**PROCEDURE 16**

**Distal Femoral Osteotomy**

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**INDICATIONS**

- Age less than 60 years old.
- Symptomatic unicompartmental arthritis.
- Malalignment with or without cartilage deficiency.
- Malalignment with or without meniscal deficiency.
- Normal, or correctable, ligamentous status.
- Willing to comply with rehabilitation.

**ABSOLUTE AND RELATIVE CONTRAINDICATIONS**

- Tricompartmental arthritis.
- Opposite compartment articular surface pathology.
- Flexion contracture >10°.
- Baseline knee flexion <90°.
- Medial/lateral tibial subluxation >1 cm.
- Inflammatory arthritis.
- Body mass index >35 kg/m².
- Smoker unwilling to quit.

**EXAMINATION/IMAGING**

- Examination
  - Inspection
  - Alignment (Q-Angle)
  - Muscle bulk
  - Prior surgical incisions
  - Palpation
  - Tenderness
  - Crepitus (medial, lateral, patellofemoral)
  - Active and Passive Range of Motion
    - Hip
    - Knee
  - Core
  - Lower extremity
  - Flexibility
  - Ober test
  - Hamstring
  - Neurovascular Exam
  - Bilateral lower extremity
  - Patellar Exam
  - Tilt
  - Apprehension
  - J sign
  - Static and dynamic Q angle assessment
  - Crepitus
  - Knee tests of stability and special tests
    - Pivot shift, Lachman, anterior drawer
    - Posterior drawer
    - Varus and valgus stress (at full extension and at 30° of flexion)
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- McMurray, Thessaly
- Anteromedial rotary instability
- Posterolateral rotary instability
- Imaging (Fig. 16.1)
  - Standard weight bearing radiographic series
  - Anteroposterior (AP), Rosenberg, lateral, and Merchant views
    - Used to evaluate joint degeneration and overall alignment.
    - Standardized sizing AP radiographs are performed weight bearing with the knees flexed 45° and the beam angled 10° in the caudal direction.
    - A calibration marker is placed at the level of the joint on the affected side.
  - Long-leg alignment views
    - Measurements of the mechanical axis are documented on the long-leg radiographs.
  - Lateral nonweight bearing
    - Sizing radiograph performed with the markers placed at the level of the patella and the joint line.
  - Magnetic resonance imaging
    - Used to evaluate the soft tissues of the knee and the presence or absence of soft tissue fluid or joint effusion.
    - The articular cartilage, menisci, and ligaments should be closely evaluated.
    - Unicompartmental bone edema can be an indicator of chronic compartment overload.
    - Meniscal volume can be assessed using the coronal and sagittal sequences; however, caution should be used in evaluating meniscal injury following a prior meniscal surgery.
    - Gradient echo sequences are used to decipher articular cartilage from the surrounding joint fluid and subchondral bone; however, gradient echo sequences are not able to identify intrasubstance cartilage defects.
    - T2-weighted or short tau inversion recovery fluid sequences are used to evaluate internal signal within the cartilage or subchondral bone edema.
    - Computed tomography scans
      - Helpful adjuvant in cases of prior anterior cruciate ligament reconstructions in which there is concern for bone tunnel enlargement.

TREATMENT OPTIONS

- Oral anti-inflammatory medications
- Cortisone injections
- Viscosupplementation
- Activity modifications
- Varus producing off-loader brace
- Assistive devices (canes, walkers)

FIG. 16.1
**SURGICAL ANATOMY**

- A line is drawn from the center of the femoral head to the desired point on the plateau (Fig. 16.2).
- Another line is drawn from the point on the plateau to the center of the tibial plafond.
- The angle formed by the two lines is the degree of correction needed (Fig. 16.3).
- The correction point for correction of valgus arthrosis may be to the medial tibial spine or slightly into the medial compartment.
- The correction point for correction of valgus alignment in the setting of cartilage preservation or meniscal transplantation may be more modest such as into a neutral alignment between the tibial spines or to the medial tibial spine; however, the correction should not overcorrect into the medial compartment.

**POSITIONING**

- The patient is placed supine on the operating table. A radiolucent extension is applied to enable fluoroscopic examination. Alternatively, the patient can be placed on the ipsilateral edge of the table to enable fluoroscopic access by abducting the leg.
- A lateral post is applied in the middle of the thigh for the arthroscopic procedure.
- A tourniquet is applied and can be used if needed. It is usually deflated prior to closure to obtain adequate hemostasis.
- If a large correction is anticipated, the ipsilateral iliac crest is draped and a rolled blanket is placed under the same buttock.

**POSITIONING PEARLS**

- Bump the hip until the leg is in neutral alignment with the patella facing straight up.
- Ensure adequate fluoroscopic examination can be performed prior to prepping and draping.
PORTALS/EXPOSURES

- A diagnostic arthroscopy is performed to verify that the patient is a good candidate for the osteotomy procedure, which includes no arthritis in the medial compartment.
- Two standard arthroscopy portals (anteromedial and anterolateral) are utilized.
- The irrigation fluid is aspirated at the end of the arthroscopic evaluation.

PROCEDURE

Step 1 Incision and Approach

- The planned incision is marked out on the lateral thigh beginning 2 cm to 3 cm distal to the lateral femoral epicondyle and extending proximally 12 cm to 15 cm (Fig. 16.4).
- The skin is incised and the subcutaneous tissues are dissected to the iliotibial band.
- The iliotibial band is incised in-line with the skin incision (Fig. 16.5).
- Care is taken to incise only the tendinous portion of the iliotibial band and not the vastus musculature deep to it.
- Cautery is used to coagulate any large femoral perforating vessels as they are encountered.
- Once the distal femur is exposed, retractors are carefully placed anteriorly and posteriorly to protect the soft tissue and neurovascular bundle, respectively.

STEP 1 PEARLS

- The surgical approach is done in a stepwise and methodical fashion to avoid the femoral perforating vessels, which can be cut and retract into the posteromedial thigh making hemostasis difficult.
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**Step 2 Guide Pin Insertion**
- Once the exposure is complete, the knee is extended and under fluoroscopic guidance a guidewire is inserted mirroring the trajectory of the osteotomy (Fig. 16.7).
- The appropriate guidewire starting position is 2 cm proximal to the lateral epicondyle, aiming distally toward to proximal aspect of the medial epicondyle.
- A second guidewire is placed parallel to the first (Fig. 16.8).

**Step 3 Lateral Opening-Wedge Osteotomy**
- A small oscillating saw is used to initiate the osteotomy on the lateral cortex (Fig. 16.9).
- Cutting proximal to the parallel pins, further from the joint surface, decreases the likelihood of stress-riser propagation into the trochlea or through the medial cortex (Fig. 16.10).
- The saw is followed by osteotomes in stacked fashion to a depth 1 cm from the medial cortex (Fig. 16.11).

**Step 4 Correction**
- Calibrated anterior and posterior wedges are placed to the planned preoperative level of correction (Fig. 16.12).
- The wedge position is assessed (Fig. 16.13).
- The anterior wedge is removed and the plate is placed in the osteotomy site (Fig. 16.14) and secured with sequential screws (Fig. 16.15).

**STEP 2 PEARLS**
- Ensure proper placement of the guide pins. The superior aspect of the trochlea can be marked under fluoroscopy to avoid pin placement into the patellofemoral joint.

**STEP 3 PEARLS**
- Avoid violating the medial femoral cortex.
- Use osteotome (instead of saw) to finish the cut.
- Use fluoroscopy to guide the bone cuts.

**STEP 3 PITFALLS**
- Avoid using thick osteotomes.
- If medial femoral cortex is fractured, fix with medial sided plate and/or staples.

**STEP 3 CONTROVERSIES**
- Medial closing wedge DFO has reduced risk of nonunion, but requires two separate cuts for osteotomy.
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Step 5 Assess Position and Closure

- Under fluoroscopic guidance, care should be taken to ensure the plate wedge is securely in the osteotomy site (Fig. 16.16).
- Cortical and cancellous allograft can be used in the osteotomy site.
- The tourniquet is released and hemostasis is achieved.
- The wound is then irrigated and closed in a standard layered fashion (Fig. 16.17).

POSTOPERATIVE CARE AND EXPECTED OUTCOMES

- Osteotomies are performed as an outpatient procedure at our institution; however, these procedures can be long in duration and an overnight stay is reasonable.
- At the conclusion of the sterile dressing, patients have a cooling unit incorporated into the dressing and a hinged knee brace locked in extension placed on the operative leg.
- The weight bearing status is dictated by the concomitant procedures; however, 4 weeks to 6 weeks of nonweight bearing is customary.
- Range of motion is encouraged in the early postoperative period.
- Progressive weight bearing begins at 4 weeks to 6 weeks with a goal of full weight bearing without a brace at 8 weeks to 10 weeks.

EVIDENCE

In this study, the authors reported functional outcomes using the Knee Injury and Osteoarthritis Outcome Score (KOOS) for twenty-four consecutive patients with lateral knee osteoarthritis treated with DFO. KOOS increased significantly as compared with baseline during the first year by 28% to 122% for all five subscores. This notable gain in functional outcomes remained at 10-year follow-up for those with surviving osteotomy. Six knees (25%) were converted to total knee arthroplasty at a mean of 6.4 years (CI 3.3–9.6, range 4.0–11.8). The DFO survival rate was 74% at 10 years.

The authors followed 21 knees (20 patients) long term or until failure after undergoing DFO. The probability of survival at 10 years was 74% at 10 years.

In this study, the authors reported on 18 patients undergoing DFO (21 knees). Four patients underwent total knee arthroplasty (19%) at a mean of 4.5 years. The cumulative survival rate for the procedure was 79% at 5 years. Functional outcomes scores (KOOS Pain and International Knee Documentation Committee) in the surviving cohort improved significantly from baseline.

STEP 4 PEARLS

- Intraoperative alignment rods or the bovie cord may be used to assess correction; however, these methods have been shown to be largely unreliable.
- Preoperative planning of correction is the best measure of successful correction.

STEP 5 PEARLS

- Ensure hemostasis before closure.

STEP 5 PITFALLS

- Large perforating femoral vessels can cause hematoma and compartment syndrome if injured and not checked by releasing the tourniquet.

POSTOPERATIVE PEARLS

- Early motion is encouraged.

POSTOPERATIVE PITFALLS

- Early weight bearing (within the first 1 week to 2 weeks) is discouraged.
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This study reported on six patients (7 knees) after undergoing DFO with a mean followup of 6.5 years. Clinical outcomes were assessed by the Oxford Knee Score. The mean Oxford Knee Score improved from 13.1 ± 8.6 to 26 ± 12.5 from preoperation to most recent followup. No patients required additional surgery.


In this study, 30 patients (30 knees) were managed with DFO for the treatment of noninflammatory lateral-compartment arthritis with an associated valgus deformity. The authors reported 25 patients (83%) had a satisfactory result, 2 (7%) had a fair result according to the Hospital for Special Surgery rating system, and 3 (10%) were converted to a total knee arthroplasty. With conversion to total knee arthroplasty as the end point, the cumulative 10-year survival rate for all patients was 87% (95% CI, 69% to 100%).


The authors reported on 20 patients (22 knees) after undergoing opening DFO for lateral tibiofemoral osteoarthrosis of a valgus knee. Eighteen knees had good or excellent results (80%), two had fair results (9.5%), and two had poor results (9.5%). The 8-year survival rate was 91% (CI, 69–100%). The mean preoperative International Knee Society score increased from 49.28 to 74.23 at the most recent follow-up.