Varus Distal Femoral Osteotomy: Lateral Opening

16

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Introduction

In this chapter, we present the surgical steps to perform an opening lateral wedge distal femoral osteotomy for valgus deformity; fixed either with a 95 angled blade plate, or a locked plate. The overall aim of this osteotomy is to correct the mechanical axis of the lower limb to a normal varus (0–3° of varus). In general, it is better to slightly overcorrect than to under correct. During preoperative planning, one can determine the desired angle of correction and the opening that will be needed to obtain this correction.

Radiological Workup

See chapter on surgical indications for osteoarthritis.

The radiographs serve not only to determine the proper indications but also to measure the correction needed (Figs. 16.1, 16.2 and 16.3). A torsional deformity is likely if the valgus is due to femoral fracture.

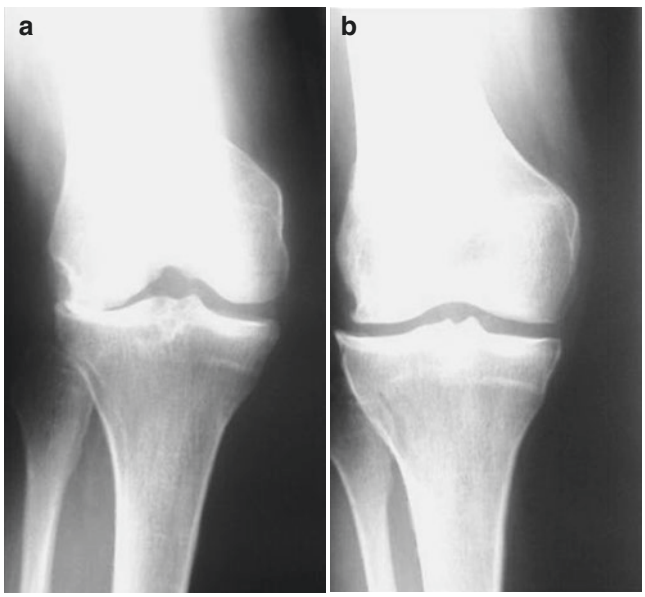

Fig. 16.1 Schuss X-rays (**a**) have better sensitivity for osteoarthritis diagnosis than full extension X-ray (**b**), particularly for lateral femoro-tibial OA

Surgical Technique: 95° Plate

With the knee in 90° of flexion, a lateral skin incision starts 15 cm proximal to the joint line and ends at a level of Gerdy's tubercle (Fig. 16.4). The fascia lata is incised slightly anteriorly in the direction of its fibres and the lateral vastus muscle is elevated. The perforating arteries of the vastus lateralis are carefully coagulated or ligated. Subsequently, the vastus lateralis is elevated from the intermuscular septum and the lateral border of the femoral diaphysis, using a periosteal elevator. The patella tendon is identified and a limited lateral arthrotomy is performed: this is to visualise the orientation of the trochlea and the condyles. Two guide pins are inserted into the joint: one at the femoro-tibial joint line, another in the patello- femoral joint (Fig. 16.5). The guide pins act as a guide to help orient the surgeon to accurately place the blade plate. This step reduces the radiation due to imaging. Next, the osteotomy site is prepared. The osteotomy is horizontal, just proximal to the lateral part of the trochlea. An additional anterior coronal osteotomy may be added to increase stability. With the knee in extension, the supra-patellar pouch is elevated and with the knee at 90° of flexion soft tissues on the posterior side of the metaphyseal region are elevated. With the oscillating saw, a landmark is made on the lat-

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P Neyret et al. (eds.), *Surgery of the Knee*, https://doi.org/10.1007/978-3-030-19073-6_16

Fig. 16.2 Long leg films (full weight bearing) are required to measure the femoro-tibial mechanical axis, the femoral mechanical axis, and the tibial mechanical axis and to diagnose a lower limb discrepancy

eral side of the femur perpendicular to the horizontal osteotomy. This mark will serve as a guide to determine the rotation following osteotomy (Fig. 16.5).

Introduction of the Blade

The blade should be introduced into the epiphyseal region, 30 mm proximal to the joint line. The blade plate is 5.6 mm in thickness, 16 mm in width, and the distance between the screw holes is 16 mm. The guide for the blade plate should be introduced anteriorly and proximally to the femoral insertion of the lateral collateral ligament. The angle of insertion depends on the level of the deformity. If the deformity is situated at the diaphyseal level, the blade should be introduced obliquely to the joint line (Fig. 16.6). To obtain a varization of 10°, the angle should be set at 75° (85°–10°; complementary angle to the anatomical medial distal femoral angle (95°)—angle of correction). If the deformity is situated at the metaphyseal level, the blade should be introduced parallel to the joint line (Fig. 16.7). This is the most common situation. When introducing the blade parallel to the joint line, an automatic correction to the normal anatomical femoral valgus of 5° is automatically obtained by introducing a 95° angle blade plate. In other words, if the femur is normal, no correction would be obtained when the blade plate is introduced parallel to the joint line. If we are confronted with a combined deformity or mixed with a metaphyseal component (lateral condyle hypoplasia or diaphyseal malunion), the angle of introduction should be even smaller and the blade plate should be introduced at a smaller angle. This preoperative planning is essential to evaluate the correction needed.

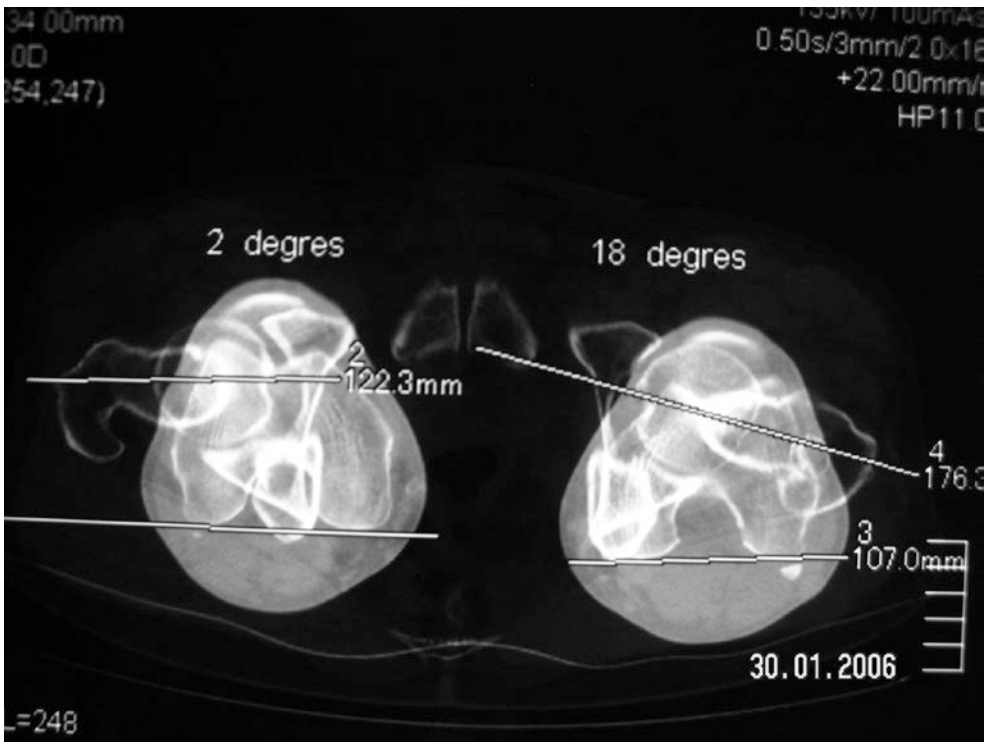

Fig. 16.3 In case of rotational deformity, a CT-Scan is required to measure the femoral neck anteversion/retroversion according to the posterior condyles line

Fig. 16.4 The skin incision is from 15 cm proximally to the joint line to the Gerdy's tubercle

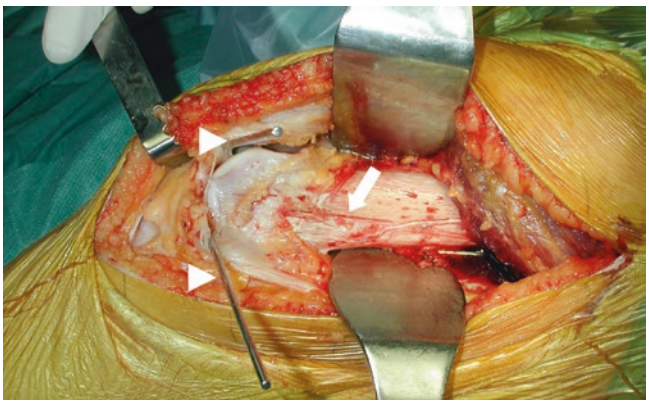

Fig. 16.5 Preoperative view showing the lateral cortical of the femur (left knee). A proximal arthrotomy is necessary. Two wires (left arrows) are inserted into the femoro-tibial joint and patello-femoral joint. A rotational landmark is superficially done on the femoral cortex using the saw (right arrow)

Intra-operative Control

The position of the blade can be checked using the image intensifier. The angle of correction can now be measured on a printout by drawing a line tangent to the medial and lateral condyle and another line tangent to the blade.

The Osteotomy

The femoral osteotomy is performed with an oscillating saw. The medial cortex should not be cut (the saw should "knock on the door" of the medial cortex as said by Henri Dejour). The blade plate is introduced, and the medial cortex is weakened using a 3.2 mm drill bit. Two or more osteotomes are then introduced into the osteotomy. It is however the impaction of the blade plate that will progressively open up the

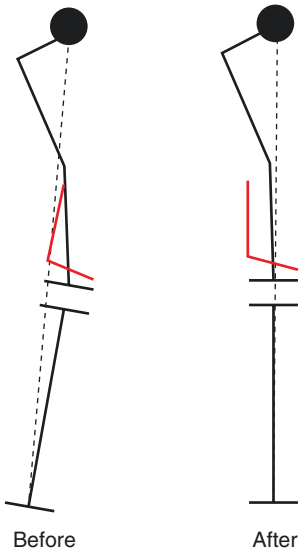

Fig. 16.6 Diaphyseal deformity: the blade should be introduced obliquely to the joint line. The correction angle will be equal to the femoral deformity angle

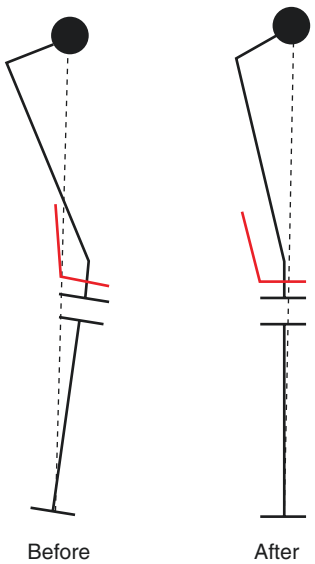

Fig. 16.7 Metaphyseal deformity: the blade should be introduced parallel to the joint line. An automatic correction to the normal anatomical femoral valgus of 5° is automatically obtained

osteotomy once in contact with the diaphysis. Temporarily, a screw is placed in the distal part of the oval screw hole (Fig. 16.8a). The blade plate is now impacted. The screw is then in the proximal zone of the hole (Fig. 16.8b). Subsequently, a screw is introduced in another screw hole while the former is taken out (Fig. 16.8c). The impaction of the blade plate is continued and the osteotomy will progressively open up until the blade plate is in full contact with the lateral side of the femoral diaphysis (Fig. 16.9).

Progressive impaction allows opening of the osteotomy. Provisional fixation with one screw helps to control the correction and gives additional stability. By playing with the

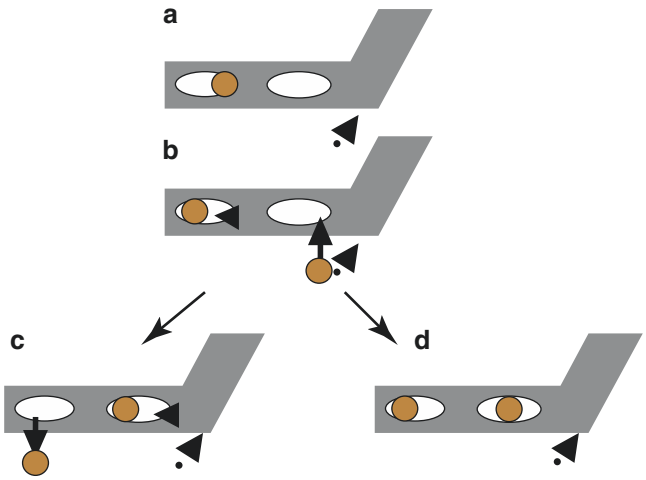

Fig. 16.8 A screw is temporarily placed in the distal part of the oval screw hole (**a**). The blade plate is then impacted. The screw is in the proximal zone of the hole (**b**). Subsequently, a screw is introduced in another screw hole while the former is taken out. First situation: the blade impaction enhances the corrective effect if the first screw is removed (**c**). Second situation: the blade is impacted without removal of the first screw stopping the corrective effect (**d**)

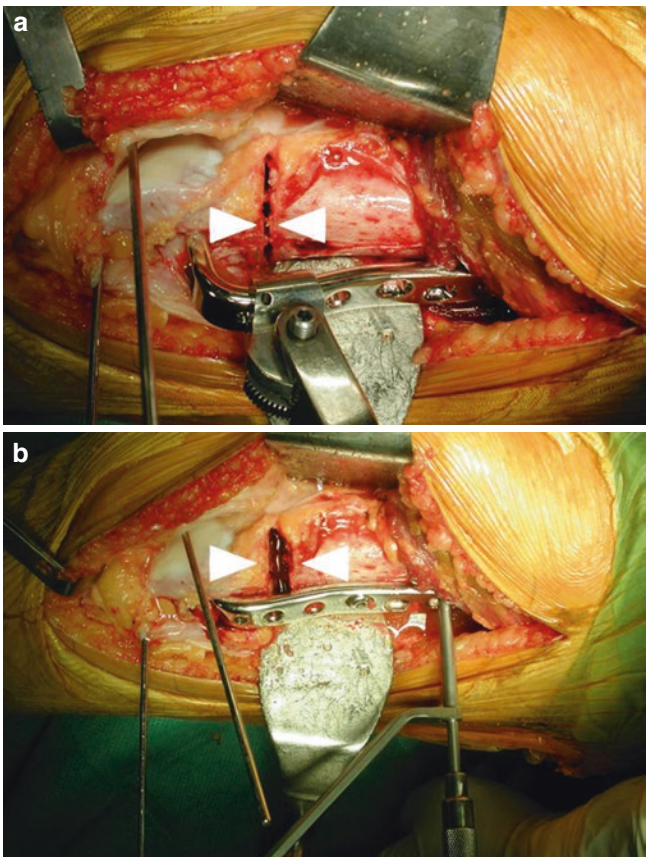

Fig. 16.9 The impaction of the blade plate is continued and the osteotomy will progressively open up until the blade plate is in full contact with the lateral side of the femoral diaphysis

impaction and the positioning of the screws, one can either augment or decrease the amount of opening. If the blade plate is impacted with the screw left in place, the correction will be halted. To the contrary, if an additional screw is again placed in the distal part of the screw hole and the former screw is taken out, the correction can be augmented (Fig. 16.8c). Final fixation of the blade plate is achieved by four cortical screws of 4.5 mm diameter (Fig. 16.10). Cortical and cancellous iliac crest bone grafts are used to fill the osteotomy site. The soft tissues and skin are closed over a drain, which is introduced underneath the fascia lata.

Surgical Technique: Locked Plate

The technique is different in several aspects:

- It is possible to make a smaller approach in some cases when using a locked plate, making a shorter incision, and only elevating the very distal part of the vastus lateralis. The plate can be slid under the vastus lateralis, and screw insertion performed through the skin and muscle. We prefer routinely a loner approach in order to well position the plate along the shaft. An arthrotomy is optional and may be directed by any desire to treat intra-articular pathology (like a lateral partial facetectomy). In this case, a formal but limited lateral parapatellar approach may be more appropriate.
- The osteotomy must be performed and opened before the application of the plate. Consequently, great care must be taken to maintain stability while opening the osteotomy. To aid in this regard, the osteotomy may be more oblique, aiming towards the flare of the medial femoral condyle where the bone is less brittle (Fig. 16.11). Subsequent opening of the osteotomy is slow and controlled with one or two laminar spreaders, avoiding complete fracture of the medial hinge, or a sagittal plane deformity. Once satisfactory alignment has been confirmed with a metal rod or cord, the plate can be applied and fixed. If using bone graft, additional stability can be achieved at this point by the addition of wedges, applied anterior or posteriorly to counter any tendency to anterior or posterior tilt.
- The particular plate must be analysed for screw position, and the osteotomy started on the lateral cortex at an appropriate place to maximise the number of screws in the distal fragment. In practice, starting just proximal to the lateral superior geniculate vessels will be sufficient. The varying anatomy in this region means that the contoured plate may not fit the bone perfectly, but the temptation to prioritise fit over screw position must be resisted. The most distal screws may be needed to be short to avoid entering the intercondylar notch. Our concern is the amount of correction. In fact, once the plate is perfectly adapted to the lower

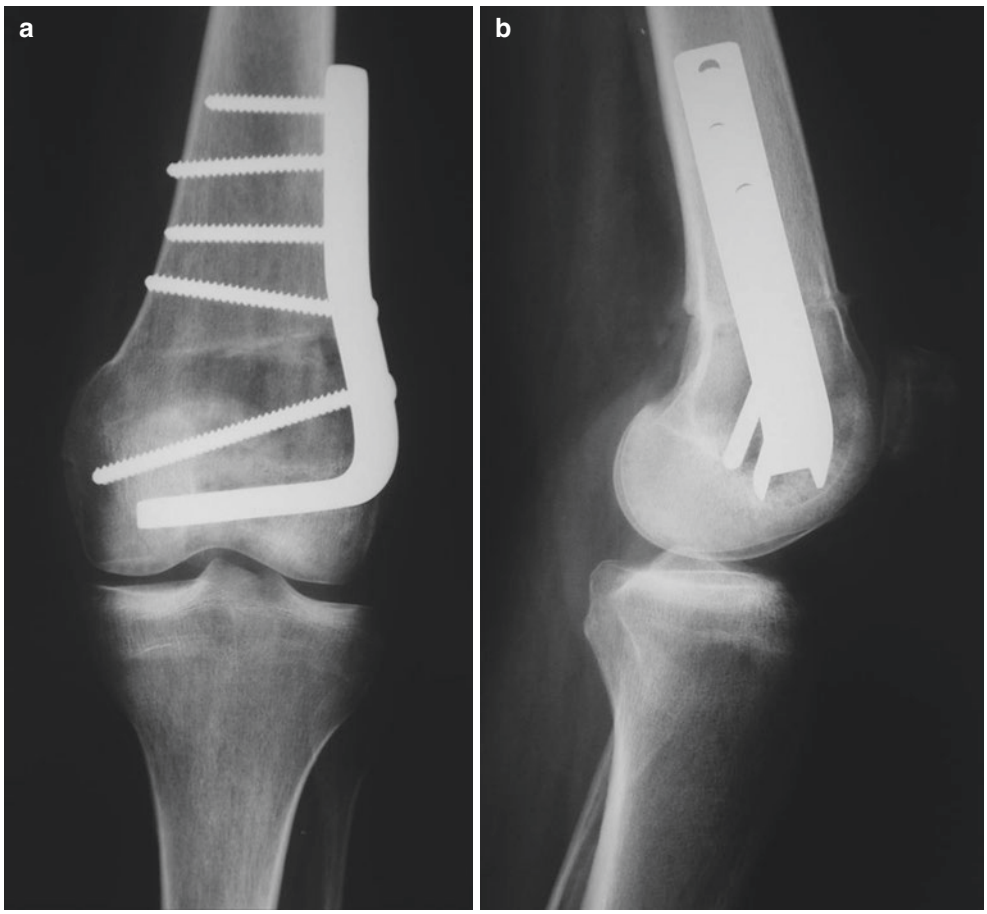

Fig. 16.10 (**a**, **b**) Post-operative X-rays showing a 95° angle blade plate with 4 proximal cortical screws. The final femoro-tibial angle is good

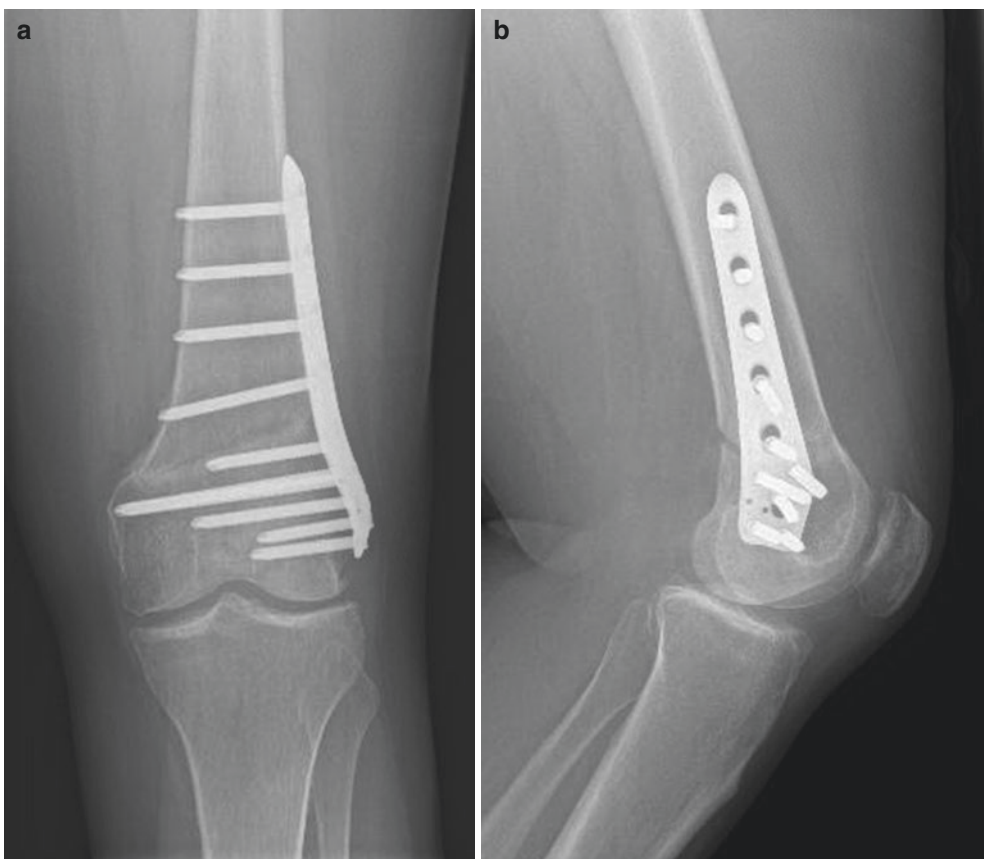

Fig. 16.11 (**a**, **b**) Post-operative X-rays showing a locked plate. The osteotomy is oblique, aiming towards the medial flare of the medial femoral condyle

extremity the angle of the distal shaft and the line passing through the 2 condyles is 95° and the anatomical angle number 1 is 90°. This plate is perfect for treatment of fracture, sequellae of supracondylar fracture or epiphysiodesis without osteoarthritis. But it doesn't allow for a proximal deformity of the mid diaphysis malunion or a correction of articular deformity. To do so one needs to bend the plate or to use a customised plate. The current plates available (e.g. Tomofix, Synthes) are very strong, and altering the shape is problematic.

- Future directions
  A solution could be a customised plate. The plate will be designed in order to fit the bone after correction. We are considering this option with both locking screws and normal screws in oval holes in order to combine the advantages of the blade plate with a controlled progressive correction and the rigidity of the fixation with locking screws.

Post-operative Guidelines

Continuous passive motion is initiated immediately post-operatively. The flexion should be limited to 120° for the first 15 days post-operatively. Non-weight bearing is continued for 2 months and an extension brace is applied. Complications are observed somewhat more frequently than after a tibial osteotomy. Specifically, blood loss can be significant and stiffness of the knee and delayed union are more frequent. Complications can be minimised by careful surgical technique and adherence to a specific post-operative rehabilitation protocol and a rigid fixation.