left
4. 13 mm and 15 mm 0 mm offset.

Fig. 3.24 Old fracture upper tibia with arthritis of knee joint

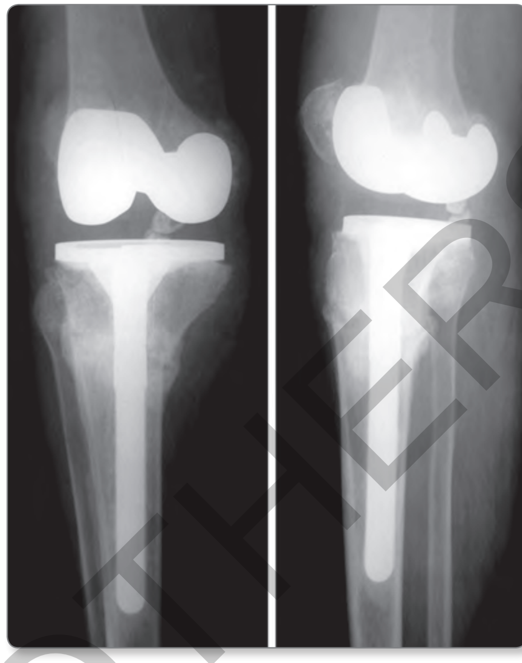


Fig. 3.25 Extension rod with tibial tray to avoid stress over fractured tibia (AP and lateral views)

Fig. 3.26 Non-union tibia and fibula with arthritis of knee joint

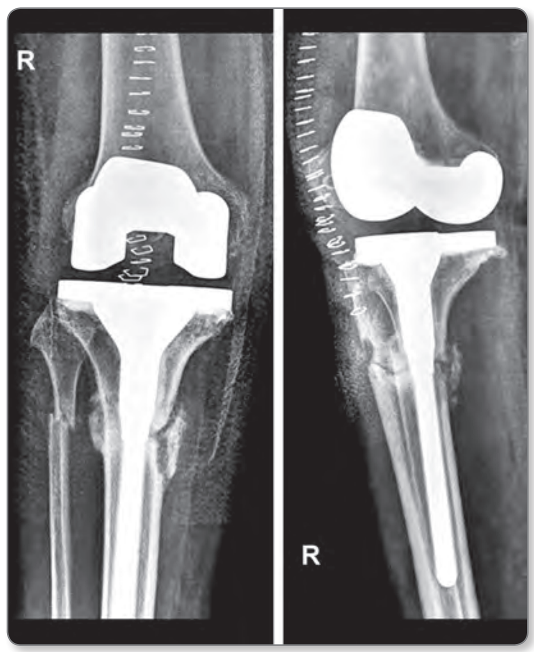


Fig. 3.27 TKR with extension rod

Fig. 3.28 Cemented tibial rod (without and with cement)

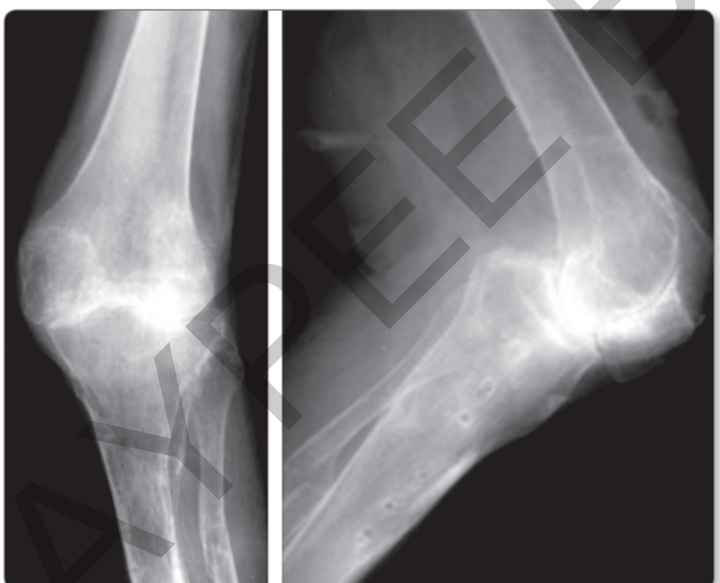


Fig. 3.29 Severe osteoporosis in case of RA

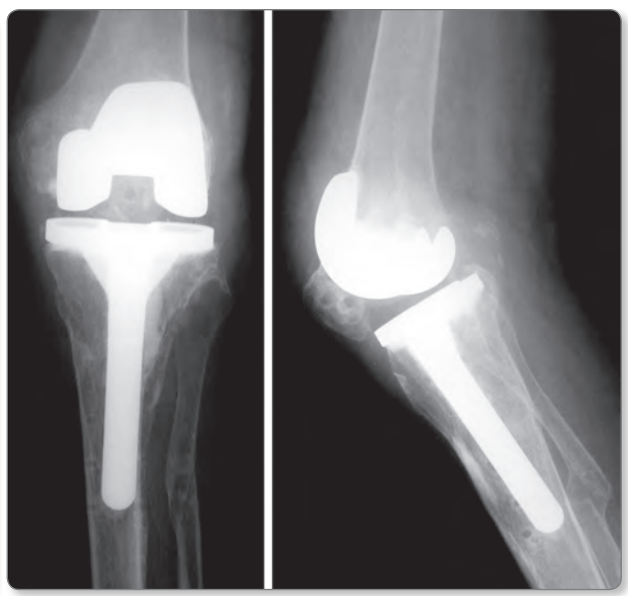
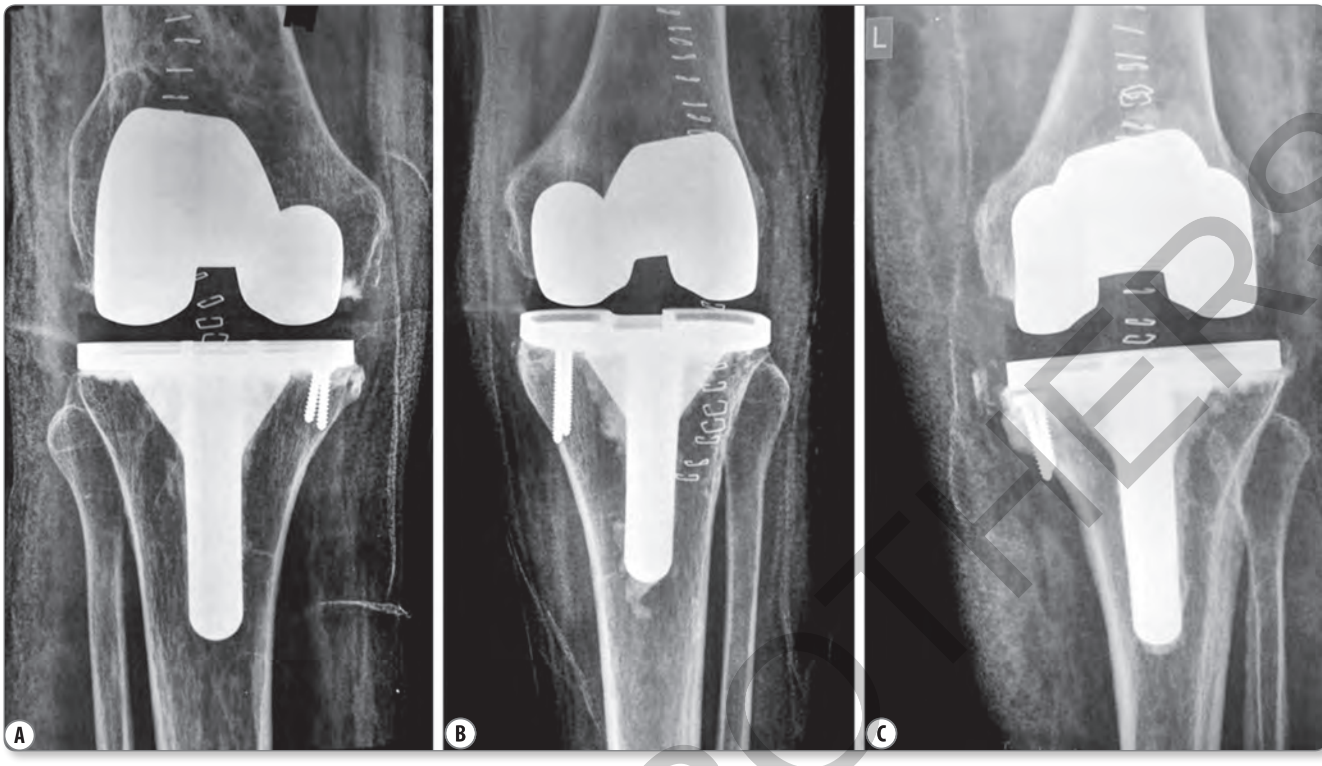


Fig. 3.30 Cemented rod 60 mm with tibial tray



Figs 3.31A to C Buit up the medial defect of tibial condyle by screws and bone cement augmented by 30 mm cemented rod

Post-HTO TKR

Eighty percent of the knees have patella infera after HTO which may contribute to alter biomechanics of patello-femoral joint after TKR. Preoperative templating is helpful in deciding the medialization or use of offset stem. Post HTO TKR is technically more demanding than primary TKR.

Technical Difficulties

Prior Incision

1. Longitudinal midline incision should be used for TKR regardless of incision of previous osteotomy.
2. In case of transverse incision, the longitudinal incision crossing at 90° is ideal, even up to 60° angle is safe.
3. Old healed long previous incision can be incorporated in new incision.
4. If more than one long scars then most lateral scar should be chosen.
5. The intervening bridge between old and new incision should not be less than 2.5 cm.

Soft Tissue Scarring

1. Periosteal exposure of proximal tibia is difficult.
2. Soft tissue dissection is more demanding and preferably done with scalpel or electrocautery rather than periosteal elevator or osteotome.

Patellar Eversion

1. Adherence and scarring of patellar tendon—shortening.
2. Difficult to evert patella.
3. Pin at tibial tubercle.
4. May need quadriceps snip/tibial tubercle osteotomy.
5. Lateral retinacular release.

Patella Infera (Insall-Salvati index)

Insall-Salvati index is defined as the ratio between length of the patellar tendon to the length of the patella in true lateral view X-ray of the knee in at least 30 degree flexion. This ratio is 0.9–1.1 in males and 0.94–1.18 in females (adults) and it is less in post HTO knee **(Figs 3.32A and B)**.

Implant

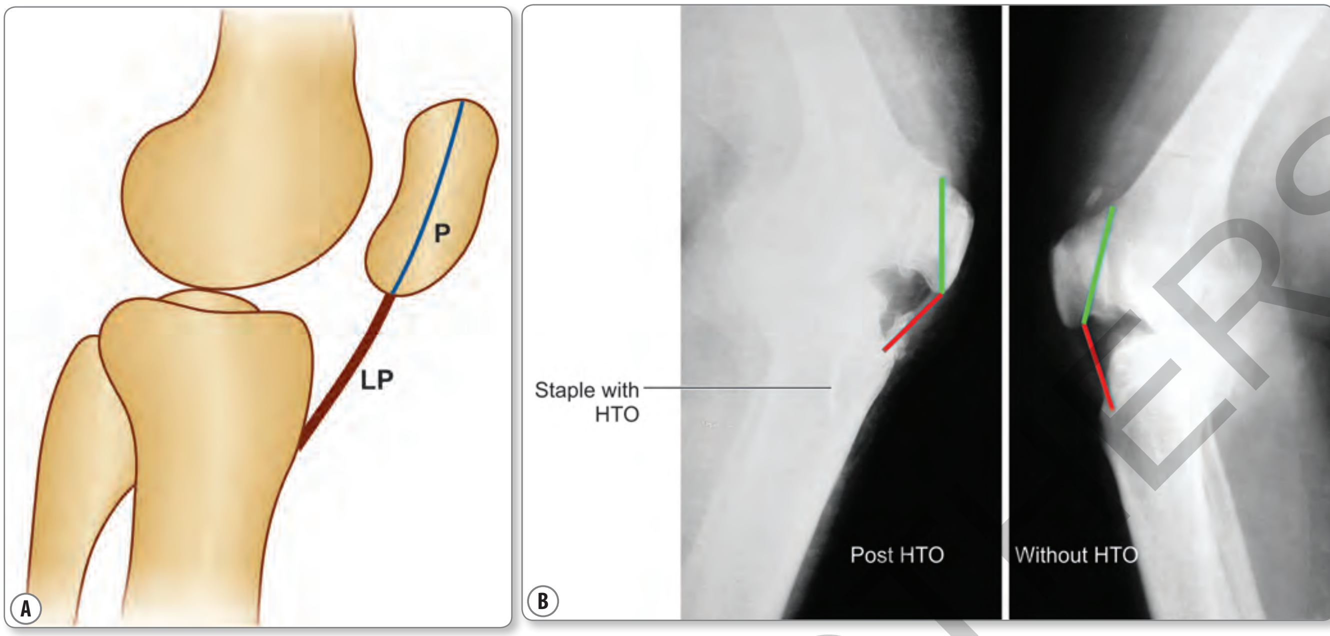
1. Preferably implants should be removed before TKR.
2. Possibility of subacute infection.

Varus Cut of Tibia

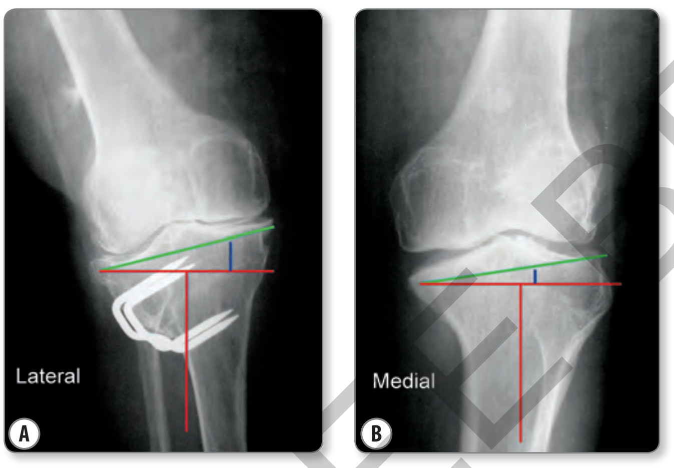
Altered mediolateral slope **(Figs 3.33A and B)**.

Loss of Bone Stock

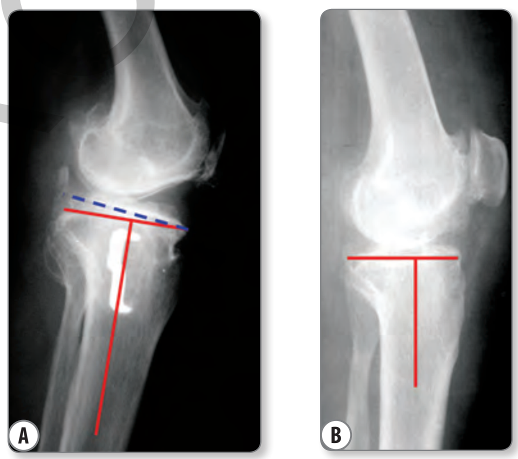
1. HTO results in reduction in amount of bone stock from proximal tibia.



Figs 3.32A and B (A) Diagrammatic picture showing length of patellar tendon and patella; (B) X-ray showing length of patellar tendon and patella



Figs 3.33A and B (A) With HTO, slope on lateral side; (B) Without HTO, slope on medial side



Figs 3.34A and B (A) Tibial cut in Post HTO TKR; (B) Tibal cut in primary TKR

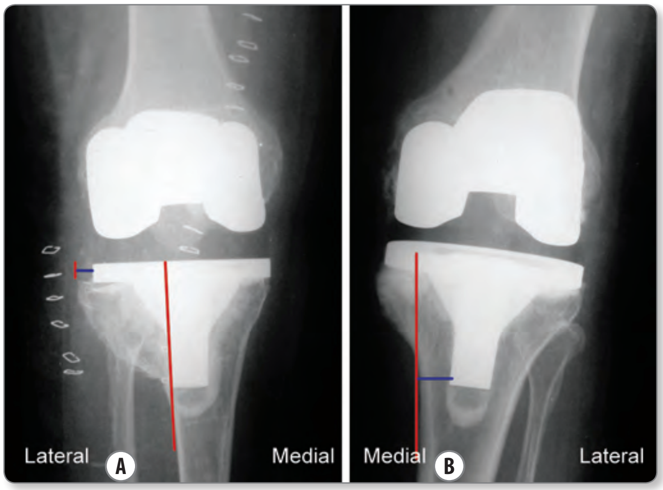
2. In closed HTO, removal of wedge of bone results in deficient lateral tibial plateau for tibial bone cut in TKR.
3. In open wedge osteotomy, wedge of bone elevated results in extra native bone resection from medial tibial plateau during TKR results in implant seated on bone graft.

Anterior Tilting of Tibial Plateau

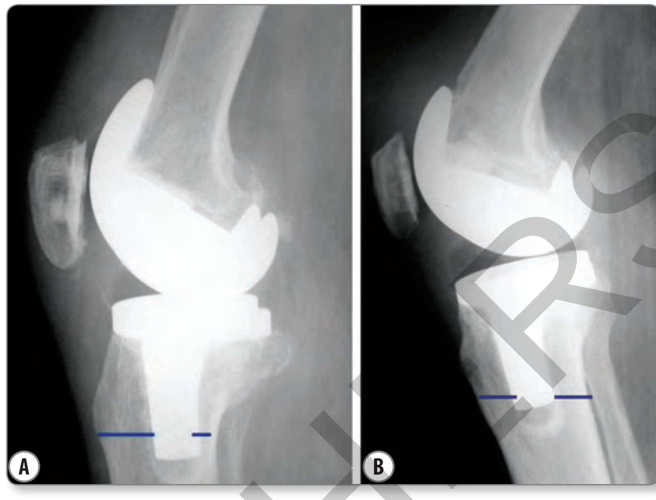
1. Osteotomy healed with anterior tilting of tibial plateau **(Figs 3.34A and B)**.
2. Considerable amount of bone cut from posterior aspect of tibial plateau.
3. Large space between femoral condyle and tibial plateau in 90° flexion.

Centralizing the Stem

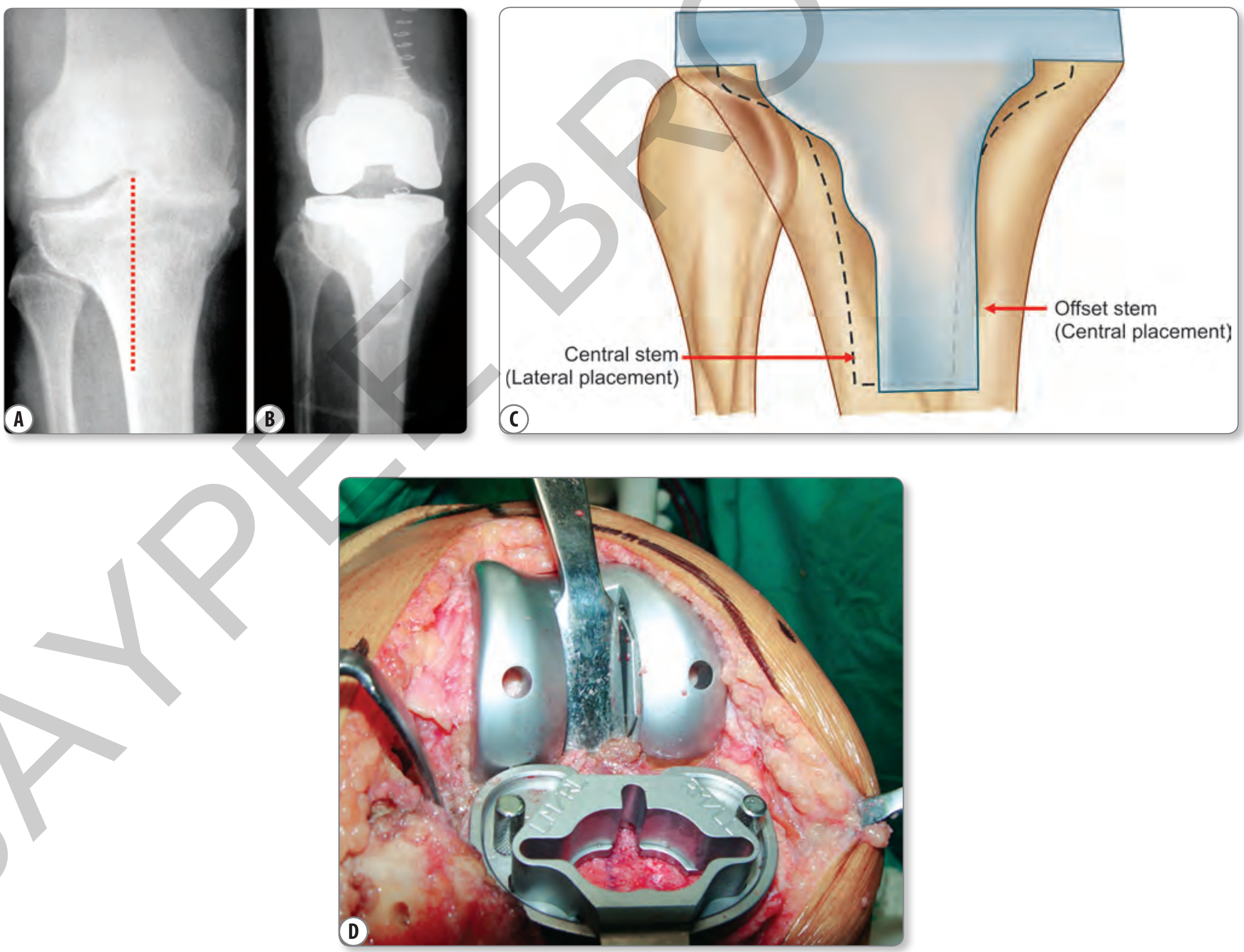
1. Altered geometry of upper tibia.
2. Any offset and malrotation of osteotomy will create mismatch between articular surface of proximal tibia and tibial shaft which results in difficulty to center the implant **(Figs 3.35 and 3.36)**.
3. Medialization of tibial stem but >5 mm medialization of tibial component should be avoided due to high risk of subluxation or dislocation of patella.
4. Possibility of offset stem tibial tray should be kept where there is chance of excessive lateral placement of tibial stem **(Figs 3.37A to F)**. This should be planned in advance after templating.



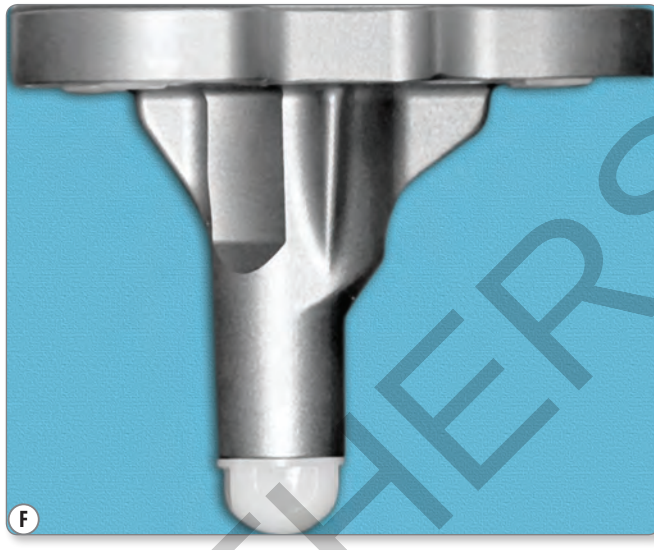
Figs 3.35A and B (A) Post HTO—Lateral placement of tibial stem even after medialization of tibial component; (B) Primary TKR central placement of stem



Figs 3.36A and B (A) Post HTO— Posterior placement of tibial stem; (B) Primary TKR central placement of tibial stem



Figs 3.37A to D (A) Post HTO; (B) Offset stem; (C) Diagrammatic picture of central and offset stem in tibial flare following HTO; (D) Tibial preparation for offset stem



Figs 3.37E and F (E) Trial tibial tray with peg for offset stem (anterior aspect); (F) Offset stem modular plus tibial tray (posterior aspect)

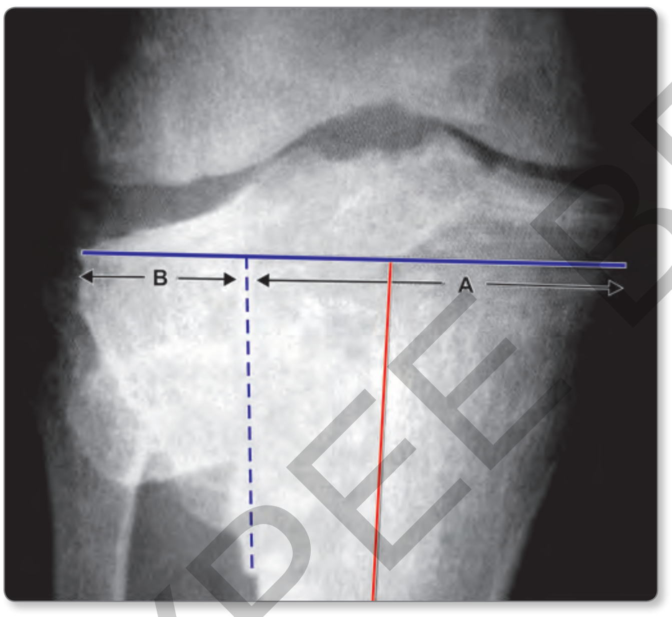


Fig. 3.38 Post-HTO with lateral flare

5. Tibial flare index: Draw a vertical line from the lateral tibial cortex up to the joint surface. Draw a horizontal line across the maximum width of the upper tibia.

$$\frac{\text{Lateral flare to medial tibial margin–A}}{\text{Lateral flare to lateral tibial margin–B}}$$

If the index is <2.5, anticipate difficulty in tibial tray placement and require a tibial tray with offset stem **(Fig. 3.38)**.

Non-union

1. Rare.
2. Long tibial stem is required.

Culture swab should be taken from osteotomy site to rule out possible subacute infection during TKR in cases of post HTO.

Important Points

Do Not Undermine the Skin

During midline skin incision, raise the skin flaps deep to the fascial layer to avoid skin necrosis.

Sequential Soft Tissue Release

Preliminary essential soft tissue release is being done on anteromedial and medial aspect of upper tibia in the beginning. Second time soft tissue release can be done while putting the spacer block between cut ends of femur and tibia if there is tightness in either medial or lateral side. Third time soft tissue release (posteromedial and posterior part of upper tibia) can be done when trial is being done with trial femoral and tibial component if there is tightness. Soft tissue release on the posterior surface of femoral condyle is being done in case of FFD.

Adequate soft tissue balance preserves bone stock and reduces cement bone interface stress which prevents early failure. A properly performed soft tissue release, which achieves balance between medial and lateral ligamentous structure and posterior capsule can provide stability to knee even in severe deformities.

1. *Soft tissue balance in varus deformity*: Stagewise soft tissue balance in varus deformity
   i. Generous dissection just below medial joint line.
   ii. Elevation of deep medial collateral ligament.
   iii. Removal of all osteophytes from entire margin of medial femoral condyle, medial and posteromedial margin of tibia.
   iv. Capsular release sub-periosteally from antero-medial and posteromedial margin of tibia.
   v. Release of semimembranosus from postero-medial aspect of joint.
   vi. Release of superficial medial collateral ligament.
   vii. Complete release of superficial medial collateral ligament and pes in severe cases.

   After each release, varus/valgus stability is examined. Care to be taken not to do over release. Under release of varus knee will be tight on medial side in extension. Over release will open on medial side.
2. *Soft tissue balance in valgus deformity*: Valgus deformity consists of bone loss from lateral condyle and lateral plateau tibia, lateral soft tissue contractures of IT band, lateral collateral ligament (LCL), popliteus tendon, posterolateral capsule and hamstrings. Medial collateral ligament (MCL) and capsule are elongated.

   Stage-wise soft tissue release in valgus knee:
   i. Removal of femoral and tibial osteophytes.
   ii. Iliotibial (IT) band (multiple puncture, i.e. pie-crusting of iliotibial band from inside out. Pie-crusting technique involves palpation of tight soft tissues followed by their selective release with multiple stabs of a BP blade No. 11).
   iii. Posterolateral capsule.
   iv. Popliteus.
   v. LCL (Lateral collateral ligament).
   vi. Gastrocnemius.
3. *Soft tissue release in flexion contracture of knee*:
   i. PCL detached from inter-condylar notch of femur.
   ii. Sub-periosteal release of posterior capsule from medial and lateral femoral condyle.
   iii. In severe cases, gastrocnemius release.

In varus deformity, the soft tissues on medial side are contracted which require stage-wise release **(Figs 3.39A and D)**. In valgus deformity, the soft tissues on lateral side are contracted which require stage-wise release **(Figs 3.39B and E)**. In subluxated knee, both medial and lateral collateral ligaments are elongated. So do only essential soft tissue release **(Figs 3.39C and F)**. Thicker plastic insert is usually required in cases of subluxated knee.

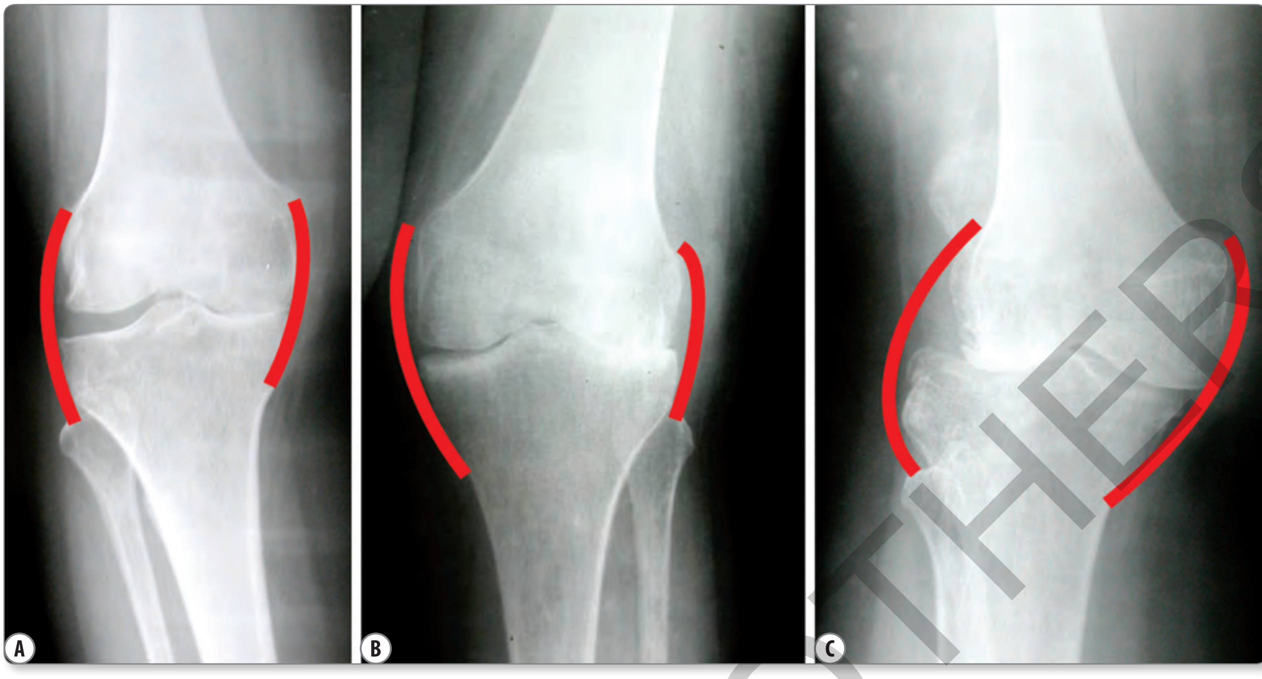
Balancing Flexion and Extension Gaps

Where there is preoperative deformity and contracture, imbalance of flexion and extension gaps may be present.

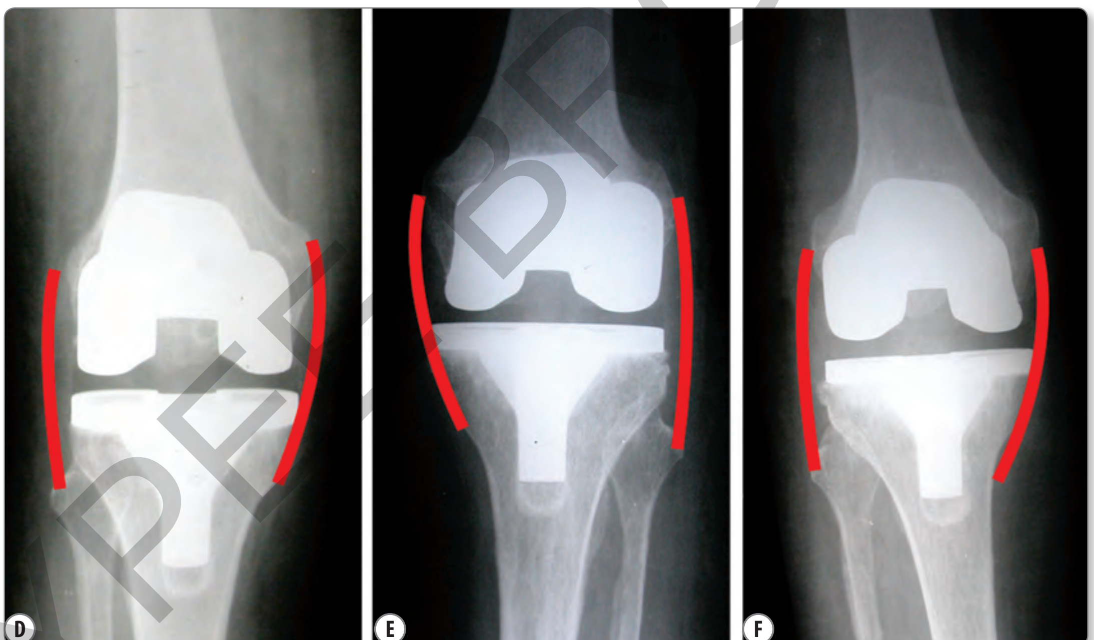
1. *Residual tightness in extension only*: When there is restriction in extension but not in flexion, additional bone is removed from the distal femur. This affects the extension gap but not the flexion gap. When contracture persists following appropriate retinacular release, removal of posterior osteophytes and scar tissues, depending on severity, removal of an additional 2–4 mm of distal femur is indicated. For this, the Steinmann pins are re-applied to their original position in the anterior femur and the distal cutting block returned to the pins using the holes designated +2. The distal cut is accordingly revised. Chamfer cuts are subsequently revised by open chamfer to maintain the correct configuration but A/P cuts are not revised. This affects ligamentous tension but not in flexion.
2. *Residual tightness in flexion and extension both*: A thinner tibial insert or additional tibial resection is indicated, as either will affect flexion and extension gaps. When resection is selected, 2 mm of proximal tibia is removed. For this, the Steinmann pins are re-applied to their drill holes in the anterior tibial cortex and the tibial cutting block returned to the pins using the holes designated +2. The cut is accordingly revised.
3. *Residual tightness in flexion only*: Residual posterior osteophytes, soft tissue and loose bodies may be factor and must be addressed. In the rare cases where tension persists following appropriate correction, 5° of additional posterior slope may be indicated. For this, the pins are re-applied to their holes in the anterior cortex of tibia and the 5° tibial cutting block positioned using the holes designated square. Final slope should not exceed 7°. Alternatively, tightness in flexion may be corrected by downsizing the femoral component, but there should not be anterior notching. The pins are re-applied to the distal femoral surface, the designated cutting block positioned and the cuts revised. As an additional posterior condyle is resected, flexion gap is increased. Alternatively, anteroposterior adjustment of the rod of tibial alignment device also allows the amount of posterior slope to be adjusted apart from the designed slope in the proximal tibial cutting jig. By moving the rod anteriorly about 5 mm at the ankle, 1° of posterior slope is increased at the proximal tibial jig.

Posterior Tibial Slope

Usually take 3° posterior sloped tibial cutting block for tibial cut but there are three circumstances in which posterior slope should not be applied. One is the severe flexion contracture. Every degree of posterior slope is building in a degree of flexion contracture. Therefore, posterior slope is not applied to relieve a severe flexion



Figs 3.39A to C (A) Varus knee (contracted medially); (B) Valgus knee (contracted laterally); (C) Subluxated knee (elongated both medially and laterally)



Figs 3.39 D to F Properly performed soft tissue release achieves adequate soft tissue balance after TKR in varus, valgus and subluxated knees

contracture. Second is the distorted tibial joint line. Post-osteotomy is the most frequent situation in which the tibial joint line slopes up instead of normally down. In that case, it is easier to balance the knee by not giving posterior slope. The third situation is with posterior stabilized component in which most system does not allow hyperextension of the articulating surfaces beyond 8–10°. Excessive posterior slope will increase the potential for tibial post impinging against the femoral housing in extension.

3° External Rotation

Upper surface of tibia has 3° varus slope **(Fig. 3.40)**. So ideally the tibial cut should be done at 87° to the mechanical axis of tibia **(Fig. 3.41)**. But tibial cutting at 87° is very difficult as one may cut more tibia. So chance of error in cutting tibia at 87° is very high. It has been demonstrated that tibial component placed in more than 5° of varus tend to fail by subsiding into more varus **(Figs 3.44 and 3.45)**. To avoid this error, we cut the tibia at 90° to the mechanical axis of tibia and this 3° varus slope of tibia is compensated by 3° externally rotating the AP cutting block of femur and cutting more posterior part of medial condyle of femur and creating rectangular space at 90° flexion of tibia (i.e. rectangular flexion gap) **(Fig. 3.42)**. If 3° external rotation of AP cutting block is not done then the space between femur and tibia at 90° flexion will be trapezoidal (i.e. trapezoidal flexion gap) which will lead to tight medial collateral ligament and lax lateral collateral ligament on flexion of knee at 90° **(Fig. 3.43)**.

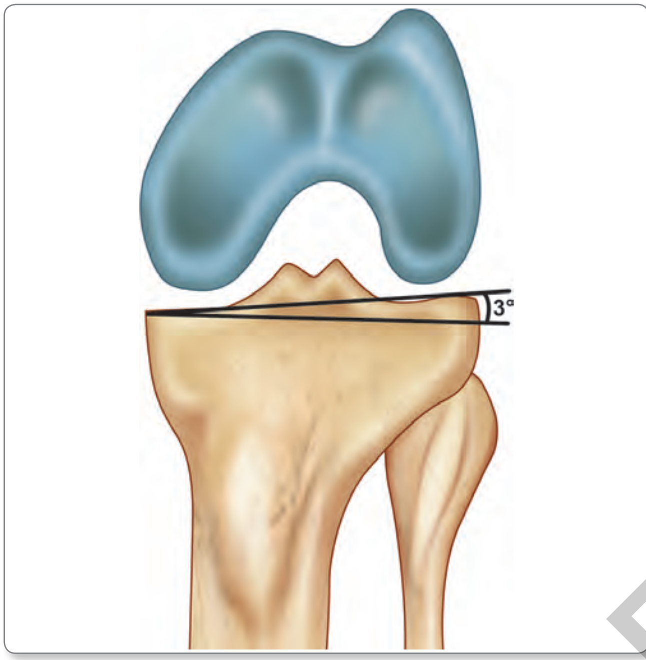


Fig. 3.40 Diagrammatic picture showing 3 degree varus slope of upper surface of tibia

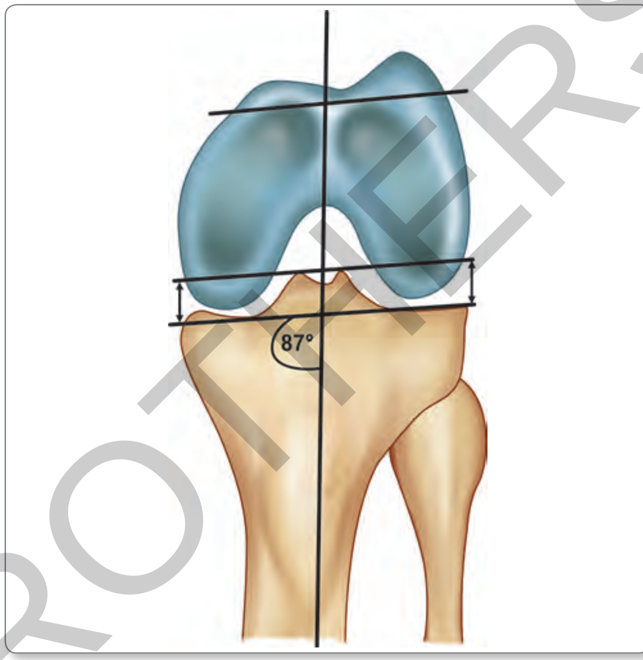


Fig. 3.41 Diagrammatic picture showing rectangular flexion gap if the tibial cut is done at 87° to the mechanical axis of tibia and posterior cut in neutral rotation but cutting the tibia at 87° is difficult and error in cutting is very high

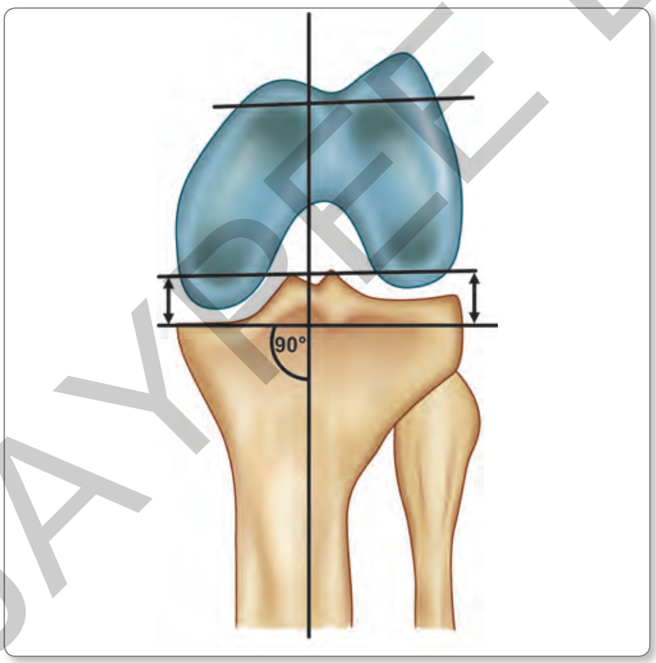


Fig. 3.42 Diagrammatic picture showing rectangular flexion gap if the tibial cut is at 90° to the mechanical axis of tibia and posterior cut in 3° external rotation

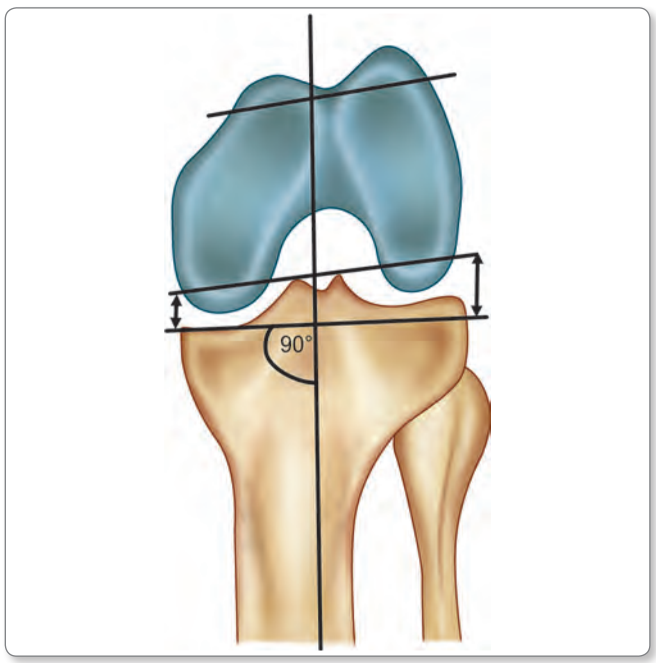


Fig. 3.43 Diagrammatic picture showing trapezoidal flexion gap if the tibial cut is done at 90° to the mechanical axis of tibia and posterior cut is not done in 3° external rotation (tight medial collateral ligament and lax lateral collateral ligament on flexion of knee at 90°)

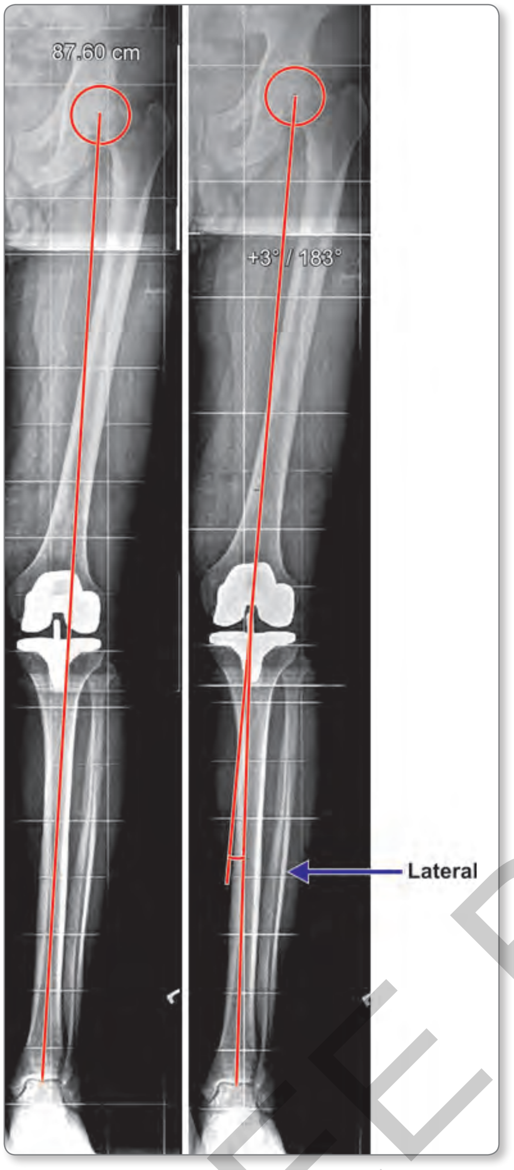


Fig. 3.44 Left knee—3° valgus (perpendicular cut of tibia) normal alignment

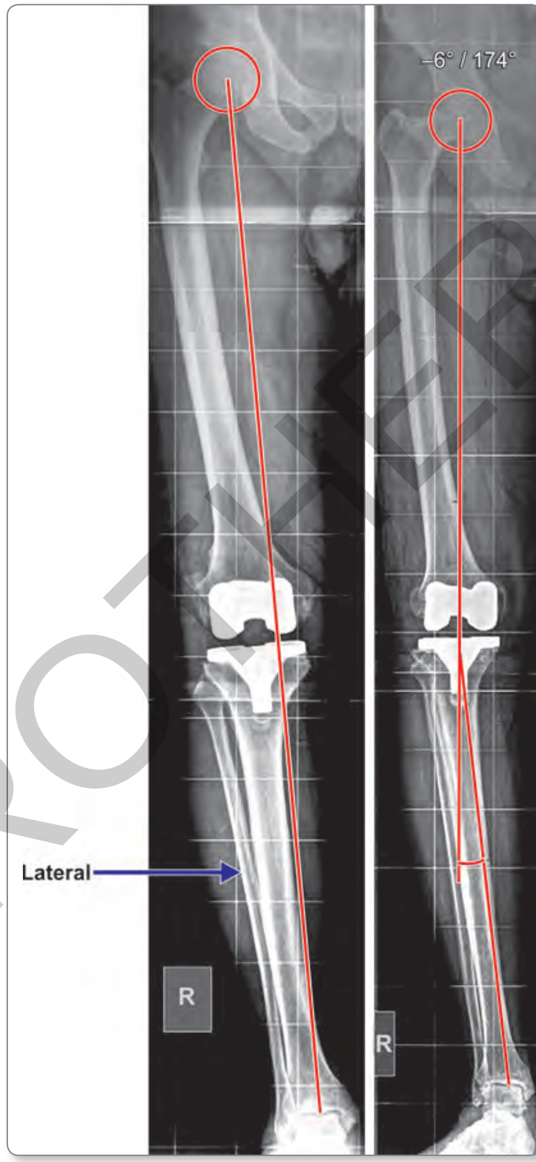


Fig. 3.45 Right knee—6° varus (varus cut of tibia—tends to fail) malalignment

Downsizing Versus Upsizing the Femoral Component

When the femur measures between two sizes, a decision needs to be made whether to "up-size" or "down-size" the femoral component. If the decision is made to downsize, the drill guide is set to lower size, and a lower size A/P cutting block is used. The anterior cut remains constant and more bone will be resected from the posterior condyles. If the decision is made to upsize, the drill guide needs to be set to higher size, and a higher size A/P cutting block is used. The anterior cut will remain constant, but less bone is removed from the posterior condyles. In both cases, the under or over resection of the posterior condyles will affect the flexion gap, and therefore, care must be taken to ensure that the flexion/extension gap is correctly balanced. Undersizing of the femoral component will create looseness in flexion and possible notching of the femoral cortex. Oversizing will create tightness in flexion and increased excursion of the quadriceps mechanism.

Important Points for TKR in FFD >20 Degree

1. Try to minimize the FFD preoperative by vigorous physiotherapy, passive stretching by use of knee brace and if required by traction and serial casting.
2. Resect the femur 11 mm in place of 9 mm. This will slightly increase the extension gap.

3. Remove posterior osteophytes as much as possible but take care of vessels lying nearby.
4. Do posterior release.
5. Lastly if not correcting the FFD, then resect tibia 2 mm more. This will slightly increase both flexion and extension gap.
6. Dedicated physiotherapy and use of knee brace postoperatively.

Avoid Elevating or Lowering Joint Line

Elevated joint line (>8 mm) leads to motion problems
1. Midflexion instability.
2. Patellofemoral tracking problems—increased stress over the patellofemoral joint.
3. Patella baja.

Lowered joint line leads to:
1. Lack of full extension.
2. Flexion instability.

Patellofemoral Alignment

Q angle: It is the angle between axis of extensor mechanism (ASIS to center of patella) and axis of patellar tendon (center of patella to tibial tuberosity). The normal Q angle is 7 degree for better patellar tracking **(Figs 3.46 and 3.47)**. Any increase in the Q angle will lead to increased lateral subluxation forces on the patella relative to the trochlear groove which can lead to pain and mechanical symptoms, accelerated wear, and even dislocation. It is critical to avoid techniques that lead to increased Q angle. Common errors include:
1. Internal rotation of the femoral component
2. Medialization of the femoral component
3. Internal rotation of the tibial tray
4. Placing the patellar implant laterally on the patella.

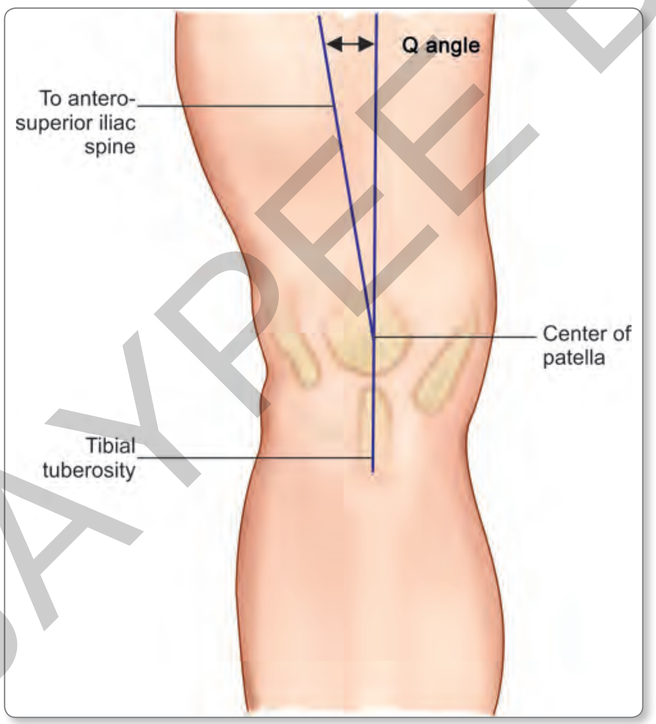


Fig. 3.46 Q angle

Check Variations

After exposure of the knee, look for variation in tibial condyle, femoral condyle and patella which, sometimes, may not be appreciated on preoperative X-ray of the knee. Deficiency in either condyle or patella may require proper adjustment of the guide, cutting block and the implants. For example, in deficient posterior part of either condyle or femur, the skid of femoral sizing guide will not sit against the deficient posterior condyle or sit in excessive rotation and hence the guide is adjusted in such a way that it lies perpendicular to the mechanical axis of the tibia. So the appreciation of variation is helpful to avoid the errors in cutting **(Fig. 3.48)**.

Two Packets Cement (CMW 1–40 g and 20 g)

Advantages:
1. Surgeon is more comfortable as there is no hurry for early setting of cement.
2. Two packets of cement are sufficient for bigger size knee while one packet may be less.

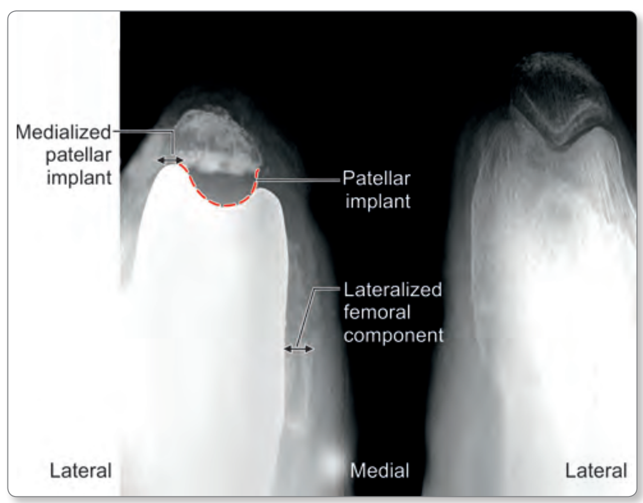


Fig. 3.47 Skyline view showing excellent patellar tracking when femoral component is lateralized and patellar implant is medialized (compare from nonoperated knee)

3. With two packets cement, the tibial component is pressurized against fixed femoral component hence there is no chance of tilting of component while pressurization. With one packet cement while pressurizing the femoral and tibial component against each other simultaneously, there may be tilt of component in cases of osteoporosed bone and rheumatoid arthritis cases.

One Packet Cement (CMW 1–40 g)

After gaining experience, one can do the cementing with one packet of 40 g bone cement especially in cases of osteoarthritis with good bone stock. The femoral and tibial components are pressurized against each other. The bone cement should be brought out from the refrigerator just before starting the cementing to avoid early setting.

Miscellaneous Points

1. Equal size tibial tray and femoral component are used but one size up or down tibial and femoral component can be used, e.g. size 2.5 tibial tray can be used with size 2 or size 3 femoral component and vise versa.
2. Lateralize the femoral component and medialize the patella for better patellar tracking.
3. Switch off the fan while cementing. This will avoid the change of cement setting time.
4. Don't talk while mixing the cement and implanting the components. This will avoid the distraction of mind and possibility of error.
5. Do not invert the skin while suturing it. This will avoid the non-healing of wound and bad scar.
6. Don't use tourniquet in cases whose preoperative X-rays show vessel calcification.
7. Must have minimum **two different sets** of saw system, e.g. pneumatic, electric or battery operated to avoid inconvenience if one system fails during surgery.

Precautions to Prevent Peroperative Complications

1. Always have a look over the insertion of patellar ligament while everting and retracting the patella to avoid avulsion. If patellar ligament is tight, fix it with a pin.
2. Avoid notching of anterior cortex of femur. Must check before cutting that AP and chamfer cutting block is placed properly and not upside down.
3. Always check with visualization guide before each cut.
4. Be careful while box cutting in smaller femur.
5. In short statured patient, keep 1.5 size implants also and size 5 in tall patient. Common sizes are 2, 2.5, 3 and 4.
6. In Indian patients, the anteroposterior diameter of lower end of femur is less than the mediolateral diameter and hence may affect the sizing of tibial and femoral components. Anteroposterior diameter of lower end of femur determines the size of femoral component.
7. In smaller femur, be careful while passing pins in AP and chamfer cutting guide and box cutting guide. It is better to drill with 2.5 mm drill before passing the pins to avoid avulsion of lateral or medial epicondyles.

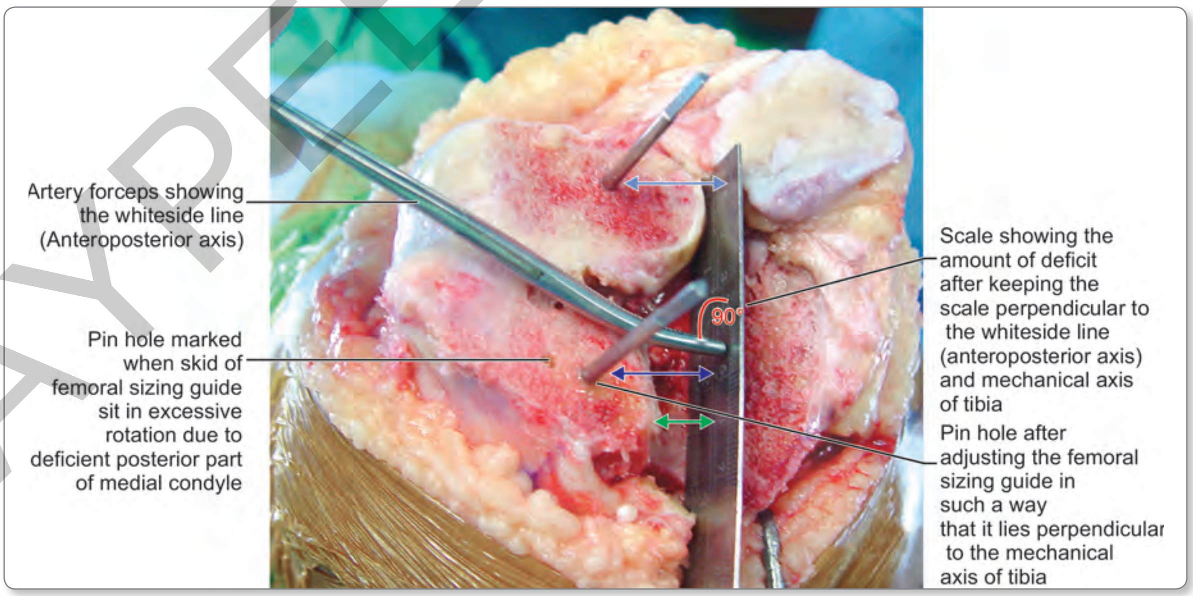


Fig. 3.48 Deficient posterior part of medial condyle (green line) where proper adjustment of femoral sizing guide avoids excessive removal of bone from deficient medial condyle

8. Box cut must be proper and adequate. First cut with saw then with osteotome to avoid splinter of femoral condyles. Fine tuning should be done by bone file and nibbler before putting the trial femoral component box assembly. The trial femoral component box assembly should be applied first with pressure of palm then with femoral punch and gentle hammer to avoid splintering of femoral condyles.
9. Use saw and osteotome for widening during upper tibial preparation before broaching to avoid shattering of upper tibia.
10. While cementing and pressurization of the components, keeping the knee in extension, apply controlled force to avoid supracondylar fracture especially in osteoporosed bone and rheumatoid arthritis cases.
11. While cementing, take care that appropriate size and side of femoral component is being applied without posterior tilt and the tibial tray in proper orientation.

Avoid Silly Mistakes

Never put wrong femoral component (i.e. putting right femoral component on left femur or vice versa). This silly mistake can be avoided by:

1. Be sure that the decided knee is being operated.
2. Keep the femoral component of the same side only.
3. The operating surgeon must see the packet of femoral component before opening and make sure that the same side femoral component is being opened.
4. Do not be in hurry while performing such type of special surgery where mistakes and errors are not acceptable.

Contraindications of TKR

1. Acute infection in joint or elsewhere in body.
2. Neuropathic arthropathy.
3. Severe deformity which is away from knee joint due to old fracture, bowing of bones.
4. Nonfunctioning muscles acting on joint.
5. Painless ankylosis.
6. Very poor bone stock.
7. Non-compliant patients.
8. Low socioeconomic conditions.

Ideal Indicated Patient for Successful TKR

1. Demand of the patient.
2. Understanding risk-benefit ratio.
3. Shared decision making.
4. Acceptance of postoperative follow-up protocol.

Complications

1. Thromboembolism
2. Infection
3. Patellofemoral complications: Patellofemoral instability, patellar fracture, patellar component failure, patellar component loosening, patellar clunk syndrome and extension mechanism tendon rupture.
4. Neurovascular complications: Arterial compromise (rare), peroneal nerve palsy.
5. Periprosthetic fractures.
6. Polyethylene wear.
7. Arthrofibrosis.
8. Aseptic loosening.
9. Flexion instability: This is a sense of instability without giving way, recurrent knee effusions, multiple areas of soft tissue tenderness about the knee and substantial anterior tibial translation at 90 degrees of flexion. The revision operation focused on balancing the flexion and extension gaps while taking care to fill the enlarged flexion gap. This may occur due to error in tibial cut, malrotation of femur, excessive ligament release, MCL rupture, flexion-extension mismatch in flexion contracture, thin poly syndrome and Next size syndrome.
10. Joint jack phenomenon: Correction of varus/valgus deformity via soft tissue balancing is the accepted technique in knee arthroplasty surgery. However, in rare instances, excessive ligamentotaxis can result in overly stretched periarticular structures leading to pain and impaired function. This has been called the "joint jack phenomenon." A very thick polyethylene insert will result in a painful knee and leg length discrepancy. Solution is to use a salvage hinge knee arthroplasty to achieve joint space reduction, restore equal leg lengths, and avoid global instability.

Implants and Cement Required for Primary TKR (Fig. 3.49)

1. Cruciate substituting femoral component—right and left
   (M/L—Mediolateral, AP—Anteroposterior)
   Size—1.5 (57 mm M/L, 53 mm AP)
   2 (60 mm M/L, 56 mm AP)
   2.5 (63 mm M/L, 59 mm AP)
   3 (66 mm M/L, 61 mm AP)
   4 (71 mm M/L, 65 mm AP)
   5 (73 mm M/L, 69 mm AP)

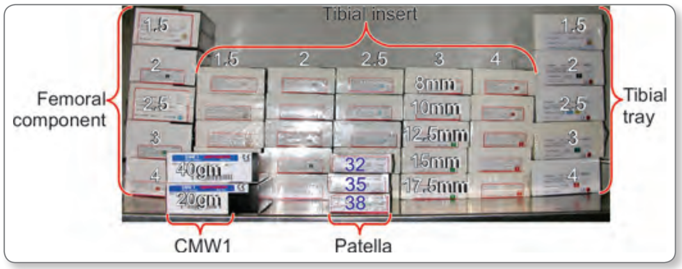


Fig. 3.49 Stock of implants and bone cement usually required during primary TKR

2. Modular tibial tray, (modular plus tibial tray if wedge has to be used and offset stem modular plus tibial tray in post HTO tibial flare, RM/LL and LM/RL)
   RM/LL—Right medial/Left lateral
   LM/RL—Left medial/Right lateral
   Size—1.5 (61 mm M/L, 41 mm AP)
   2 (64 mm M/L, 43 mm AP)
   2.5 (67 mm M/L, 45 mm AP)
   3 (71 mm M/L, 47 mm AP)
   4 (76 mm M/L, 51 mm AP)
   5 (83 mm M/L, 55 mm AP).
3. Stabilized tibial insert
   Size— 1.5, 2, 2.5, 3, 4, 5
   Thickness: 8 mm, 10 mm, 12.5 mm, 15 mm, 17.5 mm
4. Oval dome patella
   Size—32 mm (8 mm thick), 35 mm (8.5 mm thick), 38 mm (9 mm thick) and 41 mm (11.5 mm thick).
5. CMW1 gentamicin—40 g and 20 g.

Knee Implants

Femoral component and tibial tray are made up of Co-Cr-Mo alloy. The femoral components are available in right and left configuration. The components have a grit blasted finish of entire fixation surfaces to provide for enhanced cement fixation.

The tibial insert and patellar implant are made up of ultrahigh molecular weight polyethylene (UHMWPE). A new cobalt-chrome (CoCr) tibial tray and moderately cross-linked tibial insert have been added to the PFC sigma modular knee system. The cobalt-chrome alloy modular tibial tray is having the 12 locking mechanism and moderately cross-linked polyethylene further reduces the potential for polyethylene wear. Improvements in the locking mechanism of modular tibial components minimize the relative motion and thus reduces all forms of backside wear.

Summary of TKR (Steps in Sequence)

1. Midline skin incision and medial para patellar approach.
2. Sequential soft tissue release.
3. Removal of osteophytes, infrapatellar fat pad, medial meniscus, lateral meniscus, ACL, PCL, supracondylar synovectomy and release of patellofemoral plicae.
4. Tibial cut perpendicular to tibial axis (0 mm on more involved condyle or 8 mm or maximum 10 mm on less involved condyle) with usually 3° posterior sloped tibial cutting blocks.
5. Femoral cuts (7° valgus, 9 mm thickness, 3° external rotation)—6 cuts
   i Distal cut.
   ii. Anterior cut.
   iii. Posterior cut.
   iv. Anterior chamfer cut.
   v. Posterior chamfer cut.
   vi. Box cut (in lateralized position).
6. Rectangular and equal flexion—extension gap.
7. Resurfacing of patella and drilling for 3-pegs of patellar implant in superiorly and medialized position.
8. Tibial preparation in 3 degree external rotation (appropriate size drilling, widening with saw and osteotome, broaching).
9. Wash with gentamicin mixed normal saline by pulse lavage.
10. Cementing of patella, femoral component and tibial tray in sequence.
11. Apply appropriate size and thickness of tibial insert, reduce and extend the knee.
12. Apply two drains and suture the wound in layers.

Instruments Required for TKR (Figs 3.50 to 3.54)

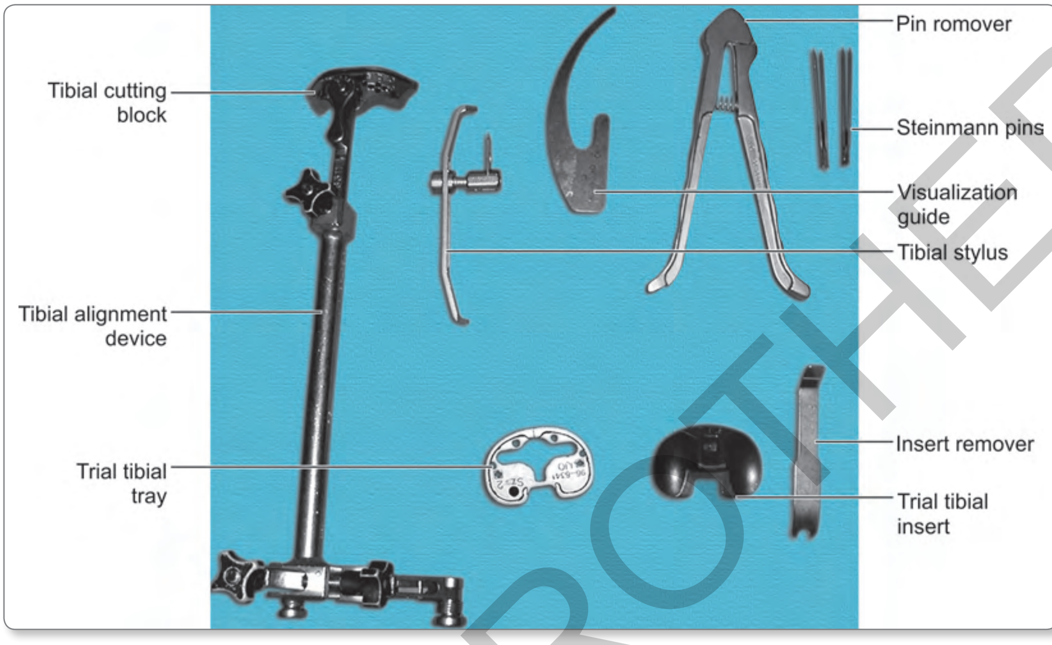


Fig. 3.50 Instruments required for tibial cutting and sizing, insert and insert remover

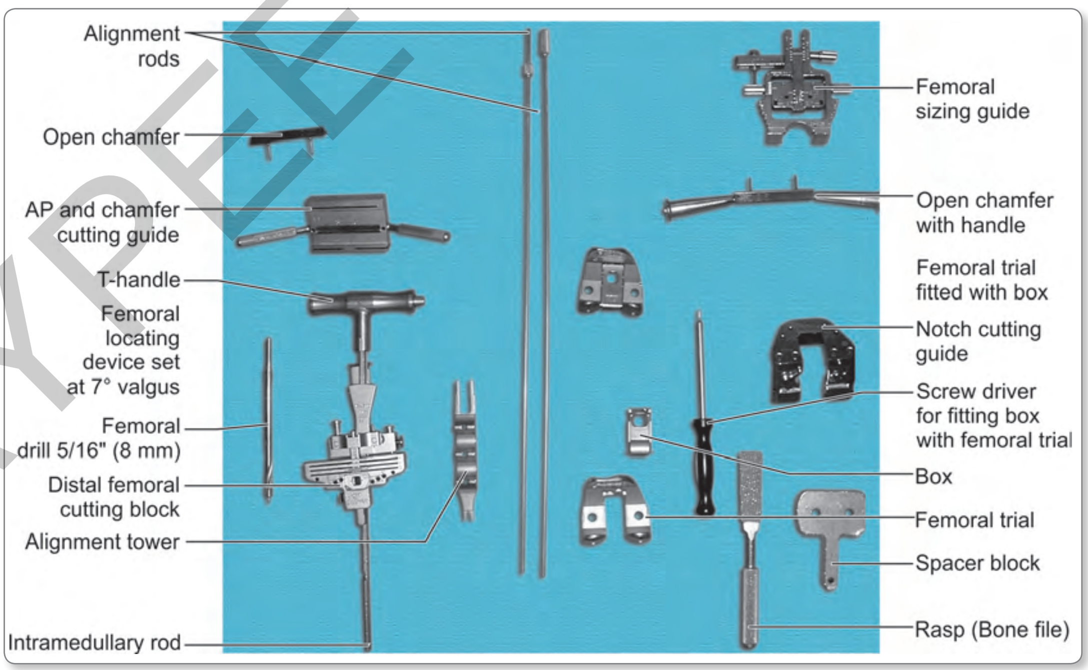


Fig. 3.51 Instruments required for femoral cutting

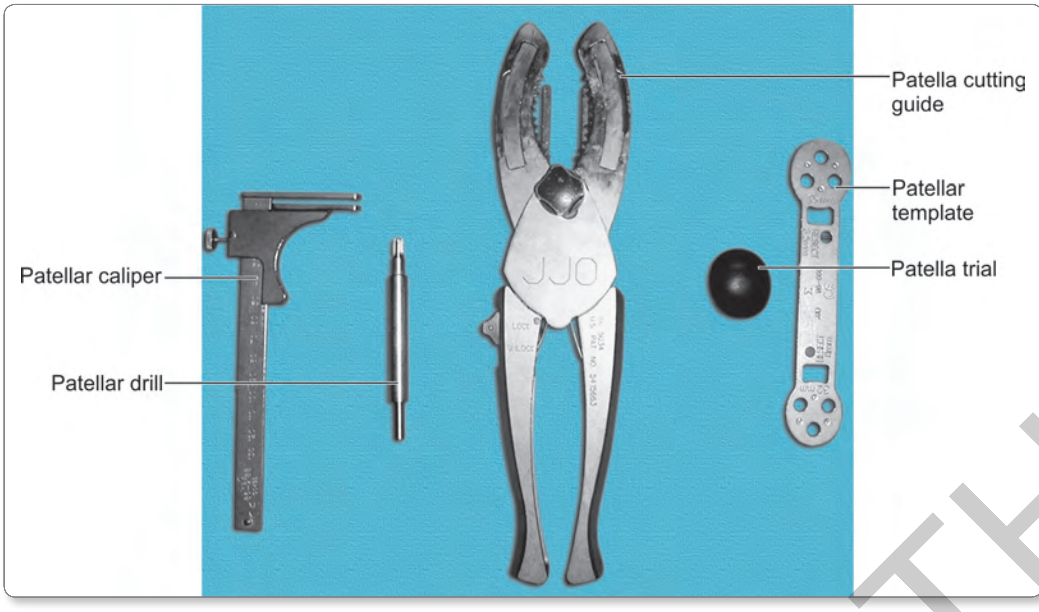


Fig. 3.52 Instruments required for patellar resurfacing

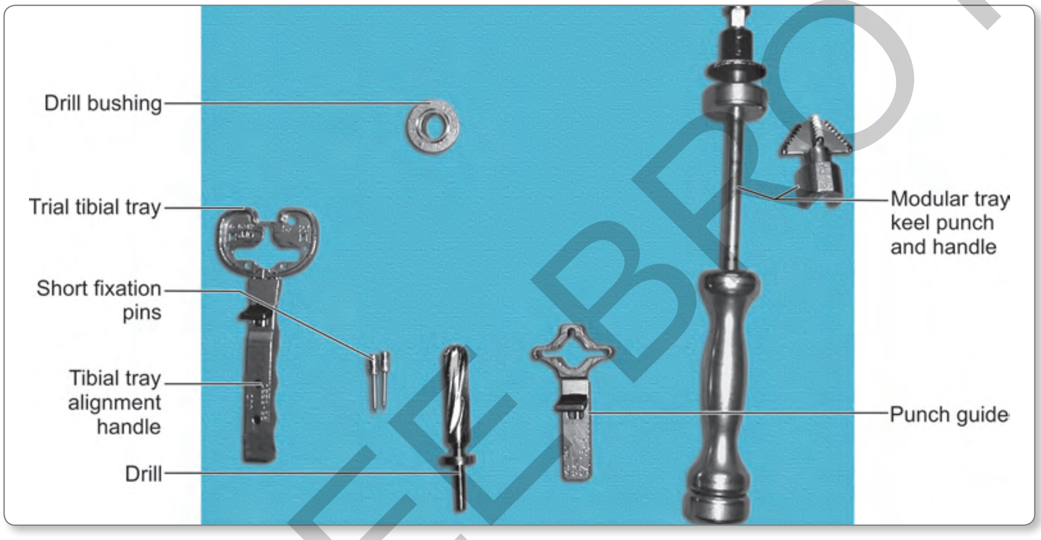


Fig. 3.53 Instruments required for tibial preparation

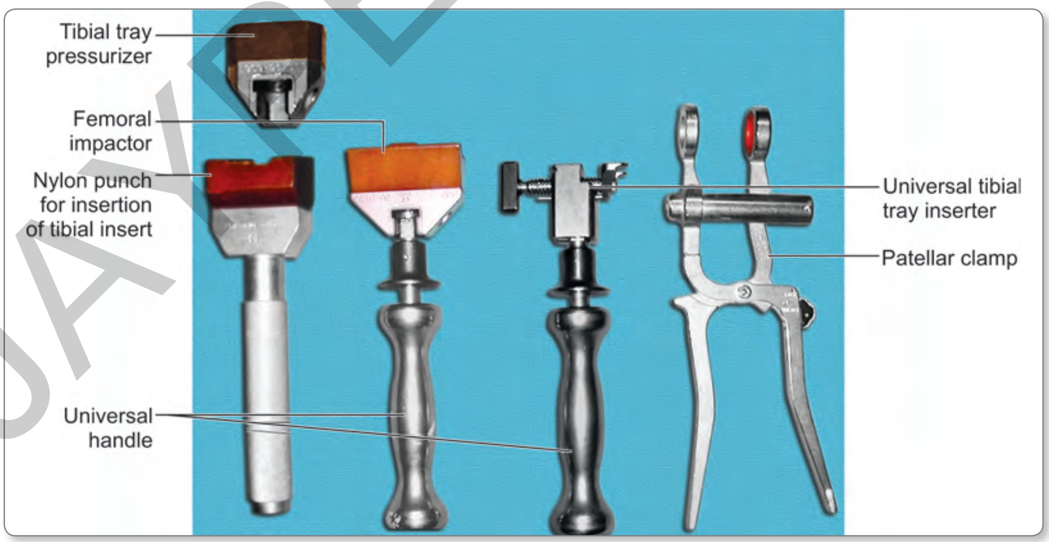


Fig. 3.54 Instruments required for cementing and insertion of tibial insert