A Review Paper

Primary Total Knee Arthroplasty for Distal Femur Fractures: A Systematic Review of Indications, Implants, Techniques, and Results

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Abstract

Distal femur fractures (DFFs) in elderly patients historically were difficult to treat because of osteoporotic bone, comminution, and intra-articular involvement. Current surgical treatment options, including intramedullary nailing, internal fixation, and external fixation, are complicated by prolonged immobility, malunion, and nonunion. Furthermore, fixation increases the complexity of subsequent arthroplasty. Primary total knee arthroplasty (TKA) is a rarely used treatment for acute DFF but may be of benefit in select patients.

For a systematic review of the reported indications, techniques, implants, outcomes, and complications of TKA for DFF, we searched the major databases Medline, EMBASE (Excerpta Medica dataBASE), and the Cochrane Library. Few studies of this technique have been reported, and the majority of published studies have been level III and level IV, with heterogeneous results and outcomes. Many of the patients in these studies achieved early weight-bearing with primary TKA. Complication rates varied and may be higher for older patients with more comorbidities, but whether these rates are higher than those of patients treated with internal fixation is unclear.

Modular constrained implants may be appropriate for comminuted intra-articular fractures, whereas extra-articular fractures may be sufficiently managed with unconstrained implants supplemented with fracture fixation.

Distal femur fractures (DFFs) in the elderly historically were difficult to treat because of osteoporotic bone, comminution, and intra-articular involvement. DFFs in minimally ambulatory patients were once treated nonoperatively, with traction or immobilization,[1,2] but surgery is now considered for displaced and unstable fractures, even in myelopathic and nonambulatory patients, to provide pain relief, ease mobility, and decrease the risks associated with prolonged bed rest.[1] Options are constantly evolving, but poor knee function, malunion, nonunion, prolonged immobilization, implant failure, and high morbidity and mortality rates have been reported in several studies regardless of fixation method.

Take-Home Points

- Arthroplasty is a rarely utilized and, therefore, a rarely reported treatment for distal femur fractures.
- Arthroplasty carries certain advantages over fixation, including earlier weight-bearing, a benefit for elderly individuals.
- Arthroplasty is more often described in situations of comminution, often necessitating constrained prostheses.
- It is not unreasonable to utilize arthroplasty in extra-articular fractures in poor-quality bone, which can take the form of unconstrained prosthesis and supplemental fixation.
- The true complication rate is unclear, given that the few papers reporting high complication rates were in sicker populations.

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Arthritis after DFF has been reported at rates of 36% to 50% by long-term follow-up.[3-5] However, total knee arthroplasty (TKA) for posttraumatic arthritis is more complex because of scarring, arthrofibrosis, malunion, nonunion, and the frequent need for hardware removal. These cases have a higher incidence of infection, aseptic loosening, stiffness,[6] and skin necrosis.[7]

Primary TKA is a rarely used treatment for acute DFF. Several authors have recommended primary TKA for patients with intra-articular DFFs and preexisting osteoarthritis or rheumatoid arthritis, severe comminution, or poor bone stock.[7-22] Compared with open reduction and internal fixation (ORIF), primary TKA may allow for earlier mobility and weight-bearing and thereby reduce the rates of complications (eg, respiratory failure, deep vein thrombosis, pulmonary embolism) associated with prolonged immobilization.[23]

As the literature on TKA for acute DFF is scant, and to our knowledge there are no clear indications or guidelines, we performed a systematic review to determine whether TKA has been successful in relieving pain and restoring knee function. In this article, we discuss the indications, implant options, technical considerations, complications, and results (eg, range of motion [ROM], ambulatory status) associated with these procedures.

Methods

On December 1, 2015, we searched the major databases Medline, EMBASE (Excerpta Medica dataBASE), and the Cochrane Library for articles published since 1950. In our searches, we used the conjoint term *knee arthroplasty* with *femur fracture*, and *knee replacement* with *femur fracture*. Specifically, we queried: *((“knee replacement” OR “knee arthroplasty”) AND (intercondylar OR supracondylar OR femoral OR femur) AND fracture) NOT arthrodesis NOT periprosthetic NOT “posttraumatic arthritis” NOT osteotomy*. We also hand-searched the current website of *JBJS* [*Journal of Bone and Joint Surgery*] Case Connector, a major case-report repository that was launched in 2011 but is not currently indexed by Medline.

All citations were imported to RefWorks for management and for removal of duplicates. Each article underwent screening and review by Dr. Chen and Dr. Li. Articles were included if titles were relevant to arthroplasty as treatment for acute (within 1 month) DFF. Articles and cases were excluded if they were reviews, published in languages other than English, animal studies, studies regarding nonacute (>3 months or nonunion) DFFs or periprosthetic fractures, or studies that considered only treatments other than TKA (ie, plate osteosynthesis).

Full-text publications were obtained and independently reviewed by Dr. Chen and Dr. Li for relevance and satisfaction of inclusion criteria. Disagreements were resolved by discussion. Given the rarity of publications on the treatment, all study designs from level I to level IV were included.

The same 2 reviewers extracted the data into prearranged summary tables. Data included study size, patient demographics, AO/OTA (Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association) fracture type either reported or assessed by description and imaging (33A, extra-articular; 33B, partial articular with 1 intact condyle; 33C, complete articular with both condyles involved), baseline comorbidity, implant used and fracture treatment (if separate from arthroplasty), postoperative regimen, respective outcomes, and complication rates.

Results

We identified 728 articles: 389 through Medline, 294 through EMBASE, and 45 through the Cochrane Library (**Figure 1**). After duplicates were removed, 476 articles remained. After titles and abstracts were reviewed, 22 articles met the screening criteria. Five series included patients with TKA-treated acute DFF but did not report their specific outcomes (these were described separately).

The current evidence regarding primary TKA for acute DFF is primarily level IV (**Table 1**). Only 1 level III study[16] compared TKA with ORIF. Three case series[11,19,24] met our inclusion criteria (Table 1, **Table 2**). In addition, 5 case series involved patients who met our criteria, but these studies did not separately report results for DFFs and proximal tibia fractures,[9,20-22] or separately for acute fractures and nonunions or ORIF failures.[8] These studies were considered level IV and were tabulated separately (**Table 3**). Specific patient characteristics and management strategies varied significantly between studies, though many studies augmented 33A fractures with internal fixation, whereas 33C fractures more often underwent resection and placement of highly constrained implants. Of 117 acute DFFs reviewed, 20% were 33A fractures, 7% were 33B fractures, and 73% were 33C fractures (Table 1). Of the studies that specified, there were 8 cases of rheumatoid arthritis and 18 cases

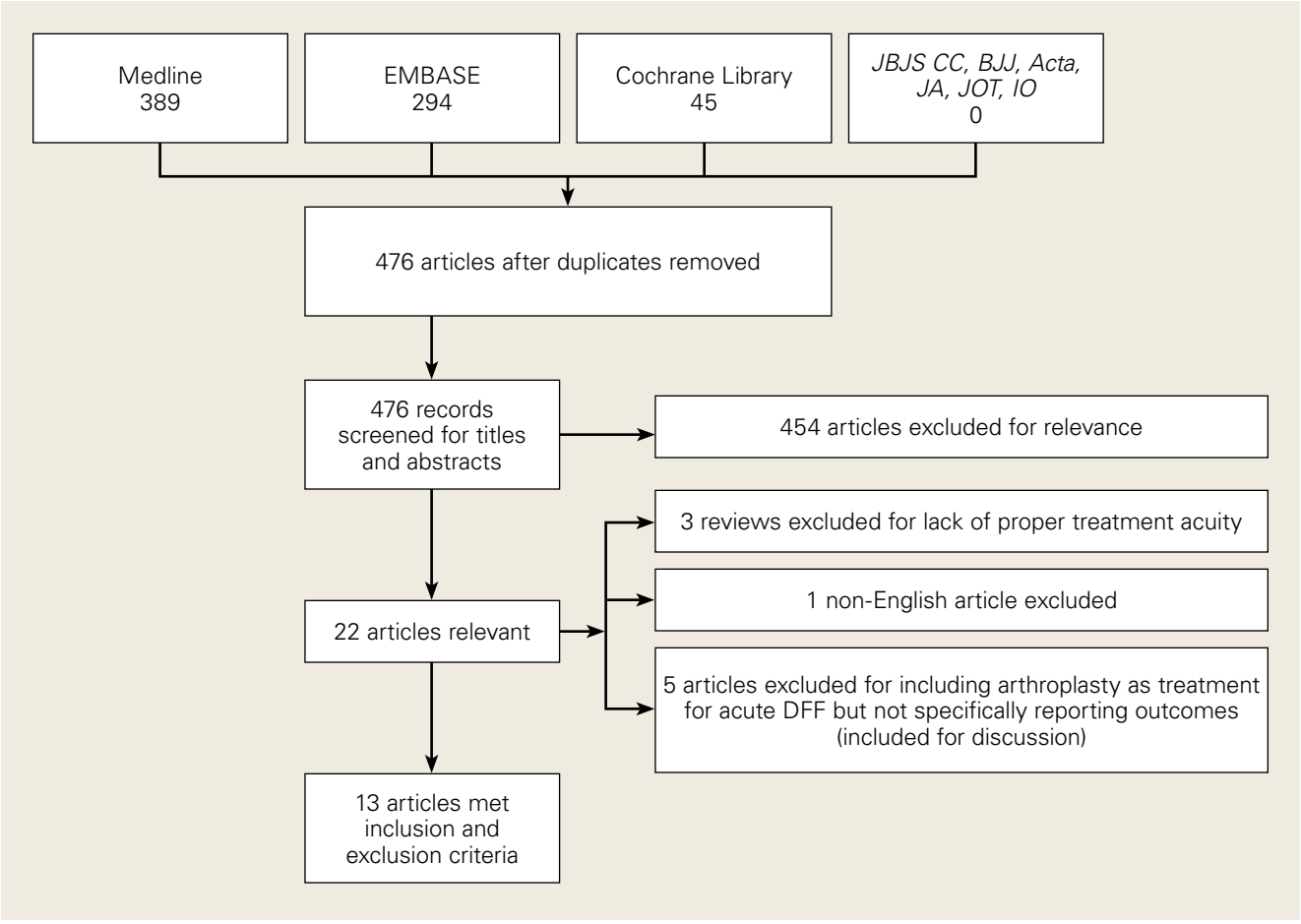

Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram showing method of article selection.
Abbreviations: *Acta, Acta Orthopaedica*; *BJJ, Bone & Joint Journal* (previously *Journal of Bone & Joint Surgery-British*); DFF, distal femur fracture; EMBASE, Excerpta Medica database; *IO, International Orthopaedics*; *JA, Journal of Arthroplasty*; *JBJS CC, Journal of Bone & Joint Surgery Case Connector*; *JOT, Journal of Orthopaedic Trauma*.

of osteoarthritis (Table 2).

Modular, hinged, and tumor-type arthroplasty designs accounted for 83% of the treatments included in this review. Trade names are listed in **Table 4**. Authors who used these implants took a more aggressive approach, often resecting the entire femoral epiphyseal-metaphyseal area, menisci, and collateral ligaments.[9,13,15,16,18] The majority of patients who underwent resection had 33C fractures (Tables 1, 3). **Figures 2A-2D** show an aggressive resection example.[8]

Authors who used less constrained arthroplasty designs focused on bone preservation, augmentation with graft, and internal fixation.[7,20] In and colleagues[25] thought that if the cruciate and collateral ligaments are found to be intact, then resecting these ligaments and performing the deep cuts necessary for linked prostheses are too aggressive. Their internal fixation methods included use of cannulated screws, Dall-Miles cabling (Stryker), and plate osteosynthesis. Choi and colleagues[19] took a similar approach but also used stem extensions in 6 of 8 fractures assessed to be unstable (**Figures 3A-3H**). Yoshino and colleagues[7] used posterior-stabilized implants with femoral stem extensions (**Figures 4A-4C**). Intraoperative use of an external fixator to align and stabilize a comminuted fracture before insertion of an intramedullary guide and during femoral cutting has also been described.[19] All 33B and many 33A fractures were treated in this fashion.

The majority of authors who treated fractures with resection and modular implants allowed their patients full weight-bearing soon after surgery (Table 1),[11,12,15-18,24] whereas authors who treated their patients partly with fracture fixation often had to delay weight-bearing (Table 1). Overall, results

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Table 1. **Summary of Studies Meeting Inclusion Criteria: Primary Total Knee Arthroplasty for Distal Femur Fractures; Fracture Types and Implants Used**[a]

Study	N	Age, y/Sex	Fracture Classification (AO/OTA)	Fracture Fixation	Implants Used	Postoperative Regimen	Evidence Level
Wolfgang[10] (1982)	1	68/F	C	No. 18 wire to join condyle fragments	Spherocentric knee	Fiberglass cylinder cast for 3 wk Articulating cast-brace for 3 mo WBAT 18 wk after surgery	IV
Bell et al[11] (1992)	13 (14 cases)	Mean, 84 (range, 67-94)/ 1 M 13 F	A1 (1) A3 (2) C1 (3) C2 (7)	Resection	Guepar hinged knee replacement Kotz modular knee replacement Bilateral kinematic prostheses	Patient with RA and bilateral fractures: NWB for 6 wk. Others: immediate WBAT	IV
Shah et al[12] (1993)	1 ORIF: 1	84/F	C	Resection	Zimmer Biomet Stanmore hinged prosthesis	WBAT on POD-3	IV
Freedman et al[13] (1995)	1	59/F	A2	Resection, cemented stem, cerclage (for shaft extension)	Howmedica (Stryker) modular segmental replacement system with kinematic rotating hinge	CPM NWB (contralateral fracture)	IV
Patterson & Earll[14] (1999)	1	60/F	A1	Retrograde nail (Ace Medical)	Depuy Synthes CR cemented	CPM TTWB for 6 wk	IV
Yoshino et al[7] (2001)	3	83/F 84/F 87/F	A (1) C (2)	Wiring (for A2)	PS total knee arthroplasties with femoral stems	Not specified	IV
Nau et al[15] (2003)	3	85/F 75/F 90/F	A3 C2 C2	Not specified	Endo-Model rotational knee system (Link) Alpina total knee system (Zimmer Biomet Merck)	CPM Early immobilization with WBAT	IV
Pearse et al[16] (2005)	6 ORIF: 4	85 (range, 77-94)/ Sex not reported	A (2) C (4) ORIF: A (4)	Resection	Zimmer Biomet Stanmore hinged prosthesis	WBAT	III
In et al[25] (2006)	3	61/F 71/F 73/F	A2 (1) B2 (2)	Screw, cable, plate, screws	Zimmer Biomet Nexgen CR augmentable femoral component	TTWB at 1 wk WBAT at 6 wk	IV
Appleton et al[24] (2006)	54	Mean, 82 (range, 55-98); only 4 under 70/ 3 M 49 F	A3 (9) C (45)	Resection	Guepar Kotz prosthesis Zimmer Biomet Stanmore hinged prosthesis	WBAT on POD-2	IV
Mounasamy et al[17] (2006)	1	74/M	B2	Partial resection, allograft, Kirschner wires	Zimmer Biomet Legacy constrained condylar knee	WBAT Hinged knee brace	IV
Mounasamy et al[18] (2007)	1	84/M	C3	Resection	Howmedica (Stryker) rotating hinge cemented with stemmed tibial component	WBAT	IV
Choi et al[19] (2013)	8	Mean, 76.8 (range, 65-89)/ 8 F	A1 (2) A2 (1) B2 (2) C1 (3)	Kirschner wires, cables, screws	Medial pivot knee (Wright Medical Technology) PS (5) CR (3) Stem extensions in 6 of 8	Long splint for 1-6 wk CPM on POD-2 PWB within 1-6 wk after surgery	IV

[a]Shaded rows indicate patients who underwent resection and received megaprosthesis.
Abbreviations: AO/OTA, Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association; CPM, continuous passive motion; CR, cruciate-retaining; NWB, non-weight-bearing; ORIF, open reduction and internal fixation; POD, postoperative day; PS, posterior-stabilized; PWB, partial weight-bearing; RA, rheumatoid arthritis; TTWB, toe-touch weight-bearing; WBAT, weight-bearing as tolerated.

Table 2. **Summary of Studies Meeting Inclusion Criteria: Primary Total Knee Arthroplasty for Distal Femur Fractures; Comorbidities and Outcomes**[a]

Study	N	Age, y/ Sex	Comorbidity/ Ambulatory Status	Follow-Up	Complications, n (%); Outcomes at Final Follow-Up
Wolfgang[10] (1982)	1	68/F	RA Ambulatory	17 mo	No complications 11 mo: ROM, 0°-80°
Bell et al[11] (1992)	13 (14 cases)	Mean, 84 (range, 67-94)/ 1 M 13 F	7 OA 4 RA 13 debilitating illnesses: COPD, *ICD*, hemiplegia	6 mo minimum	3 complications (23%) 1 death from MI at 4 wk 1 transfer to nursing home for declining mental status 1 patella tendon rupture at 15 mo 6 mo: All survivors regained full extension, and mean knee flexion was 80° (range, 50°-100°)
Shah et al[12] (1993)	1 ORIF: 1	84/F	OA RA Ambulatory	18 mo	No complications 18 mo: ROM, 5°-95°; ambulating with crutch
Freedman et al[13] (1995)	1	59/F	RA Daily assistance required	29 mo	No complications 29 mo: good results (Enneking rating) 1 patient excluded for 3-mo delay from injury to surgery; ultimately required resection for infection
Patterson & Earll[14] (1999)	1	60/F	RA Ambulatory	3 mo	No complications 3 mo: ROM, 0°-120°
Yoshino et al[7] (2001)	3	83/F 84/F 87/F	3 OA Independently ambulatory	1 y 2 y 8 mo	No complications Final follow-up: ROM, 0° to 135°, 120°, 100°
Nau et al[15] (2003)	3	85/F 75/F 90/F	3 OA Severe osteopenia All with preexisting systemic illness that required community support	Mean, 24.4 mo	No deaths and no complications ROM, 0° to 70°-110°
Pearse et al[16] (2005)	6 ORIF: 4	85 (range, 77-94)/ Sex not reported	All ASA scores ≤2 All walked independently	Mean, 33 mo	No complications Larger proportion of patients with arthroplasty returned to independent walking, more rapid rehabilitation, and better knee flexion but needed more blood transfusion
In et al[25] (2006)	3	61/F 71/F 73/F	Severe OA 2 walked without assistance	1 y	1 proximal screw loosening (33%), asymptomatic (61/F, A2 fracture) ROM, 0°-110°/120°; all walked without assistance
Appleton et al[24] (2006)	54	Mean, 82 (range, 55-98); only 4 under 70/ 3 M 49 F	9 nonambulatory 36 walked with assistance 7 walked without assistance 7 had cognitive impairment	10 y 4 lost to follow-up	9 complications (17%) 2 deaths (pneumonia, MI) within 10 d after surgery 20 other deaths (medical comorbidities) within 1 y 1 ischemic foot (required AKA) at 25 mo 1 postoperative wound hematoma (required I&D), patella tendon rupture 15 mo after surgery 1 deep wound infection (eventually required AKA) 4 periprosthetic fractures (tip of femoral stem) from simple falls All survivors regained previous level of mobility
Mounasamy et al[17] (2006)	1	74/M	OA Osteopenia Community ambulator	6 mo	No complications ROM, 5°-90°; walked with walking stick
Mounasamy et al[18] (2007)	1	84/M	OA Community ambulator Diabetes mellitus Hypertension	3 mo	No complications ROM, 5°-100°; full weight-bearing
Choi et al[19] (2013)	8	Mean, 76.8 (range, 65-89)/ 8 F	Advanced OA All previously ambulatory	49 mo (range, 17-62 mo)	No complications 2 y: ROM, 110°-125° flexion

[a]Shaded rows indicate patients who underwent resection and received megaprosthesis.
Abbreviations: AKA, above-knee amputation; ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease; *ICD, International Classification of Diseases*; I&D, incision and drainage; MI, myocardial infarction; OA, osteoarthritis; ORIF, open reduction and internal fixation; RA, rheumatoid arthritis; ROM, range of motion.

Table 3. **Studies Without Specific Primary Distal Femur Fracture Fixation Outcomes Reported**[a]

Study	N	Age, y/ Sex	Fracture Classification (AO/OTA)	Comorbidity/ Prefracture Ambulatory Status	Fracture Fixation	Implants Used	Complications, n (%)	Findings
Rosen & Strauss[8] (2004)	24 DFF Unknown number of cases from nonunions or ORIF failures	Mean, 76 (range, 68-85)/ 2 M 4 F	B2 (1) C (23)	OA (5) All with ≥1 comorbidity (eg, diabetes mellitus, hypertension) All independently ambulatory	Resection	Global modular reconstruction system (23) Link Endo-Model rotational knee system (1)	Overall: 2 (8%) 1 superficial wound infection treated with parenteral antibiotics 1 hinge disengaged status after mechanical fall (hinge required open reduction)	11 mo mean follow-up (range, 5-23 mo) Overall: 71% returned to preoperative ambulation level No major complications Mean ROM, 102°
Malviya et al[9] (2011)	11 DFF 15 PTF	Mean, 80 (range, 67-92)/ 1 M 25 F	A (2) B (2) C (7)	OA (11) Osteopenia (26) 1 wheelchair 5 assistive devices 3 assistive living	Not available	Rotating hinge (10) superstabilized with stemmed tibia and femur (1)	Overall: 2 (7.6%) 1 death 1 wound-healing complication 4 deaths after 90 d	38.8 mo mean follow-up (range, 12-104 mo) Overall: 90% patient satisfaction 81% returned to preinjury level of function
Parratte et al[20] (2011)	18 DFF 8 PTF	Mean, 80 (range, 70-98)/ 5 M 21 F	B (1) C (9)	OA (17) Preinjury knee pain (25) Mean ASA score, 2.2	Overall: Screws (3) Cerclage (5) Augments (9)	Overall: Conventional resurfacing (9) Revision-type (12) Rotating hinge (5) Simple hinge (1)	Overall: 8 (30.8%) 1 death from CVA 2 altered mental status 1 wound complication 1 common fibular nerve palsy 2 tibial tubercle avulsions 1 deep infection	16.2 mo mean follow-up (range, 4-36 mo) ROM, 4.1°-99°
Benazzo et al[21] (2014)	4 DFF 2 PTF	Mean, 62 (range, 47-76)/ 2 M 4 F	B (2) C (2)	All patients with history of pain and limited ROM	Not available	Overall: Zimmer Biomet LCCK (4) Zimmer Biomet ZSS (2)	Overall: 1 infection	12 mo mean follow-up (range, 6-16 mo)
Boureau et al[22] (2015)	10 DFF 11 PTF	Mean, 79 (range, 68-96)/ 18 M 3 F	A (2) B (3) C (5)	OA (50%) Osteopenia (21)	Resection	Implantcast Genux (8) Dedienne Shivas (1) Link Endo-Model (1)	DFF: 30% mortality at 1 y, but only 1 attributable to perioperative complication	31 mo mean follow-up (range, 9-68 mo) 4 DFF patients at follow-up 99° mean flexion Total knee arthroplasty preserves weight-bearing and ROM and avoids pain but does not improve on survival or autonomy

[a]For all categories except classification, results are reported for overall study (DFFs, PTFs).
Abbreviations: AO/OTA, Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association; ASA, American Society of Anesthesiologists; CVA, cerebrovascular accident; DFF, distal femur fracture; OA, osteoarthritis; ORIF, open reduction and internal fixation; PTF, proximal tibia fracture; ROM, range of motion.

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were encouraging, with most studies finding between 90° and 135° of flexion to near full extension after each type of treatment. At follow-up, most survivors achieved full weight-bearing and

were capable of walking up and down stairs.

Cement use was universally described in the literature. Some authors avoided placing cement in the fracture site (to reduce the risk of nonunion),[7,19] whereas others used bone cement to fill metaphyseal defects that remained after fracture resection and implantation.[11,24]

Complication rates were modest, and there were no reports specifically on implant loosening or fracture nonunion.[7,10,12-19] The majority of complications were recorded in 2 studies that used megaprostheses in sicker populations: Bell and colleagues[11] noted debilitating illnesses in all their patients, and Appleton and colleagues[24] included 9 nonambulatory patients and 36 patients who required 2 assistants to ambulate. All deaths were attributed to medical comorbidities and disseminated malignancy. Contrarily, studies by Pearse and colleagues[16] and Choi and colleagues[19] included previously ambulatory patients and reported no deaths or complications (Table 2). Likewise, in studies that combined results of DFFs and proximal tibia fractures, death and complication rates varied from 7% to 31% (Table 3).

Discussion

DFFs in the elderly historically were difficult to treat. Reported outcomes are largely favorable, but, even with newer plate designs, catastrophic failures still occur in the absence of bony union.[26,27] After ORIF, patients' weight-bearing is often restricted for 12 weeks or longer[28]—a protocol that is undesirable in elderly patients, especially given that the rate of mortality 1 year after these fractures has been found to be as high as 25%.[29]

Arthroplasty for DFFs—performed either

Table 4. **Trade Names of Implants Used in Current Literature**

Implant Type	Trade Names
Rotating hinge	GenuX (Implantcast)
	Global Modular Reconstruction System (Stryker-Howmedica-Osteonics)
	Guepar (Stryker-Howmedica)
	Kotz (Stryker-Howmedica)
	Link Endo-Model Rotational Knee Joint Prosthesis (Waldemar Link)
	S.HIVA (Dedienne Santé)
	Spherocentric Knee
	Stanmore (Zimmer Biomet)
	Zimmer Biomet Segmenta System ZSS
Lesser constrained	Depuy Synthes Cruciate-Retaining
	Legacy Condylar Constrained Knee LCCK (Zimmer Biomet)
	Medial Pivot Knee (Wright Medical Technology)
	Nexgen Cruciate-Retaining (Zimmer Biomet)

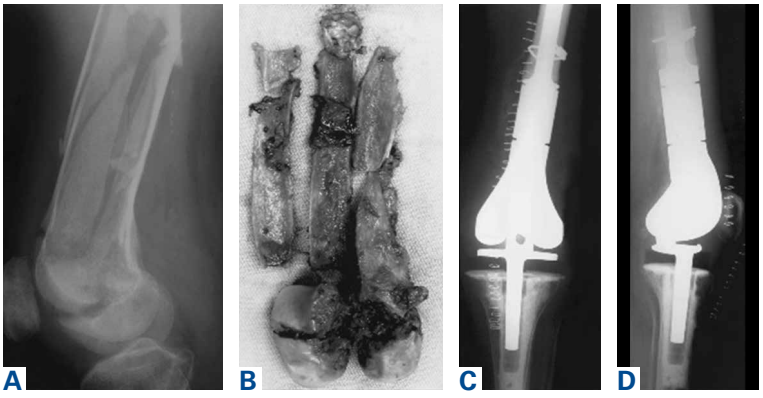

Figure 2. Preoperative (A) lateral radiographs and (B) intraoperative fragments excised from an AO/OTA (Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association) type C fracture. Postoperative (C) anteroposterior and (D) lateral radiographs following distal femoral replacement.
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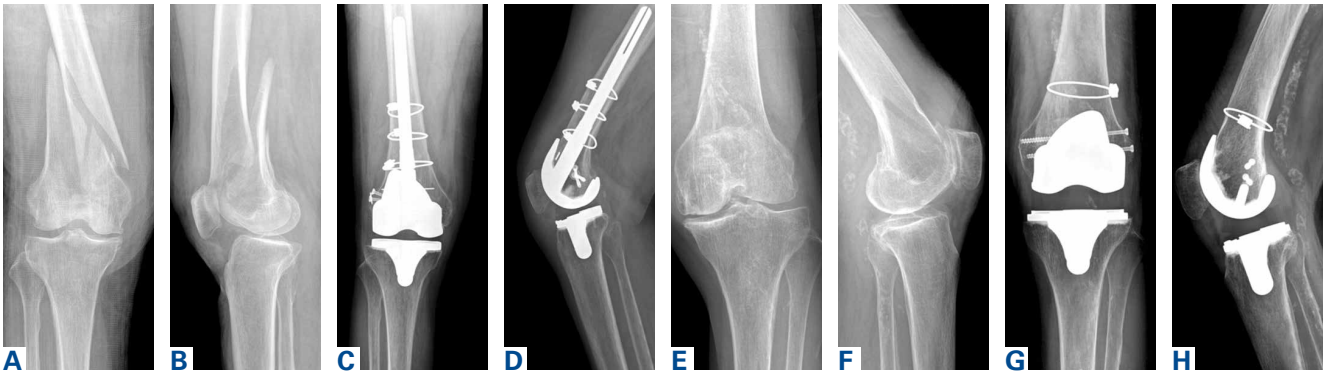

Figure 3. Preoperative (A) anteroposterior and (B) lateral images, and postoperative (C) anteroposterior and (D) lateral images of a type-A extra-articular fracture treated by an unconstrained total knee arthroplasty (TKA) with intramedullary fixation. Preoperative (E) anteroposterior and (F) lateral images, and postoperative (G) anteroposterior and (H) lateral images of a type-B partial articular fracture treated by an unconstrained TKA with internal fixation.
Reprinted with permission of Korean Knee Society.[19]

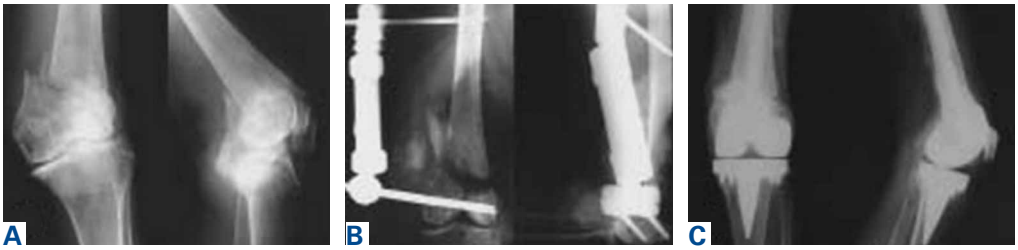

Figure 4. (A) Preoperative, (B) intraoperative, and (C) postoperative radiographs of type C distal femur fracture temporarily stabilized with external fixator during femoral cutting.
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with ORIF, or independently with a constrained implant—is a documented treatment modality, but the evidence is poor, and results have been mixed. Patients who received hinged TKA with major fracture resection had higher complication rates.[8,11,22,24] However, the problems were mostly medical, not associated with surgical technique. Appleton and colleagues[24] found a higher than expected 1-year mortality rate, 41%, but used an unhealthy baseline population (44% cognitive impairment, 17% nonambulatory before injury). Although Boureau and colleagues[22] found a 1-year mortality rate of 30%, only 1 in 10 deaths was attributable to a perioperative complication. Among the remaining cases involving resection and megaprostheses for previously ambulatory patients, only 1 perioperative death was recorded (Table 2).[11,12,16,18] Therefore, the risks associated with patients' baseline health and ambulatory status must be weighed against the benefits of aggressive arthroplasty.

An overwhelming majority of 33C fractures were treated with megaprostheses—a finding perhaps attributable to the higher likelihood that patients with osteoporosis have intra-articular, comminuted injuries. In addition, surgeons may have been more likely to indicate 33C fractures for joint replacement, whereas 33A and 33B patterns were more amenable to fracture fixation.[17,18] Interestingly, few type B fractures (0 in primary analysis and only 9 of 67 cases in Table 3) were treated with megaprostheses. In these situations, 1 condyle and ligamentous constraint remain intact, reducing the need for a constrained implant.

There were no reports of atraumatic or aseptic loosening, though use of rotating platforms with linked prostheses helps minimize this complication. Also surprising is the lack of nonunions in any of the reviewed studies, as nonunion is one of the most devastating complications of ORIF. Only 1 superficial and 2 deep infections were reported in all of the literature—representing 1.8% of all cases, which is comparable to the rate for elective primary TKA.[30]

In elderly patients with significant comorbidities, the main surgical goals are to minimize operative time and reduce time to mobility. It is therefore imperative to keep in mind that arthroplasty is elective. However, functional results of primary TKA for DFF may be more encouraging for healthier patients, as many can achieve satisfactory ROM and early weight-bearing. Therefore, TKA for DFF may benefit healthy and ambulatory patients in the setting of intra-articular comminution. Whether this treatment affects mortality rates remains to be seen.

There were several limitations to this study. First, the literature on the topic is scant. Second, exclusion criteria were kept lax to allow for inclusion of all treatments. This came at a cost to internal validity, given the heterogeneous population and differences in comorbidities between studies. Fracture classification was inconsistent as well: Although AO/OTA classification was dominant, descriptive classifications were used in several cases[7,10,12] (these descriptions, however, were sufficient for assigning equivalent AO/OTA classes). Details on preoperative functional status and comorbidity status and on postoperative protocols were also limited, though ROM and ambulatory status were provided in most studies. Last, most of these studies were single case reports or case series, so there may be reporting bias in the body of the literature, as reflected in the discrepancies between encouraging case reports and concerning case series with longer follow-up. Such bias can be avoided with larger, controlled sampling and adequate follow-up.

TKA should be considered for acute DFF in patients who have knee arthritis and are able to tolerate the physiological load of the surgery. In the choice of implant design, several factors should be considered, including bone quality, articular involvement, degree of comminution, and ligamentous injury. Unconstrained knee designs should be considered in cases in which the fracture pattern appears stable and the collateral ligaments are intact (eg, 33A and 33BB fractures). Megaprostheses, which may allow for immediate weight-bearing but require considerable bone resection, would be beneficial in 33C fractures and in fractures with

ligamentous compromise. However, their complication rates are unclear, and comparative studies are needed to investigate whether the rates are higher for these patients than for patients treated more traditionally.

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This paper will be judged for the Resident Writer's Award.