Management of Distal Femur Fractures in Adults

An Overview of Options

Anup K. Gangavalli, MD*, Chinenye O. Nwachuku, MD

KEYWORDS

• Supracondylar • Femur fracture • Adult • Distal femur • Trauma • Options

KEY POINTS

- The incidence of distal femur fractures among all orthopedic injuries is less than 1% and follows a bimodal distribution between low-energy mechanisms and high-energy trauma.
- Articular involvement, alignment of the meta-diaphyseal region, comminution, construct stability/rigidity, and the bone quality are parameters that must be accounted for.
- Current treatment options broadly include conservative management, external fixation, locked and nonlocked plating with or without augmentation (plate, wire, or graft), fixed-angle devices (blade or sliding barrel options), intramedullary nailing, and arthroplasty.
- Complications primarily include nonunion, malunion, hardware failure, infection, and reoperation.

BACKGROUND

Supracondylar femur fractures are severe injuries that can be technically challenging to operatively treat. Although they account for less than 1% of all fractures and between 3% and 6% of femur fractures, their incidence is likely to increase with the rising geriatric populations and the increasing number of peri-prosthetic injuries.[1] Injuries to the distal femur follow a bimodal distribution between geriatric low energy fractures and high-energy trauma.[1,2] As with all fractures involving periarticular metaphyseal bone, treatment invariably includes understanding the fracture characteristics, careful preoperative planning, assessment of patient goals and health, bone quality, surgeon experience and implant selection.

In the early 1960s, most distal femur fractures were managed conservatively with fracture bracing and traction, achieving acceptable results in 67% to 90% of patients.[3] However, with the advent of new surgical techniques and implants, the pendulum shifted from conservative management to surgical stabilization of these injuries. Through historical review, Henderson and colleagues[3] chronicled the increasing success rates with operative fixation from 52% to 54% in the 1960s, 73.5% to 75% in the 1970s, to 74% to 80% in the 1980s. Steady advances in our understanding of distal femoral anatomy and fracture biology have heralded various implant designs that further optimized successful treatment of these injuries. These modalities, each with their own merits and drawbacks, range broadly from external fixation, fixed-angle device (blade or sliding barrel implants), plate fixation (locked and unlocked), intramedullary nailing, arthroplasty, and distal femoral replacement (DFR) (**Box 1**). The authors intend to review these modalities and examine their success and pitfalls to provide a primer for the current clinical care of adult supracondylar femur fractures.

ANATOMY AND CLASSIFICATION

The distal femur is descriptively divided into a supracondylar region encompassing the region between the meta-diaphyseal junction and the

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Department of Orthopaedic Surgery, St. Luke's University Health Network, 801 Ostrum Street, PPHP2, Bethlehem, PA 18015, USA
* Corresponding author.
E-mail address: anup.gangavalli@gmail.com

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Box 1
Treatment options

Splinting and casting
Skin or skeletal traction
External fixation
Plate fixation (locked and unlocked)
Intramedullary nail
Arthroplasty/DFR

condyles and an intercondylar region that encompasses the condyles and articular surfaces. The periarticular/supracondylar region enjoys a better blood supply than that of the distal shaft, enabling adequate healing when stabilized. The normal anatomic axis of the femoral shaft is oriented between 6° and 11° of valgus in relation to the joint line (**Fig. 1**A). Restoration of this mechanical axis and prevention of varus collapse is a crucial factor in the success of distal femoral reconstruction and ultimate longevity of the joint. The medial and lateral cortices of the distal femur also taper anteriorly toward the midline at angles of approximately 25° and 10°, respectively (see **Fig. 1**B). This taper must be taken into account when selecting screw lengths and confirmed with internal rotation views to prevent hardware irritation from prominent screws medially. Knowledge of anatomy is crucial during placement of plates, which are often designed to be positioned along the anterior distal femur, approximating the border of the articular surface while avoiding intra-articular penetration of screws within the notch posteriorly or the trochlea anteriorly. Care must be taken during patient positioning and prep to allow for satisfactory imaging to be obtained intraoperatively in order to avoid such pitfalls. Other considerations during the preoperative setup include obesity, body habitus, other prostheses, and wounds.

The distal femur is spanned by several muscle groups that can create deformities across fractures. Depending on the fracture plane and comminution, the quadriceps typically cause shortening,[1] whereas in the coronal plane varus/valgus deformity can be imparted by the adductors or iliotibial (IT) band.[4] Additionally, the distal segment can be deformed by the two heads of the gastrocnemius, causing an apex posterior deformity best seen on lateral radiographs or in the form of a "paradoxic notch view" on an anteroposterior (AP) image.[5]

The most commonly used classification system for distal femur fractures is the AO/Orthopedic Trauma Association (OTA) system (**Fig. 2**). Fractures are broadly classified into types A, B, and C corresponding to extra-articular, partial articular, and intra-articular injuries, respectively. They are further subclassified (1–3) based on pattern and degree of comminution. Type B1 involves sagittal splits of the lateral condyle; B2 involves sagittal splits of the medial condyle; B3 involves coronal patterns commonly known as Hoffa fractures. Type C fractures are divided into C1 (simple articular, simple metaphyseal), C2 (simple articular, multi-fragmentary metaphyseal), and C3 (multi-fragmentary). Careful scrutiny of radiographs and additional studies may be needed to accurately describe fracture patterns.

DIAGNOSIS AND IMAGING

Initial evaluation of patients begins with an accurate history and physical examination to identify the mechanism and time course of the injury. Identification of high- versus low-energy mechanism

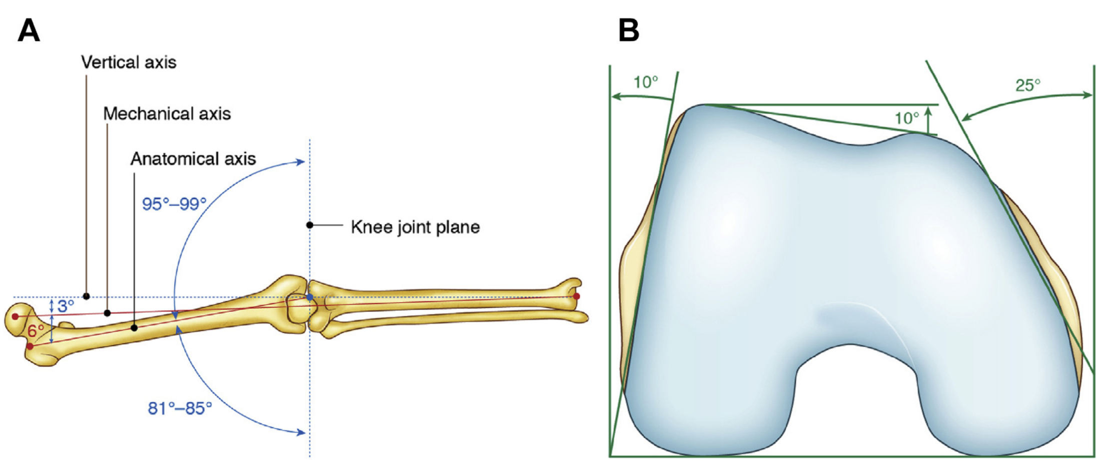

Fig. 1. (*A*) Anatomic and mechanical axis of femur. (*B*) Dimensions of distal femur.