Robotic-Assisted Total Knee Replacement in a Patient with Severe Varus Deformity and High Cardiac Risk

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Abstract

Severe varus deformity of the knee is a complex condition that is managed with scrupulous pre-operative planning and intraoperative technique, more so in cardiac-risk patients. Robotic-assisted total knee replacement (TKR) has emerged as an exciting option for improving precision and better outcomes in complex cases. The authors report a case of Robotic-assisted TKR in a 65-year-old patient suffering from severe varus deformity of the knee and multiple significant cardiac comorbidities.

Keywords: Robotic assisted TKR, Severe varus deformity, Cardiac risk

Introduction

A total knee replacement (TKR) in the setting of severe varus deformity entails risks with balancing of the ligaments, component positioning, and increased blood loss. The case is complicated by the patient's high cardiac risk and requires precise execution to prevent perioperative complications. Robotic-assisted surgery emerged as a reliable method for addressing these challenges and achieved better accuracy and decreased soft tissue trauma [1, 2].

Case Presentation

A 65-year-old male was admitted with debilitative pain in the right knee, which had been severely limiting his ambulation. Clinical and radiological assessment included: The patient's knee range of motion was considerably limited, ranging from a 10° fixed flexion deformity to a maximum flexion of 90°. Severe varus deformity of 30° and mediolateral laxity 10–15 mm with advanced tricompartmental osteoarthritis with bone loss on tibial side (Fig. 1a & clinical 1b). Medical History: Ischemic heart disease with ejection fraction of 45% hypertension and well-controlled diabetes mellitus.

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Pre-operative assessment

The cardiac assessment had rated the patient American Society of Anesthesiologists grade IV. A multi-disciplinary approach was adopted to prepare the patient for surgery as much as possible.

Surgical planning

The complexity of the deformity and the cardiac risk made robotic-assisted TKR (RTKR) the better choice for enhanced precision while not elevating intraoperative stress.

Pre-operative protocols

- Management of the cardiac status through beta-blockers and antiplatelet medications, cardiology supervised.
- Pre-operative assessment in 3D computed tomography (CT) imaging for measurement of deformity correction and component alignment [3].

Surgery

- The patient was put under regional anesthesia with sedation for the RTKR.
- Procedure involved: Given the complexities of this case, the RATKA Cuvis surgical arthroplasty system was recommended as a surgical method. For planning implant size that would better fit this patient's specific geometric bony anatomy, with the goal of bringing the mechanical axis within 3° of neutral biomechanical alignment. The risks and benefits of the surgical operation were discussed, along with pre-operative 3-D CT pictures of her knee.
- Surgical planning involved obtaining a curexo protocol CT

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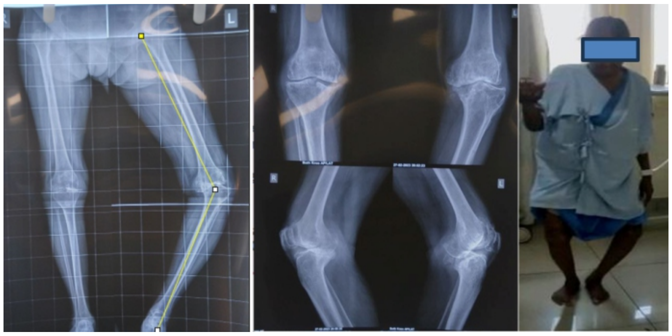

Figure 1a, 1b: Pre-op x-ray and clinical image

scan. The robotic program turns CT data into a virtual model, allowing surgeons to plan implant size, location, and joint alignment (Fig. 2). Robotic software allowed us to plan the implant position to re-establish the mechanical axis.

• Minimal invasive medial parapatellar approach.

• Following exposure, femoral and tibial trackers were applied. Bony registration was completed. We then identified the existing deformity using a correction maneuvre and checked the balances on the medial and lateral sides in extension and flexion at 90° (Fig. 3a).

To address the gap in flexion and extension, the femur was shifted proximally by 1 mm and given 1° varus, while the tibia component was lowered down by 1 mm and given 2° varus to balance. The robot is attached to patient.

Guided bone preparation with a robotic system for optimal, precise cuts and alignment [4]. Achieving balanced ligament tension using real-time feedback provided through the robotic interface. Intraoperative parameters: Blood loss: 140 mL. Surgery time: 47 min.

The patient continued in the hospital for 2 days to receive proper pain management before being returned home with post-operative X-ray on day 3 (Fig. 4a) and 3 months of clinical picture (Fig. 4b).

The patient was mobilized on post-operative day 1 with full weight-bearing using a walker. Pain was managed effectively using multimodal analgesia.

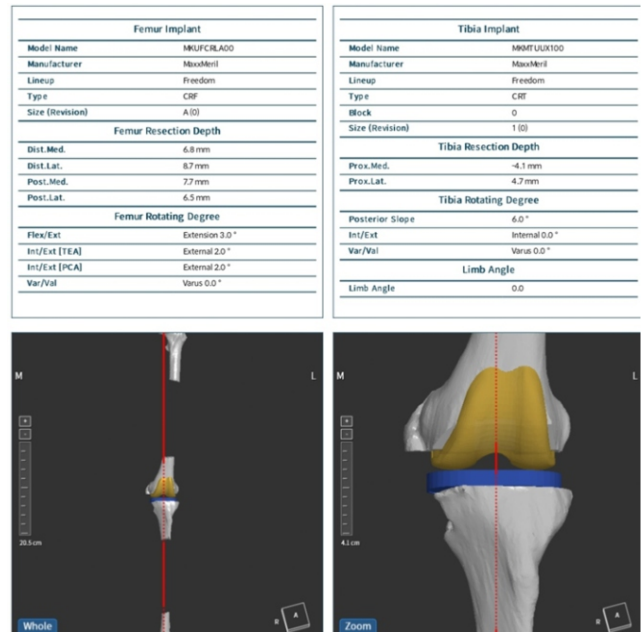

Figure 2: Preoperative CT planning

Key outcomes

• Radiographic evaluation showed accurate alignment (mechanical axis restored to 0°)

• Range of motion at 6 weeks was 0°–110°

• No perioperative cardiac events were observed.

Further, the presence of severe varus deformity complicates attaining correct mechanical alignment and high-risk cardiac patients need reduced surgical stress with high-precision execution to avoid bad outcomes. The robotic assistance significantly enhances precision of the task, lessens soft tissue injury, and improves outcomes in such high-risk cases [2, 5]. This case very well brings out the application of RTKR in achieving an excellent functional as well as excellent radiological outcome in such complex scenarios. Conclusion

This case demonstrates that RTKR is feasible and safe in the management of severe varus deformity in patients with

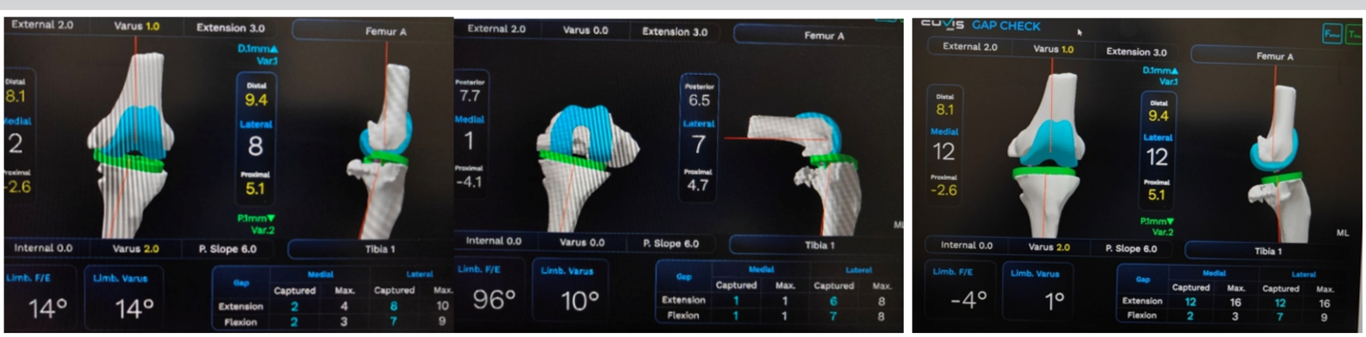

Figure 3 a, 3b: Intraoperative gap balancing and post-bone resection GAP

Figure 4: Postoperative x-ray and clinical image

significant cardiac risks. Multidisciplinary care combined with technological advancements ensures optimal outcomes even in such high-risk cases.

Key learning points

1. RTKR provides precise alignment and ligament balancing in severe deformities
2. Optimal pre-operative preparation and multidisciplinary management are critical for managing high-risk cardiac patients
3. Recovery after surgery can be significantly enhanced by minimally invasive and accurate surgical techniques.

Conclusion

The results of RTKR in the Indian population have shown promising short-term outcomes, improved surgical precision, faster recovery time, and high patient satisfaction. There was an initial steep learning curve, after which efficiency improved dramatically with experience, resulting in better operative workflow and consistency in outcomes. The 6-month follow-up shows the potential for improving functional recovery and reducing complications when using robotics rather than conventional techniques. The results have indeed been encouraging; however, more long-term studies should be conducted for the implant longevity, functional durability, and cost-effectiveness in the larger population.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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