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Primary Total Knee Arthroplasty Using Revision-Type Stems for Distal Femoral Bone Compromise Following Previous Fracture Fixation: A Report of Two Cases and Narrative Review

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Abstract

Total knee arthroplasty (TKA) following previous distal femoral fracture treated with internal fixation presents unique surgical challenges due to altered metaphyseal anatomy, retained hardware, and compromised bone support that may persist despite fracture healing. We report two cases of primary TKA performed in patients with previous distal femoral fractures treated with osteosynthesis, in whom revision-type stems were implanted in both the femoral and tibial components to optimize fixation in the setting of compromised bone quality while maintaining a primary polyethylene insert without increasing prosthetic constraint. The patients were 58 and 61 years old and were followed for six months. At six months, both patients demonstrated stable, well-aligned knees with favorable clinical outcomes, with Knee Injury and Osteoarthritis Outcome Score-12 (KOOS-12) scores of 54 and 58 and Single Assessment Numeric Evaluation (SANE) scores of 60% and 80%, respectively. Additionally, we present a narrative review addressing the use of stem extensions in primary TKA and the clinical scenarios in which they have been described. These cases illustrate individualized surgical decision-making in a poorly defined clinical scenario and demonstrate that revision-type stems may serve as a mechanical adjunct when residual distal femoral bone compromise following previous fracture fixation raises concerns regarding conventional fixation while allowing the preservation of primary prosthetic constraint. In selected patients with residual distal femoral bone compromise following previous fracture fixation, revision-type stems may provide a reasonable mechanical adjunct during primary TKA, supporting individualized implant selection.

Categories: Orthopedics

Keywords: bone loss, distal femoral fracture, implant fixation, osteoporosis, post-traumatic osteoarthritis, revision-type stems, total knee arthroplasty

Introduction

Stem extensions are used in selected cases of primary total knee arthroplasty (TKA), although their indications vary across clinical settings [1]. Nevertheless, aseptic loosening remains an important cause of failure and is closely related to fixation at the bone-implant interface [2,3]. Durable fixation depends not only on implant design, alignment, and surgical technique but also on the mechanical properties of the host bone [4]. Patients undergoing primary TKA after a previous distal femoral fracture treated with internal fixation may present a particularly challenging fixation environment, with residual metaphyseal bone compromise, retained hardware or screw holes, and altered bone architecture. Although low bone mineral density has been associated with greater tibial component migration in uncemented TKA, the implications of localized post-traumatic bone compromise for implant fixation remain insufficiently characterized [4,5]. Previous studies have described the technical challenges associated with TKA following distal femoral fractures, highlighting the potential effects of residual deformity, bone defects, retained fixation devices, and previous surgical interventions on arthroplasty outcomes [6].

Stem extensions are well established in revision TKA because they can transfer loads from deficient metaphyseal bone toward the diaphysis and contribute to construct stability [2]. In primary TKA, their use has been described in selected situations, including severe deformity, obesity, metaphyseal bone defects, and concerns regarding implant fixation. Clinical and biomechanical studies have evaluated their use and potential effects on implant outcomes and load distribution, although indications and findings vary across populations and study designs [3,7,8]. A systematic review of TKA for post-traumatic arthritis reported improvements in pain, range of motion, and functional outcomes while also identifying relevant complications and a higher revision burden compared with TKA for primary osteoarthritis [9]. However, the specific role of revision-type stems in primary TKA for residual distal femoral bone compromise following fracture fixation remains insufficiently defined. In this context, we report two cases of primary TKA in patients with residual distal femoral bone compromise following previous fracture fixation, in whom revision-type stems were used in both femoral and tibial components while maintaining a primary polyethylene insert without increasing prosthetic constraint. We also present a narrative review of stem use in primary TKA to contextualize this underreported clinical scenario and illustrate individualized implant

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selection.

Case Presentation

Patient 1

Medical History and Clinical Description

A 58-year-old woman with a medical history of hypertension and hypothyroidism on treatment presented with a prior supracondylar distal femoral fracture, which was complicated by nonunion and required four surgical procedures, including fixation with a distal femoral plate (Figure 1). She had no history of infection or wound-healing complications related to her previous procedures. Before TKA, she had an independent gait with a cane and was able to walk approximately two blocks, beyond which she developed pain. Conservative management before TKA consisted of occasional short courses of NSAIDs and physical therapy. Her BMI was 28 kg/m², she was a nonsmoker, and she was not receiving treatment for osteoporosis. Radiographic evaluation from 2014 demonstrated advanced osteoarthritis of the left knee (modified Kellgren-Lawrence grade 4 in all compartments [10]).



FIGURE 1: Patient 1. LHS: anteroposterior X-ray showing distal femoral hardware and severe tricompartmental osteoarthritis of the left knee. RHS: lateral X-ray showing distal femoral hardware and severe tricompartmental osteoarthritis of the left knee.

LHS: left-hand side; RHS: right-hand side

The patient remained clinically stable for several years until 2025, when distal femoral hardware removal was performed. Subsequently, she developed a one-year history of progressive left knee pain, functional limitation in activities of daily living, and progressive deformity of the left lower extremity.

During the management of the nonunion, serial radiographic follow-up was performed until complete fracture union was confirmed. Erythrocyte sedimentation rate, C-reactive protein, and complete blood count were obtained at different time points and were within normal limits, with no findings suggestive of infection. Cultures obtained during the revision procedures for nonunion and during hardware removal in 2025 were negative for infection. No joint aspiration was performed. No clinical signs of infection were documented at any point.

Physical Examination

Initial evaluation demonstrated left knee range of motion from 0° to 120° with generalized crepitus, along with mild right hip pain.

At the assessment, the left knee exhibited grade 1 effusion, reduced range of motion from 0° to 100°, severe global crepitus, and varus collapse with a flexible deformity, consistent with advanced joint degeneration.

Additional Examination

Radiographs obtained in 2025 confirmed end-stage osteoarthritis of the left knee (modified Kellgren-Lawrence grade 4 in all compartments [10]), with a normal contralateral knee (grade 0 in all compartments). Imaging also demonstrated severe osteoporosis involving the distal femur (Figure 2).



FIGURE 2: Patient 1. LHS: anteroposterior X-ray showing compromised distal femoral bone quality following hardware removal and severe tricompartmental osteoarthritis. RHS: lateral X-ray showing compromised distal femoral bone quality following hardware removal and severe tricompartmental osteoarthritis.

LHS: left-hand side; RHS: right-hand side

Bone densitometry demonstrated osteoporosis, with T-scores of -2.9 at the lumbar spine and -2.1 at the femoral neck. In addition to systemic osteoporosis, local radiographic and intraoperative findings raised concerns regarding conventional femoral fixation. These included residual screw tracks, cortical defects and thinning, compromised metaphyseal bone support, and residual deformity related to the previous fracture and surgical procedures. Although the fracture had achieved union, the local bone changes and suboptimal bone quality observed intraoperatively supported the use of a stemmed femoral component to obtain diaphyseal fixation. The residual deformity was not quantitatively measured. The collateral ligaments were competent, without evidence of ligamentous insufficiency.

Diagnosis

The patient was diagnosed with end-stage post-traumatic osteoarthritis of the left knee associated with severe osteoporosis and progressive varus deformity.

Intervention

Given the severity of symptoms, functional impairment, and compromised bone quality, a left TKA with stemmed components was indicated to mitigate the risk of periprosthetic fracture. The preoperative Knee Injury and Osteoarthritis Outcome Score-12 (KOOS-12) (summary score) was 40, with a Single Assessment Numeric Evaluation (SANE) score of 10% [11,12].

In February 2026, primary TKA was performed using the Legion revision system (Smith & Nephew, Hertfordshire, UK). A size 4 revision femoral component with a 4-mm offset and a 160×16 -mm uncemented stem was used, together with a size 4 revision tibial component with a 2-mm offset and a 160×14 -mm uncemented stem. Cement was applied at the component-bone interface, while the intramedullary canals were not cemented and the stems achieved press-fit fixation within the diaphyseal bone. A 9-mm primary posterior-stabilized polyethylene insert was used. The procedure was performed through a midline skin incision with a medial parapatellar arthrotomy. All ligaments were clinically competent, with no collateral ligament insufficiency. The knee was balanced in both flexion and extension without requiring specific ligament releases. A primary posterior-stabilized polyethylene insert was selected to provide the lowest level of constraint compatible with the competent ligamentous structures. No bone defects were identified; the indication for stem augmentation was the compromised bone quality rather than a structural bone defect.

The operative time was 95 minutes, with an estimated blood loss of 150 mL.

Postoperative radiographs showed appropriate alignment and positioning of both femoral and tibial components, with satisfactory cortical engagement of the stems (Figure 3). The patient followed an accelerated rehabilitation protocol including immediate full weight bearing as tolerated, progressive active and passive range of motion exercises, anti-inflammatory therapy, and multimodal analgesia. She was discharged after three days with home-based physical therapy, oral analgesics, and anticoagulation therapy.

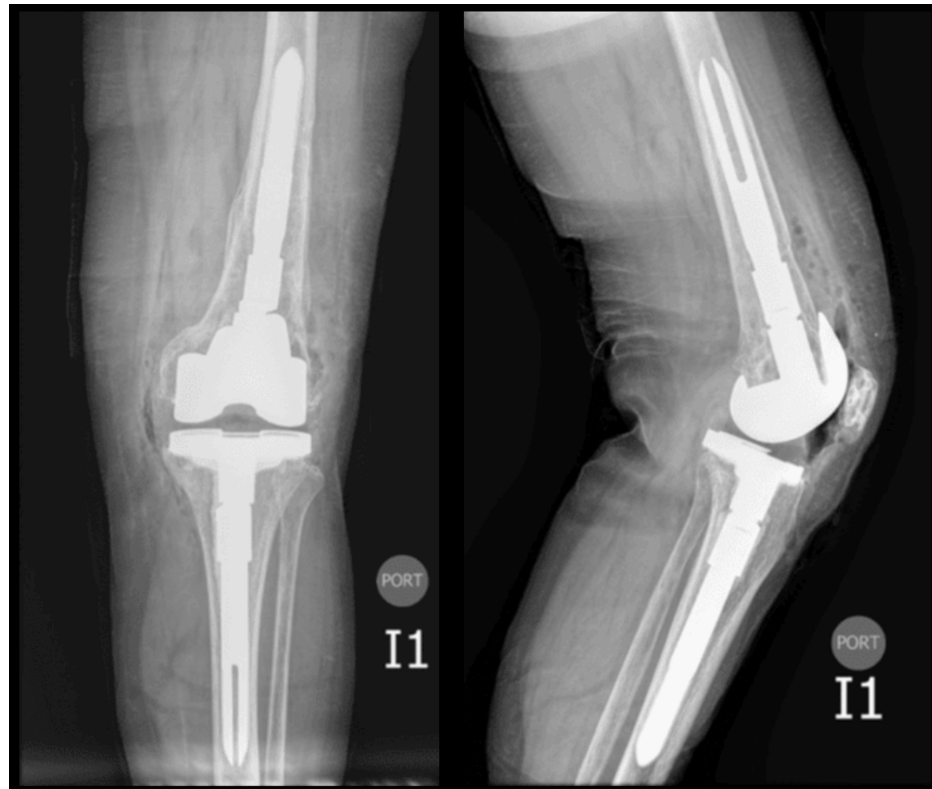


FIGURE 3: Patient 1. LHS: anteroposterior postoperative X-ray showing femoral and tibial stemmed components. RHS: lateral postoperative X-ray showing femoral and tibial stemmed components.

LHS: left-hand side; RHS: right-hand side

The postoperative rehabilitation protocol, thromboprophylaxis, analgesic management, and bone-health treatment for both patients are described together in the following section.

Outcomes

At two weeks postoperatively, the patient demonstrated favorable early recovery, with adequate pain control and adherence to both anticoagulation and rehabilitation protocols. Physical examination revealed ambulation with a walker, a well-healing surgical incision without signs of infection, and active range of motion from 0° to 70°. Sutures were removed, and rehabilitation was intensified to optimize range of motion.

At the one-month follow-up, the patient reported continued clinical improvement, with effective pain modulation and adherence to rehabilitation. Physical examination demonstrated a fully healed surgical wound, mild periarticular swelling without effusion, and improved range of motion from 0° to 105°. The knee was stable, well-aligned, and mechanically balanced, consistent with satisfactory early postoperative outcomes.

At four months follow-up, the patient reported continued clinical improvement, with mild pain over the surgical scar. Physical examination demonstrated a fully healed surgical wound with hypersensitivity to touch, no periarticular swelling, and improved range of motion from 0° to 110°. The knee was stable, well-aligned, and mechanically balanced.

At six months, the patient reported a KOOS-12 summary score of 54, with a SANE score of 60% [11,12].

No intraoperative or postoperative fractures, infection, thromboembolism, reoperation, or other complications were reported during the six-month observation period. The patient developed scar hypersensitivity, which resolved five months after surgery following scar desensitization exercises during physiotherapy.

Immediate postoperative radiographs showed the initial position and alignment of the prosthetic components. No subsequent routine radiographs were available because the institutional protocol schedules radiographic surveillance at one year after surgery, which had not yet been reached at the time of the last follow-up.

Patient 2

Medical History and Clinical Description

A 61-year-old woman with a history of left anterior cruciate ligament (ACL) reconstruction at 20 years of age and a supracondylar distal femoral fracture at 55 years of age presented with progressive left knee pain and functional limitations in activities of daily living. The fracture initially underwent open reduction and internal fixation, followed by revision fixation three months later because of delayed healing and fixation failure. She reported pain while walking and could walk approximately four blocks before being limited by symptoms. Conservative treatment before TKA included NSAIDs and physiotherapy. Her BMI was 23.5 kg/m², she was a nonsmoker, and she had no history of infection or wound-healing complications following her previous surgeries. She was not receiving osteoporosis treatment before surgery and was subsequently referred to endocrinology for medical management.

Radiographs showed retained osteosynthesis material, a healed fracture, and severe osteoarthritis of the left knee (modified Kellgren-Lawrence grade 4 in all compartments [10]) (Figure 4). Because no radiographs obtained before the fracture were available, it was not possible to determine whether osteoarthritis developed after the fracture or predated it, particularly given the history of previous ACL reconstruction. Based on these findings, staged management was recommended, beginning with the removal of the osteosynthesis hardware before planning TKA.



FIGURE 4: Patient 2. LHS: anteroposterior X-ray showing distal femoral hardware and severe tricompartmental osteoarthritis of the left knee. RHS: lateral X-ray showing distal femoral hardware and severe tricompartmental osteoarthritis of the left knee.

LHS: left-hand side; RHS: right-hand side

One year later, the patient returned after hardware removal performed at an outside institution. The operative report indicated complete removal of the hardware, except for one screw that remained fully embedded within the bone.

Physical Examination

On examination, the left knee demonstrated increased joint volume with well-healed surgical scars and no signs of infection. There were severe global crepitus and a painful range of motion from 0° to 110°.

Additional Examination

Follow-up radiographs revealed severe tricompartmental osteoarthritis of the left knee, predominantly affecting the medial compartment, along with decreased bone mineral density in the distal femur (Figure 5).



FIGURE 5: Patient 2. LHS: anteroposterior X-ray showing compromised distal femoral bone quality following hardware removal and severe tricompartmental osteoarthritis. RHS: lateral X-ray showing compromised distal femoral bone quality following hardware removal and severe tricompartmental osteoarthritis.

LHS: left-hand side; RHS: right-hand side

Bone densitometry demonstrated osteoporosis, with a T-score of -2.6 at the femoral neck. In addition to systemic osteoporosis, local radiographic and intraoperative findings raised concerns regarding conventional femoral fixation. These included residual screw tracks, cortical defects and thinning, compromised metaphyseal bone support, and residual deformity related to the previous fracture and surgical procedures. Although the fracture had achieved union, the local bone changes and suboptimal bone quality observed intraoperatively supported the use of a stemmed femoral component to obtain diaphyseal fixation. The residual deformity was not quantitatively measured. The collateral ligaments were competent, without evidence of ligamentous insufficiency. A retained screw embedded in bone was exposed and removed during surgery without complications or fracture.

Diagnosis

Radiographs showed postsurgical changes following the removal of the osteosynthesis hardware from the distal diaphysis and metaphysis of the left femur, with a retained cortical screw located within the distal femoral medullary canal. The distal femoral fracture was consolidated, with associated disuse osteopenia and advanced degenerative changes of the left femorotibial and patellofemoral joints.

Intervention

Given the patient's clinical history, severe degenerative changes, compromised bone quality, and multiple prior surgical interventions, a left TKA with stemmed components was indicated. Stem augmentation was selected as a potential means of optimizing fixation and improving mechanical stability, with the theoretical benefit of mitigating periprosthetic fracture risk. The preoperative KOOS-12 summary score was 35, with a SANE score of 30% [11,12].

Primary TKA was performed using the Legion revision system (Smith & Nephew). A size 4 revision femoral

component with a 2-mm offset and a 160 × 12-mm uncemented stem was used, together with a size 3 revision tibial component with a 4-mm offset and a 120 × 10-mm uncemented stem. Cement was applied at the component-bone interface, while the intramedullary canals were not cemented and the stems achieved press-fit fixation. An 11-mm primary posterior-stabilized polyethylene insert was used. The procedure was performed through a midline incision with a medial parapatellar arthrotomy. All ligaments were competent, with no collateral ligament insufficiency. The knee was balanced in both flexion and extension without requiring specific ligament releases. A primary posterior-stabilized insert was selected to provide the lowest level of constraint compatible with the competent ligamentous structures. No structural bone defects were identified; stem augmentation was used because of compromised bone quality. During femoral canal preparation, the retained screw, which was completely covered by bone, was exposed and removed without complications, fracture, or the need for an additional surgical approach (Figure 6). The operative time was 102 minutes, with an estimated blood loss of 200 mL.

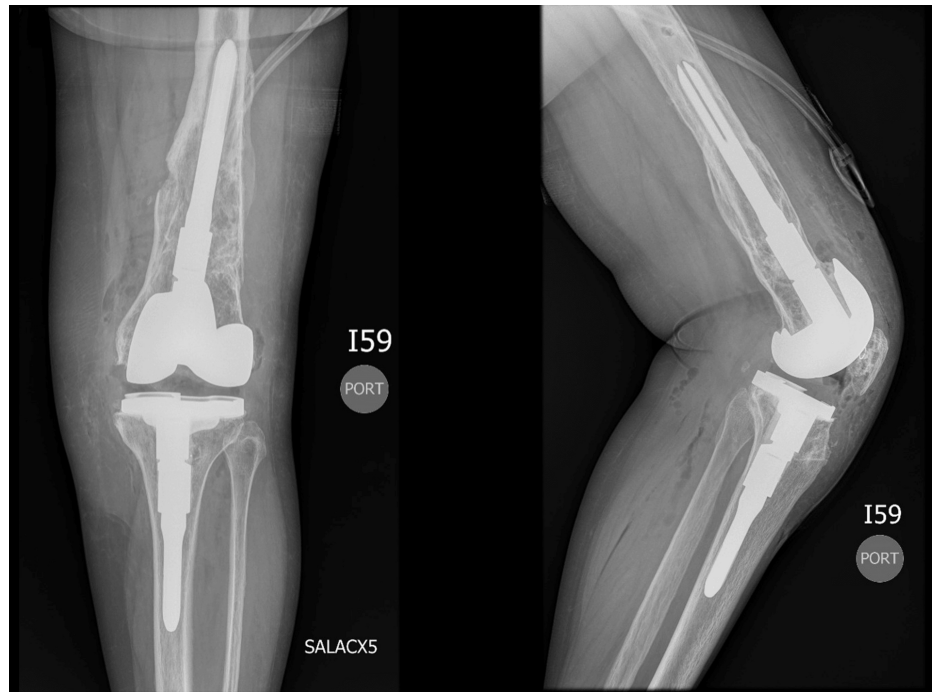


FIGURE 6: Patient 2. LHS: anteroposterior postoperative X-ray showing femoral and tibial stemmed components. RHS: lateral postoperative X-ray showing femoral and tibial stemmed components.

LHS: left-hand side; RHS: right-hand side

Outcomes

At two weeks postoperatively, the patient demonstrated adequate pain control and adherence to rehabilitation protocols. Physical examination revealed ambulation with a walker, a healing surgical incision without signs of infection, and active range of motion from 0° to 85°. Sutures were removed, and the rehabilitation protocol was continued.

At the six-week follow-up, the patient reported clinical improvement with effective pain modulation. Physical examination demonstrated mild periarticular swelling and range of motion from 0° to 110°. The knee was stable, well-aligned, and mechanically balanced.

At four months follow-up, the patient reported continued clinical improvement without pain in the knee. Physical examination demonstrated a fully healed wound, no periarticular swelling, and range of motion from 0° to 115°. The knee remained stable, well-aligned, and mechanically balanced. The patient required external support for ambulation only on uneven terrain.

At six months, the patient reported a KOOS-12 summary score of 58, with a SANE score of 80% [11,12].

No intraoperative or postoperative fractures, infection, thromboembolism, reoperation, or other complications were reported during the six-month observation period.

Immediate postoperative radiographs showed the initial position and alignment of the prosthetic components. No subsequent routine radiographs were available because the institutional protocol schedules radiographic surveillance at one year after surgery, which had not yet been reached at the time of the last follow-up.

Postoperative rehabilitation and medical management in both patients

Postoperative rehabilitation and medical management were similar in both patients, following the institutional joint replacement protocol. Both patients began full weight-bearing ambulation with a walker immediately after surgery, with physiotherapy initiated on the first postoperative day during hospitalization. The rehabilitation protocol consisted of immediate ambulation with external support and progressive recovery of knee range of motion. The walker was used for two weeks, followed by a cane until one month after surgery. After discharge, rehabilitation was continued through home-based physiotherapy. Adherence was assessed through reports from the physiotherapists, who documented compliance with the rehabilitation objectives without difficulties or nonadherence.

For thromboprophylaxis, both patients received enoxaparin during the three-day hospital stay. After discharge, Patient 1 received dabigatran 220 mg once daily for one month, whereas Patient 2 received rivaroxaban 15 mg once daily for one month. The difference in post-discharge thromboprophylaxis reflected the treating surgeons' individual medication preferences. Postoperative pain management was provided by the acute pain service during hospitalization, including patient-controlled analgesia with hydromorphone followed by progressive weaning to oral acetaminophen and hydrocodone/acetaminophen. At discharge, both patients received acetaminophen 500 mg every eight hours and hydrocodone/acetaminophen every eight hours for 10 days. No adverse effects or treatment intolerance were reported.

Given the underlying compromised bone quality, both patients were referred for outpatient endocrinology evaluation for the initiation of medical treatment of osteoporosis with teriparatide.

Rationale for stem augmentation and stem selection

Although the primary concern was the compromised distal femoral bone, tibial stem extensions were also used in both patients based on the intraoperative assessment of tibial bone quality. Despite the absence of previous tibial surgery, the tibial bone was considered suboptimal for fixation, and stem augmentation was selected to optimize fixation while maintaining a primary polyethylene insert without increasing prosthetic constraint. A 160-mm femoral stem was used in both patients to bypass the compromised distal femoral bone and obtain adequate diaphyseal fit and fixation. The tibial stem lengths differed according to the fit achieved with the available implant sizes and the individual patient anatomy: a 160-mm tibial stem was used in Patient 1 and a 120-mm stem in Patient 2. Because the components were uncemented, stem length was selected intraoperatively based on the available implant options and the quality of diaphyseal engagement achieved. No alternative stem lengths or non-stemmed configurations were considered intraoperatively.

Biomechanical studies, such as the finite element analysis by Conlisk et al. [7], provide general support for the role of stem extensions in modifying load distribution and reducing periprosthetic stress; however, these findings do not directly validate the specific stem lengths or constructs used in our patients (Table 1 and Table 2).

Clinical event	Patient 1	Patient 2
Original fracture	2002: supracondylar distal femoral fracture	2020: supracondylar distal femoral fracture
Initial fixation	First surgery: open reduction and internal fixation	Initial open reduction and internal fixation
Treatment of nonunion/fixation failure	Second surgery: treatment of nonunion with bone grafting	Revision fixation 3 months after fracture for delayed healing and fixation failure
Additional procedure	Third surgery: fracture-site revitalization and additional bone grafting	-
Documented fracture union	Mid-2003, after the third surgery	Subsequently documented as healed
Hardware removal	2025: removal of osteosynthesis material	2025: removal of osteosynthesis material; one screw remained embedded in bone
TKA	February 2026	March 2026
Six-month follow-up	KOOS-12 summary score: 54; SANE: 60%	KOOS-12 summary score: 58; SANE: 80%

TABLE 1: Chronological summary of clinical events and follow-up in both patients.

TKA: total knee arthroplasty; KOOS-12: Knee Injury and Osteoarthritis Outcome Score-12; SANE: Single Assessment Numeric Evaluation

Variable	Patient 1: preoperative	Patient 1: 6 months	Patient 2: preoperative	Patient 2: 6 months
KOOS-12 summary score (0-100)	40	54	35	58
SANE score (%)	10	60	30	80
Range of motion	0-100°	0-120°	0-90°	0-120°
Pain	Severe, progressive pain	No pain reported	Preoperative pain	No pain reported
Functional limitations	Activities of daily living limited	No limitations reported	Preoperative functional impairment	No limitations reported
Walking aids	Cane	None reported	Cane	None reported

TABLE 2: Comparative clinical outcomes and patient-reported measures before and six months after total knee arthroplasty.

KOOS-12: Knee Injury and Osteoarthritis Outcome Score-12; SANE: Single Assessment Numeric Evaluation

The SANE score was obtained by asking patients, "On a scale from zero to 100, how would you rate your knee today (100 being normal)?" The question was administered in Spanish.

Discussion

In this report, we describe two cases of primary TKA in patients with previous distal femoral fractures treated with internal fixation, resulting in compromised distal femoral bone stock. Revision-type stems were used in both the femoral and tibial components despite the absence of conventional indications such as severe deformity, ligamentous instability, or major segmental bone defects. In both cases, previous fracture fixation and subsequent surgical interventions had altered the distal femoral metaphyseal bone, raising concerns regarding its ability to provide reliable support for the femoral component [2,8]. The femoral stems were selected to address the compromised distal femoral metaphysis, whereas the tibial stems were used to optimize fixation in the setting of suboptimal tibial bone quality. This strategy provided additional fixation while preserving a primary posterior-stabilized articulation without increasing prosthetic constraint.

Bone quality is an important determinant of implant fixation and long-term stability after TKA. Osteopenia and osteoporosis are prevalent among patients undergoing knee arthroplasty and may remain undiagnosed before surgery [5]. Furthermore, lower preoperative bone mineral density has been associated with increased tibial component migration in uncemented TKA, highlighting the potential influence of bone quality on implant fixation [4]. However, systemic reductions in bone mineral density should be distinguished from localized bone compromise resulting from previous fractures and surgical interventions. In the present cases, the primary concern was not solely bone fragility, but the structural alterations of the distal femoral metaphysis following fracture fixation and subsequent procedures.

In contrast to systemic osteoporosis, previous distal femoral fracture fixation may result in localized structural compromise that is not fully captured by bone mineral density measurements alone. Screw holes, cortical defects, altered load transmission, and remodeling associated with previous fracture fixation and subsequent surgical procedures may affect the mechanical integrity of the distal femur [2,7]. These changes may be particularly relevant when preparing the femoral component during primary TKA, as the remaining metaphyseal bone may provide less reliable support for implant fixation. Therefore, preoperative planning and intraoperative assessment should consider not only systemic bone quality but also the location and extent of previous fixation-related defects and the amount of remaining bone available to support the implant.

The biomechanical rationale for using stems in TKA is to transfer part of the load from the metaphyseal region to the diaphysis, potentially reducing stress within compromised bone and improving the mechanical support of the implant [2]. Finite element analyses have further demonstrated that stem length influences load distribution and periprosthetic fracture risk, although these effects depend on the implant configuration and the characteristics of the surrounding bone [7]. In addition, clinical research has examined changes in periprosthetic bone mineral density with cemented and uncemented tibial stems in primary TKA [13]. These biomechanical principles provide a rationale for stem use but do not, by themselves, establish clinical benefit in this specific setting.

Stem extensions are used in selected primary TKA procedures when additional fixation is considered necessary, although the indications and supporting evidence remain heterogeneous [3,8]. Barlow et al. reported that post-traumatic arthritis was strongly associated with the use of stems in primary TKA (odds ratio: 10.5), highlighting the relevance of post-traumatic conditions to implant selection [8]. However, this association does not establish the effectiveness of stems in patients with distal femoral bone compromise following previous fracture fixation. In a registry-based study of primary TKA for osteoarthritis, Osan et al. found a higher rate of all-cause revision with tibial stem extensions during the first six months, followed by a lower rate after 1.5 years; revision for aseptic loosening was also lower beyond two years [1]. The stemmed group also had a higher rate of revision for infection between three months and 1.5 years and a higher rate of insert-only revision across all time points [1]. These time-dependent observational findings should not be interpreted as evidence of a uniformly beneficial effect, particularly because patient selection and differences in clinical complexity may influence the results. Furthermore, the use of increased implant constraint for ligamentous insufficiency or substantial deformity addresses a different mechanical issue from stem-mediated fixation and should be considered separately [14].

The available evidence must be interpreted according to the clinical setting and component being studied. Research on tibial stem extensions in primary TKA provides information on revision rates, fixation, and selected high-risk populations [1,3], whereas literature on stem fixation in revision TKA describes diaphyseal load transfer as a rationale when metaphyseal support is compromised [2]. In contrast, biomechanical studies in primary TKA have examined the effects of stem length on load distribution and periprosthetic fracture risk [7]. Although post-traumatic arthritis has been associated with stem use in primary TKA [8], evidence specifically addressing femoral revision-type stems for localized distal femoral bone compromise following previous fracture fixation remains limited.

Previous studies have explored stem use in selected primary TKA scenarios involving challenging mechanical conditions. For example, Bourdier et al. reported an association between tibial stem use and a lower rate of postoperative pain in patients with preoperative frontal deformity exceeding 10° [15]. Although this represents a different clinical scenario, it illustrates the use of stems in selected primary TKA procedures based on specific anatomical and mechanical considerations. In our cases, revision-type stems were selected to address concerns regarding the structural integrity of the distal femoral metaphysis following previous fracture fixation while retaining a primary posterior-stabilized articulation without increased constraint. This approach highlights the importance of tailoring stem selection to the underlying bone deficiency rather than relying solely on conventional indications for increased implant constraint.

In clinical practice, revision-type stems may be considered in primary TKA when previous distal femoral fracture fixation has compromised metaphyseal bone and raises concerns about reliable femoral component support. This decision should be based on the residual bone stock, the location and extent of screw holes or cortical defects, the integrity of the remaining metaphysis, and the feasibility of obtaining adequate fixation. Alhifzi compared kinematic and conventional alignment strategies in TKA; however, their findings do not directly inform indications for stem use [16]. Potential advantages of stem extensions must be balanced against their disadvantages, including additional bone removal, altered load transfer, and stress

shielding, which may affect the remaining bone stock and future revision options [2,3,7]. Accordingly, stems should be considered a selective mechanical adjunct rather than a routine requirement after distal femoral fracture fixation.

This report has several limitations. First, it describes two cases that occurred within a relatively short period and were treated by different surgeons. These cases were not part of a prospectively defined or consecutively enrolled series, and no comparator group was available. Second, follow-up was limited to six months, precluding conclusions regarding long-term implant survival. Third, local bone quality and the adequacy of metaphyseal support were assessed primarily through clinical and intraoperative judgment rather than a standardized objective grading system, which may limit reproducibility. Furthermore, the independent contribution of the stems to the observed outcomes cannot be isolated from the effects of the overall TKA procedure and postoperative rehabilitation. A systematic review and meta-analysis of primary cemented TKA reported a lower rate of revision for tibial aseptic loosening with stem extensions than with standard tibial components, although the evidence was limited by heterogeneity and methodological concerns [17]. Similarly, a clinical and biomechanical study in obese patients undergoing primary TKA evaluated short and long tibial stems and reported favorable outcomes with short stems at the two-year follow-up [18]. These findings should be interpreted in the context of tibial stem use and cannot be directly extrapolated to femoral revision-type stems. Therefore, these cases support the technical feasibility of using revision-type stems in selected patients with distal femoral bone compromise following previous fracture fixation and describe the observed early postoperative recovery; however, they cannot establish a reduction in periprosthetic fracture risk, superior fixation, or durable implant survival. Future comparative studies should evaluate clinical outcomes, implant survival, and complications in patients with localized post-traumatic bone compromise to better define appropriate indications and implant selection criteria.

Literature search strategy

A narrative literature search was conducted to identify studies relevant to stem use in primary and revision TKA, with particular emphasis on bone quality, post-traumatic bone compromise, and implant fixation. The search strategy included combinations of terms related to "total knee arthroplasty", "tibial stem", "femoral stem", "stem extension", "revision TKA", "post-traumatic arthritis", "distal femoral fracture", "osteosynthesis", and "bone quality". Relevant studies were selected based on their clinical relevance, study design, and applicability to the present cases. The literature was synthesized narratively, considering the differences between primary and revision TKA and between tibial and femoral stem indications.

Table 3 summarizes the principal findings of the selected studies and their applicability to the clinical scenarios presented in this report.

Study	Design/setting	Main finding	Applicability to our cases
Osan et al., 2024 [1]	Registry study; primary TKA	Reported time-dependent associations between tibial stem use and revision outcomes, including aseptic loosening	Provides clinical evidence on tibial stems, but not specifically on femoral stems for post-traumatic bone compromise
Kang et al., 2018 [2]	Narrative review; revision TKA	Described stem fixation principles, including load transfer toward the diaphysis when metaphyseal support is compromised	Provides a biomechanical rationale for stem use; evidence is derived primarily from revision TKA
Supramaniam et al., 2025 [3]	Systematic review; primary TKA	Reported heterogeneous evidence regarding indications and outcomes of tibial stems in primary TKA	Supports the selective consideration of tibial stems but does not establish indications for post-traumatic femoral bone compromise
Andersen et al., 2017 [4]	Prospective study; 92 uncemented TKAs	Lower preoperative bone mineral density was associated with greater tibial component migration	Supports the relevance of systemic bone quality to implant fixation, although it does not directly evaluate post-traumatic bone defects
Delsmann et al., 2022 [5]	Observational study; elderly patients undergoing TKA	Reported the prevalence of osteoporosis and osteopenia in patients scheduled for TKA	Provides context for systemic bone health but does not establish the implications of localized post-traumatic bone compromise
Papadopoulos et al., 2002 [6]	Clinical study; TKA following previous distal femoral fracture	Described the clinical challenges and outcomes associated with TKA after distal femoral fracture	Directly contextualizes the technical complexity of TKA after distal femoral fracture, but does not establish the effectiveness of revision-type stems in this setting
Conlisk et al., 2018 [7]	Finite element study	Evaluated stem length and its influence on load distribution and modeled periprosthetic fracture risk	Supports the biomechanical consideration of stem length but does not demonstrate clinical fracture prevention in patients with post-traumatic bone compromise

Barlow et al., 2017 [8]	Retrospective study; primary TKA	Evaluated the incidence, indications, outcomes, and survivorship of stems in primary TKA; post-traumatic arthritis was strongly associated with stem use	Supports the clinical relevance of stem use in selected primary TKA cases involving post-traumatic arthritis, without proving stem superiority
Saleh et al., 2016 [9]	Systematic review; TKA for post-traumatic arthritis	Reported improvements in pain, range of motion, and functional outcomes while identifying relevant complications following TKA for post-traumatic arthritis	Contextualizes the challenges and outcomes of post-traumatic TKA but does not specifically evaluate revision-type stem effectiveness
Sangaletti et al., 2025 [13]	Prospective study; primary TKA	Compared cemented and uncemented tibial stems using periprosthetic bone mineral density measurements	Informs considerations regarding tibial fixation and bone density, not the specific indication for femoral stems after distal femoral fracture fixation
Vedoya et al., 2018 [14]	Clinical study; primary TKA	Examined the use of constrained prostheses in complex primary TKA	Helps distinguish the role of implant constraint in managing instability from the use of stems to address concerns about fixation
Bourdier et al., 2024 [15]	Comparative study; primary TKA with frontal deformity greater than 10°	Evaluated tibial stem use in patients with substantial frontal deformity and reported differences in postoperative pain	Provides evidence from a selected complex primary TKA population, but the indication differs from post-traumatic distal femoral bone compromise
Alhifzi, 2024 [16]	Systematic review	Reviewed contemporary alignment strategies in TKA	Provides broader context for individualized implant planning but does not directly establish stem indications in the present clinical scenario
Heidari et al., 2025 [17]	Systematic review and meta-analysis; primary cemented TKA	Compared tibial stem extensions with standard tibial components, reporting potential differences in aseptic loosening outcomes with limitations in the evidence	Informs the discussion of tibial stem use but cannot establish the comparative effectiveness of femoral revision-type stems
Druel et al., 2024 [18]	Clinical and biomechanical study; obese patients undergoing primary TKA	Compared short and long tibial stems, including clinical and biomechanical outcomes	Informs stem-length selection in a different population and does not directly address post-traumatic distal femoral bone compromise

TABLE 3: Comparative summary of studies on stem use in primary TKA.

TKA: total knee arthroplasty

Conclusions

Primary TKA following distal femoral fracture fixation may present specific challenges when residual metaphyseal bone compromise raises concerns about implant fixation. In the two cases presented, revision-type stems were used in both femoral and tibial components while maintaining a primary level of prosthetic constraint, with satisfactory clinical outcomes and no reported complications at six months. These findings support the technical feasibility of this individualized approach in selected patients but do not establish its effectiveness, biomechanical advantages, or superiority over standard primary components. The short follow-up and limited number of cases preclude conclusions regarding long-term fixation, implant survival, or complication rates. Further studies with larger cohorts, comparative designs, and longer follow-up are needed to clarify the indications and clinical outcomes of stem augmentation in this specific setting.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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