Supplementary Data

Extramedullary Alignment Techniques and Case Examples

Techniques

Technique A: Extramedullary Alignment with Electronic Referencing
1. Assemble arm and attach to operating room table
2. Standard approach, apply clamp to distal femoral diaphyseal flare (►Fig. S1A)
3. Attach clamp to arm, and apply alignment system
   a. Skid plate on anterior femoral surface (►Fig. S1B–D)
      i. Control flexion/extension
   b. Set rotational alignment (►Fig. S1E–F)
   c. Apply suspension jig with electronic position indicator (►Fig. S1G)
   d. Control varus/valgus (►Fig. S1H–J)
   e. Set position
   f. Check position under fluoroscopic guidance (optional) (►Fig. S1K–M)
4. Apply and secure distal femoral cutting block, and complete distal cut (►Fig. S1N)

Technique B: Extramedullary Alignment with Extramedullary Rod
1. Standard approach, drill intramedullary alignment hole in distal femur (►Fig. S2A and B)
2. Insert short intramedullary rod with distal block and alignment tower (►Fig. S2C and D)
   a. Insert extramedullary alignment rod (►Fig. S2E)
   b. Loosen varus/valgus control to allow positioning (►Fig. S2F and H)
   c. Align rod over femoral head with fluoroscopic guidance (►Fig. S2G and I)
   d. Tighten varus/valgus control to lock in position (►Fig. S2J and K)
3. Apply and secure distal femoral cutting block, and complete distal cut (►Fig. S2L)

Case Examples

Case 1: Patient 1—Retained Hardware
A 75-year-old male with status-post right distal femur fracture treated with open reduction internal fixation. Patient progressed to degenerative arthritis of the right knee, with retained intramedullary hardware right femur. TKA was performed using an extramedullary alignment system with electronic position indicators. (►Fig. S3; case courtesy: Benjamin E. Bierbaum, MD, Boston, MA)

Case 2: Patient 2—Post-traumatic Deformity
A 64-year-old male with status-post right midshaft femur fracture with post-traumatic deformity. TKA was performed using an extramedullary alignment system with electronic position indicators. (►Fig. S4; case courtesy: Henry M. Toczylowski, Jr., MD, Boston, MA)

Case 3: Patient 3—Post-traumatic Deformity
A 62-year-old male with status-post left midshaft femur fracture with post-traumatic deformity. TKA was performed using an extramedullary alignment system with electronic position indicators. (►Fig. S5; case courtesy: Henry M. Toczylowski, Jr., MD, Boston, MA)

Case 4: Patient 4—Osteopetrosis
A 63-year-old female with diagnosis of osteopetrosis. Profound medullary sclerosis prevented accurate passage of intramedullary tibial and femoral alignment guide rods. Extramedullary alignment was performed with intraoperative radiographic confirmation of alignment correction. (►Fig. S6; case courtesy: Thomas F. Thornhill, MD, Boston, MA)

Case 5: Patient 5—TKA with long-stem cemented femoral component
A 69-year-old female with osteoarthritis right knee. Patient had a previous total hip arthroplasty with a long-stem cemented prosthesis necessitating extramedullary alignment. (►Fig. S7; case courtesy of JVB, MD, Boston, MA)
Supplementary Fig. S1 Technique A. Extramedullary alignment with electronic referencing. (A) Exposure. (B) Distal femoral clamp in place (lateral); skid plate controls flexion/extension. (C) Distal femoral clamp in place (frontal). (D) Clamp attached to arm. (E) Bushing in place. (F) Rotational alignment guide. (G) Apparatus to set alignment. (H) Electronic indicator in varus. (I) Electronic indicator in valgus. (J) Electronic indicator in alignment with femoral head. (K) Optional alignment rods for fluoroscopic check. (L) Fluoroscopy, rods not coplanar. (M) Fluoroscopy, rods coplanar, in alignment with femoral head. (N) Distal femoral cutting jig in place.
Supplementary Fig. S1 (Continued)
Supplementary Fig. S2 Technique B. Extramedullary alignment with extramedullary rod. (A) Exposure. (B) Distal femoral drill hole. (C) Short intramedullary rod. (D) Insertion of intramedullary rod. (E) Extramedullary alignment tower. (F) Valgus orientation. (G) Fluoroscopy, valgus (rod medial to femoral head). (H) Varus orientation. (I) Fluoroscopy, varus (rod lateral to femoral head). (J) Fluoro setup. (K) Fluoroscopy, proper mechanical axis. (L) Distal femoral cutting block.
Supplementary Fig. S3 Case 1. Patient 1—Retained hardware. (A) X-ray of status-post right distal femur fracture treated with open reduction internal fixation. (B) X-ray with arrows pointing toward retained intramedullary hardware in right femur. (C) X-ray showing degenerative arthritis of the right knee. (D) X-ray after total knee arthroplasty performed using extramedullary alignment system with electronic position indicators.
Supplementary Fig. S4 Case 2. Patient 2—Post-traumatic deformity. (A, B) X-rays of status-post right midshaft femur fracture with post-traumatic deformity. (C, D) X-rays after total knee arthroplasty performed using extramedullary alignment system with electronic position indicators.

Supplementary Fig. S5 Case 3. Patient 3—Post-traumatic deformity. (A, B) X-rays of status-post left midshaft femur fracture with post-traumatic deformity. (C, E) X-rays after total knee arthroplasty performed using extramedullary alignment system with electronic position indicators.
Supplementary Fig. S6 Case 4. Patient 4—Osteopetrosis. (A–D) X-rays of profound medullary sclerosis preventing accurate passage of intramedullary tibial and femoral alignment guide rods. (E) X-rays after extramedullary alignment performed with intraoperative radiographic confirmation of alignment correction.
Supplementary Fig. S7 Case 5. Patient 5—Total knee arthroplasty (TKA) with long stem cemented femoral component. (A, B) X-rays of previous total hip arthroplasty with long-stem cemented prosthesis. (C, D) X-rays after TKA of R. Knee that necessitated extramedullary alignment.