



Medial Tibial Bone Defect with Severe Varus Deformity in Osteoarthritis Kellgren Lawrence grade IV Using Primary Total Knee Arthroplasty Combined with screwing and Autologous Bone Graft: A Case Report and Technical Notes

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Article History :

Received date : 2025/12/28
Revised date : 2026/01/19
Accepted date : 2026/02/23
Published date : 2026/03/05



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E-ISSN :

ISSN 3048-1368



P-ISSN

ISSN 3048-1376



ABSTRACT

Medial tibial bone defects in varus knee osteoarthritis pose challenges during total knee arthroplasty (TKA) due to bone loss and soft-tissue imbalance, which complicate restoration of alignment and stability. While constrained implants are an option, primary TKA with screw fixation and autologous bone grafting offers a bone-preserving, cost-effective alternative in patients with intact collateral ligaments. A 64-year-old male presented with progressive right knee pain, deformity, and inability to bear weight for nine years despite conservative treatment. Radiographs revealed tricompartmental osteoarthritis, varus deformity exceeding 15°, and a contained medial tibial defect measuring 10–12 mm. The patient underwent primary TKA via a medial parapatellar approach using a stabilized implant. The defect was reconstructed with an autologous cancellous graft harvested from the distal femoral cut and secured with two cortical screws.

Cemented femoral, tibial, and polyethylene components were implanted after achieving soft-tissue balance. Postoperatively, he remained non-weight-bearing for three months, then progressed to full weight bearing. Early follow-up showed a 0°–110° range of motion, stable fixation, and early graft incorporation on radiographs. Autologous bone graft reconstruction provides a biological, economical method to restore the joint line and mechanical axis in primary TKA. Studies by Kharbanda, Sugita, and Dewidar have reported durable outcomes with stable graft incorporation. Careful preoperative planning, rigid fixation, and structured rehabilitation are essential for success. This technique offers a reliable, bone-preserving solution that achieves alignment correction and functional recovery without the need for constrained implants.

Keywords: Total knee arthroplasty, varus deformity, bone graft, medial tibial defect, autologous bone graft

INTRODUCTION

Osteoarthritis (OA) of the knee is a leading cause of chronic pain, deformity, and disability among the elderly population. It is characterized by progressive degeneration of articular cartilage, subchondral bone sclerosis, and osteophyte formation, leading to joint space narrowing and functional impairment [1]. Among the deformities associated with advanced knee OA, varus alignment is the most common presentation, primarily resulting from chronic overload of the medial compartment [2,3]. The repetitive mechanical stress on the medial tibial plateau causes asymmetric cartilage wear, subchondral bone loss, and eventual collapse, producing a medial bone defect that complicates total knee arthroplasty (TKA) [4].

Reconstruction of the medial tibial defect is a critical step in achieving stable fixation and restoring mechanical alignment during TKA. The extent of this bone loss varies from shallow contained defects to deep uncontained cavitary defects exceeding 10 mm. If unaddressed, the defect may compromise implant stability, alter joint line orientation, and accelerate component loosening [5,6]. Several reconstructive strategies have been described, including cement augmentation, metal wedges, modular augments, and bone grafting. Each technique carries specific biomechanical and cost considerations, particularly in low-resource settings [7].

In cases of severe varus knee osteoarthritis with medial bone defect, when collateral ligaments remain intact, primary TKA with autologous bone graft reconstruction provides a bone-preserving and cost-effective solution. This method restores the joint line, supports the tibial baseplate, and maintains soft-tissue balance without requiring constrained implants [8,9]. Previous studies have reported that autologous grafts achieve excellent incorporation and long-term stability while preserving bone stock for future revision surgeries [10,11]. The present case report describes the surgical management of a patient with advanced varus knee osteoarthritis and a significant medial tibial bone defect treated using primary TKA combined with autologous bone grafting and screw fixation.

CASE PRESENTATION

We reported the following case based on the SCARE 2025 checklist. A 64-year-old male presented with complaints unable to bear weight of bilateral knee pain for approximately nine years, with progressive worsening over the past five years. The pain was more pronounced in the right knee, aggravated by ambulation, and relieved by rest and analgesic medication. The patient had difficulty performing activities of daily living such as squatting, climbing stairs, and walking long distances. There was no history of trauma, previous intra-articular injections, or systemic illness. Prior conservative management at a regional hospital included oral analgesics and physiotherapy, but symptoms persisted and gradually worsened. The patient was referred to our tertiary center for further management.

On examination, the right knee showed visible varus deformity without swelling or skin changes. Palpation revealed mild crepitus but no warmth or effusion. Range of motion in the right knee was limited, with 20 degrees of fixed flexion deformity and flexion up to 125 degrees (Figure 1.B). The left knee showed mild varus alignment with early degenerative changes. There was no neurovascular deficit in either lower limb. Laboratory investigations were within normal limits. Preoperative standing radiographs of the right knee revealed advanced tricompartmental osteoarthritis with complete medial joint space obliteration, subchondral sclerosis, and marginal osteophyte formation (Figure 1 A). The femoral condyle–tibial plateau angle measured 22.5°. The tibial plateau–tibial shaft angle (TPTS) measured 54.5°. The femoral condylar–femoral shaft angle measured 98.2°, and the femorotibial angle measured 6.4° (Figure 2).



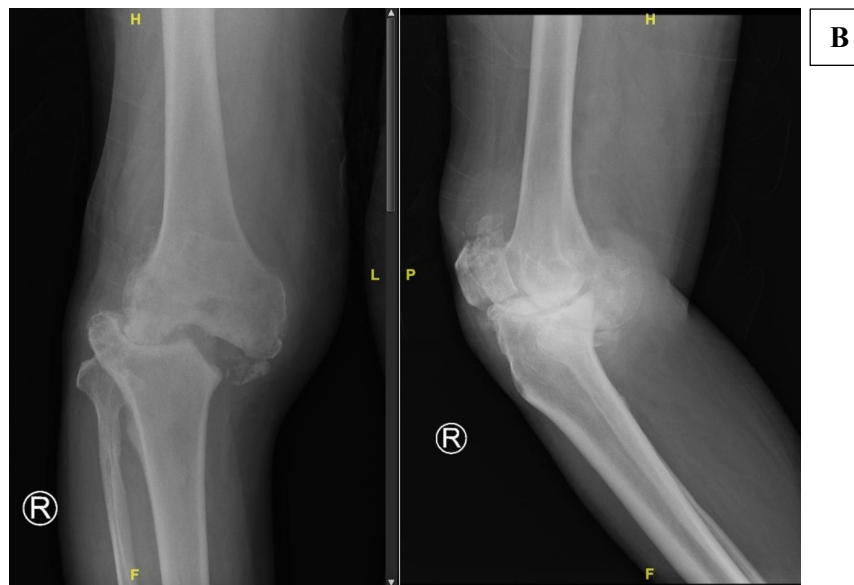


Figure 1. (A) Preoperative clinical picture and ROM exercise **(B)** Preoperative radiograph of the right knee demonstrating severe medial joint space obliteration and varus angulation.



Figure 2. Preoperative Radiograph Measurement



Figure 3. Intraoperative Preparation and Tibial Cut and Femoral Cut

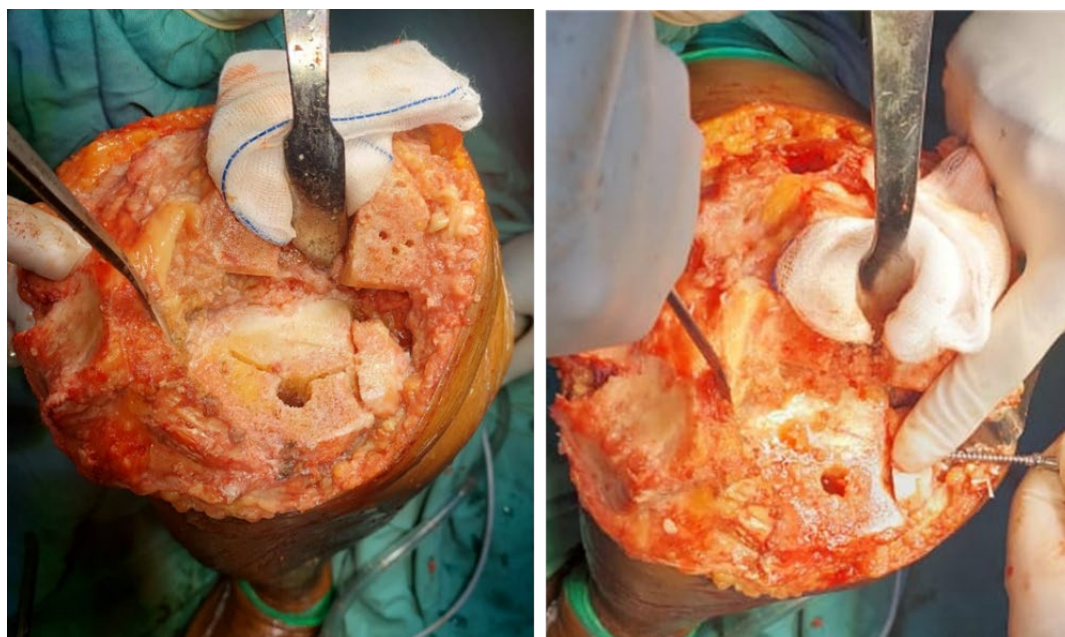
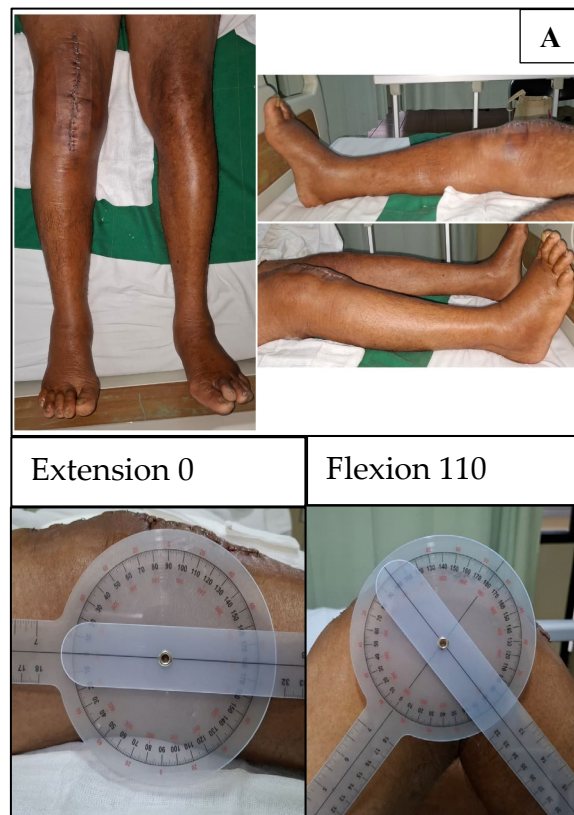


Figure 4. Medial tibial bone defect reconstruction using autologous bone graft fixed with two cortical screws



Figure 5. Implantation of total knee components (femoral, tibial, and polyethylene insert)



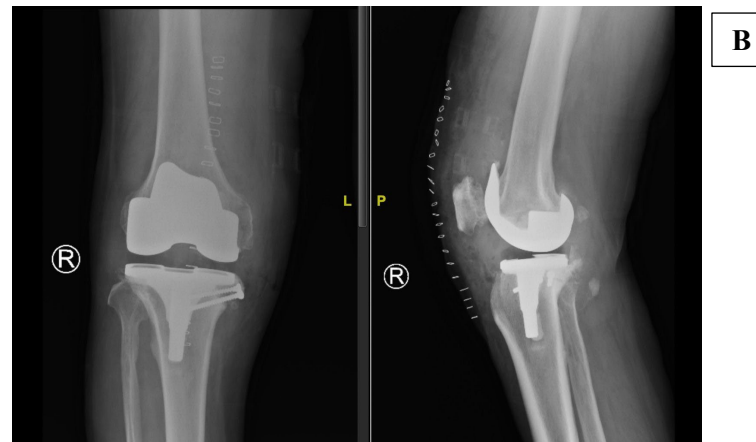


Figure 6. (A) Post operative clinical picture ROM exercise. **(B)** Postoperative radiographs (anteroposterior and lateral views) showing well-aligned cemented components with stable bone graft fixation.

Surgical Technique

Under regional anesthesia, the patient was placed in the supine position with a pneumatic tourniquet applied to the proximal thigh. A medial parapatellar approach was used to expose the knee joint. The patella was everted and osteophytes were removed to improve visualization and restore the joint contour. Soft tissue balancing began with a gradual medial release to correct the varus alignment and achieve symmetric flexion–extension gaps.

First a standard tibial osteotomy was then performed perpendicular to the mechanical axis. Following femoral cuts were made initially (Figure 3). A contained medial tibial defect measuring approximately 10–12 mm in depth was identified. To reconstruct the defect, autologous cancellous bone graft harvested from the distal femoral cut was meticulously shaped to fit the defect and secured with two cortical screws, providing rigid support for the tibial baseplate (Figure 4). Trial components were then inserted, and soft tissue balance was reassessed in both flexion and extension. Once satisfactory mechanical alignment and joint stability were achieved, the definitive primary total knee arthroplasty components (tibial 3 right, femoral 5 right, and polyethylene insert 3-4/11) were implanted with cement fixation (Figure 5). The final intraoperative range of motion

achieved was 0° to 110°, with neutral mechanical alignment and central patellar tracking. The wound was closed in layers over a suction drain.

Follow-Up

Postoperative clinical and radiograph is presented in Figure 6. Physiotherapy was initiated on the second postoperative day. The programme was aimed to allow early range-of-motion and quadriceps–hamstring strengthening. At two weeks, the sutures were removed, and the patient was trained to perform assisted transfers using a walker without bearing weight on the operated limb. The patient remained non–weight-bearing (NWB) for three months because of the medial bone defect to protect the bone graft and ensure proper incorporation. At the third month postoperatively, the patient achieved a pain-free range of motion of 0°–110° with full extension, and full weight bearing (FWB) was allowed thereafter.

DISCUSSION

Reconstruction of the medial tibial bone defect in osteoarthritic knees remains one of the most technically demanding components of TKA. The defect is most often a consequence of chronic varus alignment, in which increased load transmission through the medial compartment leads to progressive cartilage erosion, subchondral bone collapse, and remodeling of the proximal tibia and distal femur [7]. The resulting deformity alters the joint line orientation, increases medial soft-tissue tension, and produces lateral laxity, all of which complicate accurate bone resection, alignment correction, and component placement during surgery. Bone loss at the medial tibial plateau, if not properly reconstructed, may compromise the fixation of the tibial baseplate and increase the risk of early loosening [8,9].

The main surgical objective in these cases is to restore the joint line, ensure uniform load distribution, and reestablish mechanical stability. Various techniques have been developed to address medial tibial bone loss, including cement augmentation, metal wedges, modular augments, and structural bone grafting [12]. Among these, autologous bone grafting remains the most biological and cost-effective method, particularly in healthcare settings where financial limitations

or implant unavailability restrict the use of advanced modular systems [13]. The use of an autograft provides osteoconductive, osteoinductive, and osteogenic properties that support new bone formation and graft incorporation while maintaining the patient's native bone stock for possible future revision procedures.

In the present case, the defect was reconstructed using an autologous bone graft harvested from the distal femoral cut. The graft was contoured to fit the defect and secured with cortical screws, providing immediate mechanical stability to the tibial baseplate. This approach successfully restored the medial tibial plateau height, corrected the varus alignment, and allowed balanced soft-tissue tension. Radiographic follow-up demonstrated early evidence of graft incorporation and stable component positioning, which reflects adequate biological and mechanical integration.

Previous studies have consistently demonstrated favorable outcomes using autologous bone grafts for medial tibial defects in primary TKA. Kharbanda and Sharma [14] reported that autograft reconstruction achieved clinical and radiological outcomes comparable to cases without bone loss, with durable fixation and minimal complications. Sugita et al. [15] observed successful incorporation of autogenous grafts in medial tibial defects measuring 10 mm or more, with stable fixation and improved knee function at mid-term follow-up. Dewidar et al. [16] further supported these findings in a prospective series of 48 patients with uncontained defects greater than 10 mm, showing significant improvement in alignment, functional outcome, and graft stability during a mean follow-up exceeding four years. These reports affirm that bone grafting remains a reliable and biologically sound method for reconstructing large medial defects in selected patients undergoing primary TKA.

The success of this technique depends on several critical factors. Proper preoperative assessment is required to determine the size and containment of the defect, as well as the integrity of collateral ligaments. Intraoperatively, achieving stable graft fixation and restoring the mechanical axis are essential for uniform load transfer across the joint. Controlled postoperative rehabilitation also plays a vital role, particularly when a non-weight-bearing protocol is required to protect the graft during the early healing phase [17,18]. Once graft incorporation is sufficient, gradual

progression to full weight bearing can facilitate functional recovery while maintaining implant stability.

In the current case, the patient achieved early clinical improvement and radiographic signs of graft healing within three months after surgery. This outcome suggest that in patients with preserved ligamentous stability and localized medial tibial bone loss, a standard primary TKA combined with autologous bone grafting can yield excellent short-term results without the need for constrained implants. Beyond its technical advantages, this approach offers a cost-effective and bone-preserving solution suitable for institutions where economic and resource limitations restrict implant selection. Long-term follow-up is necessary to ensure complete graft incorporation and monitor potential late complications such as graft resorption or component loosening.

Ultimately, this case reinforces the importance of addressing medial tibial bone defects during TKA. Proper reconstruction not only restores alignment and stability but also contributes to the longevity of the implant. When executed with meticulous surgical planning and sound judgment, primary TKA with autologous bone graft reconstruction can achieve functional recovery and radiological stability comparable to more constrained systems while preserving native bone for the future.

CONCLUSION

Primary total knee arthroplasty with autologous bone graft reconstruction can provide a stable, biological, and cost-effective solution for osteoarthritic knees with medial tibial bone defects. In properly selected patients with preserved collateral ligament function, this technique allows restoration of joint alignment, mechanical stability, and bone stock preservation without the need for constrained implants.

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