



Case Report

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Extra-Articular Tibia Vara Deformity Managed with Kinematic Aligned Total Knee Arthroplasty: A Case Report

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Running Title Tibia Vara Deformity Managed with Restricted Kinematic Aligned TKA

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ABSTRACT

The deformity around the knee joint is considered extra-articular when it is proximal in relation to the distal femur epicondyle for the femur and distal to the level of the fibula neck for the tibia deformity. The presence of extra-articular deformity plays a significant role in arthritis around the adjacent joint. The present study shows a case of malunited proximal tibia fracture with knee osteoarthritis treated with restricted kinematic alignment total knee arthroplasty. For end-stage OA with extra-articular deformity, a well-balanced total knee replacement with robotic assistance can be done without complete intra-articular correction of extra-articular deformity. A 65-year-old male presented to the outpatient department (OPD) with a complaint of bilateral knee pain from the past six months. The radiographs showed end-stage knee osteoarthritis with a malunited proximal tibia fracture on the right side. For the right knee, total knee arthroplasty (TKA) was planned using robotic assistance with restricted kinematic alignment, which consists of bone cuts of the distal femur, proximal tibia, and soft tissue release. For the management of knee arthritis as a result of tibial side extra-articular deformity, it can be managed with bone resections and soft tissue balancing followed by total knee replacement.

Introduction

The knee joint is a commonly affected joint by osteoarthritis and is commonly seen among the Indian population. The deformity around the knee joint is considered extra-articular when it is proximal in relation to the distal femur epicondyle and distal to the level of the fibula neck. The presence of extra-articular deformity plays a significant role in arthritis around the adjacent

joint. While planning a total knee replacement for extra-articular deformity-related arthritis, a detailed clinicoradiological examination is of utmost importance [1].

The primary factors for femur and tibia deformities are (a) malunited fractures, (b) metabolic disease, (c) congenital disease, (d) previous alignment osteotomy, and (e) metabolic bone diseases. These deformities can occur in either the coronal, sagittal, or axial planes or can be of multiplanar origin [2].

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The primary aim of the treatment is correction of the axis of the limb, which can be performed either by bony resection around the joint or osteotomy at the site of previous deformity [3]. Some previous studies have stated that only bone resections around the joint and soft tissue releases may lead to translational instability in the long term. The present study shows a case of malunited proximal tibia fracture with knee osteoarthritis treated with restricted kinematic alignment total knee arthroplasty.

Case Presentation

A 65-year-old male presented to the outpatient department (OPD) with a complaint of right knee pain from the past six months. Proper history, clinical and radiological examination, and routine investigations were performed. The patient had a history of a fall five years back and had a proximal tibia fracture, which was managed conservatively. The patient had no associated comorbidities. The standing full-length radiograph (AP view), which includes the tibia and femur, was taken to determine the amount of deformity, whereas the lateral view was taken to demonstrate sagittal deformity if present, as shown in Figures 1 and 2.

The radiographs showed bilateral knee osteoarthritis with a malunited proximal tibia fracture on the right side. Thereafter, for the right knee, robot-assisted TKA was planned using restricted kinematic alignment philosophy. The patient was laid supine on the operating table after neuraxial anaesthesia, and painting and draping were done. Then a midline skin incision was made, followed by dissection of subcutaneous tissue and

fascia, after which the sub-vastus approach was used for the right knee. Thereafter, pins and tracers were placed in the distal femur and tibial shaft, followed by measurement of hip rotation; knee range of motion and stress range of motion were taken. The 3D model of the affected knee was created with the help of bone mapping based on this gap balancing, and bone was planned. The bone preparation was done, then trials were taken, followed by assessment of range of motion, stability, and patella tracking.

The intraoperative deformity was managed with the help of a robotic arm, and its pre- and post-correction values are shown in Figure 3. Then, cruciate-retaining prostheses with cement were placed in situ, and closure was performed in layers with a drain in situ. Then, from the same day onwards, as the effect of neuraxial anaesthesia wore off, the straight leg raise test, walking with a walker, and knee bending as per tolerance were started, and the drain was removed 24 hours after surgery. Table 1 shows the pre-op, intra-op, and postoperative parameter values. The postoperative radiograph of the right knee (anteroposterior and lateral views) showed a well-aligned knee joint, and the lower limb scanogram showed an improved hip-knee-ankle angle, as shown in Figures 4 and 5.

Suture removal was performed 2 weeks after surgery. After that, for the first 3 months, clinical and radiological assessments were done every month, followed by every 3 months for the next 9 months. The preoperative KSS improved from 35 to 87, KFS improved from 46 to 79, and OKS score improved from 17 to 44 at final follow-up. The knee joint range of motion was within normal



Fig. 1. Radiograph of Knee joint (Antero-posterior and Lateral view of knee joint showing malunited fracture at meta-diaphyseal junction of tibia).

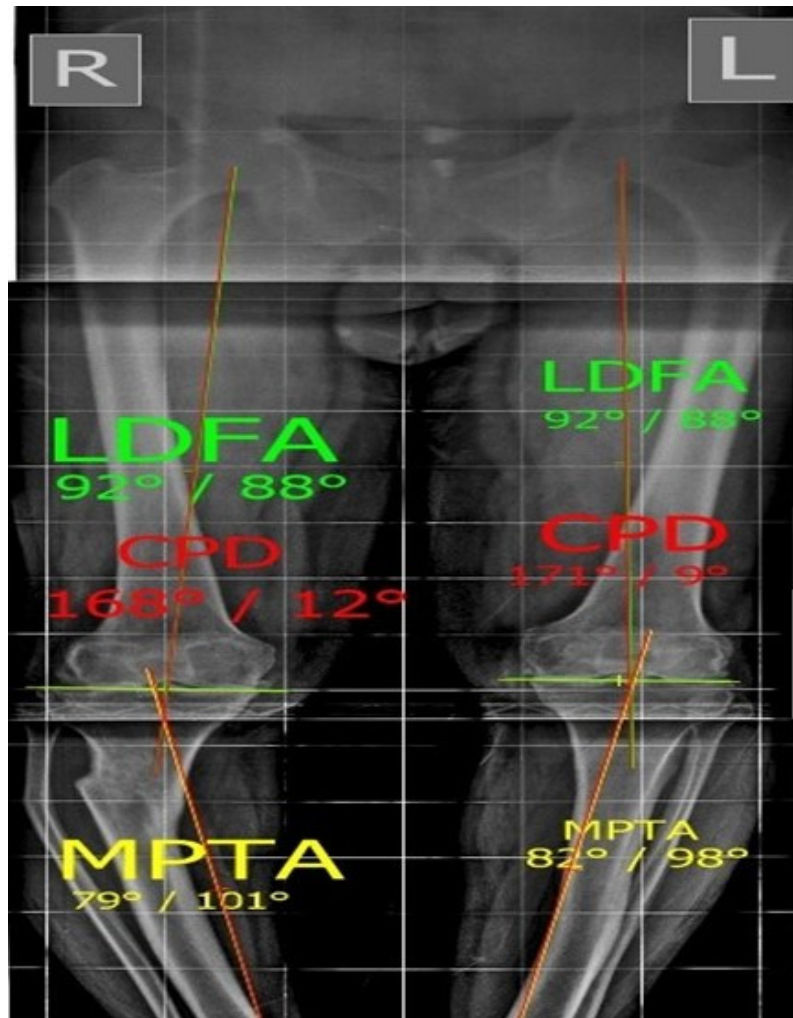


Fig. 2. Pre-op Bilateral Scanogram showing measurement of LDFA, MPTA and HKA angles.

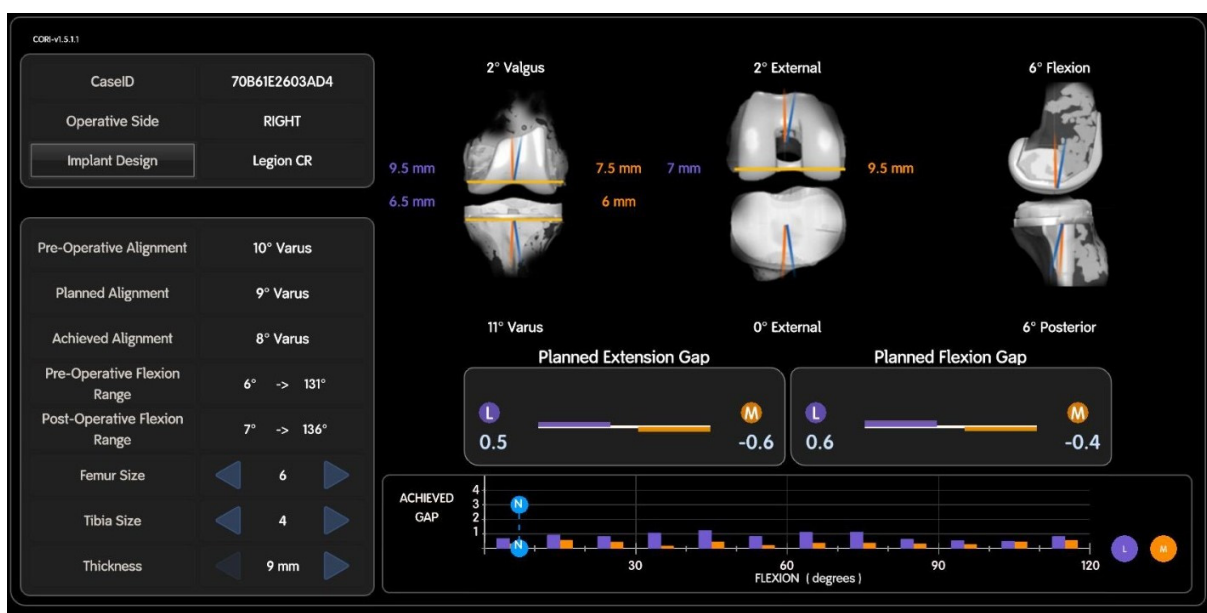
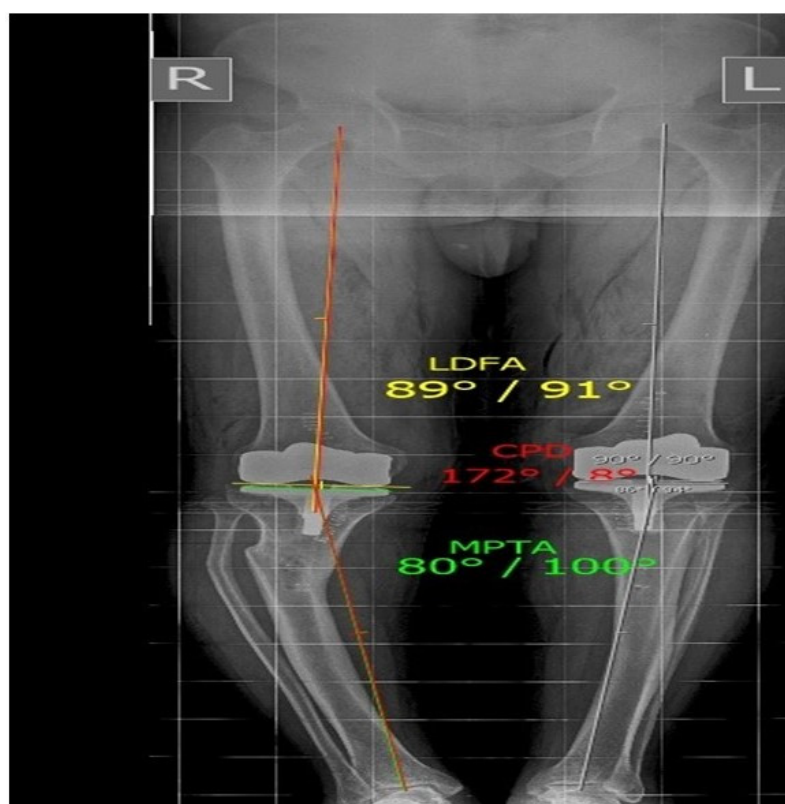


Fig. 3. Intra-operative planning of restricted kinematic alignment for tibia vara with osteoarthritis.

Table 1. Pre-op, intra-op and post-op values of various parameters.

S.NO	Parameters	Pre-op	Post-op
1	LDFA	92	89
2	MPTA	79	80
3	HKA	168/12	172/8
4	Varus	10	8
5	Range of Motion	6-131	7-136

LDFA- Lateral distal femur angle, MPTA- Medial proximal tibia angle, HKA- Hip-knee-ankle angle

**Fig. 4.** Post-operative Radiograph of Knee joint (Antero-posterior and Lateral view of knee joint showing well maintained joint post total knee replacement).**Fig. 5.** Post-operative scanogram shows corrected LDFA, MPTA, and CPD angles post total knee replacement.

limits (range 0°–130°). The patient was followed for 18 months, and that duration was uneventful. A total of 35 studies were available, out of which 7 studies were included in the literature review. The inclusion criteria were extra-articular tibia deformity with knee arthritis managed with intra-articular resection and TKA.

Discussion

The success of total knee arthroplasty depends on the correct alignment of the prosthesis, bone preservation and collateral ligaments, restoration of the limb mechanical axis, and patella tracking. The real task during total knee arthroplasty is in the case of extra-articular deformity at the level of the femur and tibia. The proximity of extra-articular deformity (EAD) near the joint line affects joint loading and needs careful consideration while planning. Though in these case scenarios, there are many options in the form of (a) bone resection of the distal femur, proximal tibia, and soft tissue balancing; (b) osteotomy of the deformity site and then knee replacement in the second stage; and (c) single-stage osteotomy and knee replacement [3-13].

Single-staged procedures, where deformity correction and total knee arthroplasty (TKA) are performed in a single sitting, offer several advantages. The chief advantage is that the patient undergoes only one surgical intervention, which leads to a single recovery period. As a result, patients are often able to resume their activities of daily living at an earlier stage compared to those who have staged procedures. However, there are also disadvantages associated with single-staged procedures. These include an increased risk of blood loss during surgery, and there is a need to prevent cement spillage from the osteotomy site. Additionally, patients are at risk of non-union at the osteotomy site, and there is a potential risk of pulmonary embolism.

Double-staged procedures, in contrast, involve two separate surgeries: one for the correction of the extra-articular deformity and another for the TKA. The advantages of this approach include greater flexibility in managing the extra-articular deformity and providing adequate time for the osteotomy site to achieve union. This staged approach also helps prevent complications related to cement extrusion from the osteotomy site and might obviate the need for TKA for a few years. On the other hand, double-staged procedures require the patient to undergo two separate surgeries, which is associated with a longer

overall rehabilitation period. Consequently, there is a delay in the patient's ability to resume their usual daily activities [13].

For most extra-articular deformities on the tibial side, a challenge arises when the deformity is near the joint, so it is better to plan bony cuts on the femur and tibia side and soft tissue balancing. In the present study, the extra-articular deformity was at the meta-diaphyseal junction of the right tibia shaft, for which total knee replacement was performed using restricted kinematic alignment. The preoperative KSS improved from 35 to 87, KFS improved from 46 to 79, and OKS score improved from 17 to 44 at final follow-up. The knee joint range of motion was within normal limits (range 0°–130°). The patient had a follow-up of 18 months with a normal range of motion. The study conducted by Wang et al. on tibia vara extra-articular deformity showed good results when managed with bone resection (lateral plateau resection > medial plateau resection) and more soft tissue release on the medial aspect [14].

The use of technology in the form of robotics allowed the surgeon to balance the knee in all degrees of freedom by aligning the bone cuts and intraoperatively assessing the balance of the knee, which reduces the need to rely only on soft tissue release. The present study showed the presence of deformity at the level of malunited fracture, but with the advances in robotic surgery, even without complete correction of intra-articular or extra-articular deformity, a well-balanced total knee arthroplasty can be performed. The advantages of bony cuts around the distal femur, proximal tibia, and soft tissue balancing are single-stage surgery, quick rehabilitation, and avoidance of complications related to osteotomy and second surgery. This method is good for coronal plane deformity around 30° for the tibial side and for both coronal and sagittal plane deformity of around 20° for the femur side [15]. The limitation of the study is the lower number of patients and a shorter follow-up.

Conclusion

Management of knee arthritis as a result of tibial side extra-articular deformity can be managed with intra-articular bone resections and soft tissue balancing followed by total knee replacement. The present case explains that in end-stage OA with extra-articular deformity, a well-balanced total knee replacement can be done without complete intra-articular correction of extra-articular deformity. However, for achieving good long-term results, pre-op clinical and radiological planning is of utmost importance.

Ethical Considerations

Ethical Approval

Institutional Review Board approval was not required.

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Conflict of Interests

The authors have no conflict of interest to declare.

Patients Consent Declaration Statement

Regarding surgery and publication of data.

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