Robotic knee replacement surgery- lets challenge a challenging case - A case report

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Abstract
Introduction: Robotic surgery is one of the recent advance in total knee replacement. It aims for accuracy and precision in execution of surgery. This case report shows a patient with osteoarthritis knee with old implants around knee managed with robotic assisted knee surgery to achieve best possible outcome without removal of previous implant.
Case Report: We present a case of 70 years old male patient with history of right knee pain, severe deformity and past history of surgery for right femur and tibia fracture 30 years back with previous implants in situ. After investigation and pre-operative planning we did single stage knee replacement surgery using robotic assistance, all deformities corrected and achieved well balanced knee without removal of previous implant and just using primary knee replacement prosthesis.
Conclusion: Robotic knee replacement surgery definitely makes surgeons task easy and more précised not only to address difficult cases but also allows to manage severe deformities without using revision implants.

Keywords: Robotic knee replacement, Osteoarthritis, Total knee replacement, Deformity correction, Implant around knee.

Introduction
With exponential increase in knee replacement surgeries all over the world, there is increase in search for technology to increase the precision of surgery and to make difficult surgeries easy. Precision is the key for any surgical outcome. Outliers beyond 2^0 of desired alignment may occur in as many as 40%-60% of cases with conventional methods.[1,2] Computer navigation was introduced to decrease this outliers but still 15% outliers recorded because of standard cutting guides and conventional method of bone preparation.[1] Therefore robotic assisted surgery was introduced not only to use the advantage of computer navigation but also to further refine and enhance the accuracy of bone preparation and to provide dynamic assessment intraoperatively.[3,4,5] In this case report we are showing the role of robotics to tackle a difficult case of osteoarthritis with previous implants around the knee and with gross deformity.

Case Report
70 year old male patient presented with history of right knee pain and deformity since 10 years. He was operated 30 years back for femur and tibia fracture which was fixed with plates and screws. On examination he was having multiple scar of previous surgery, joint line tenderness, varus deformity around 20^0, fixed flexion deformity (FFD) of 15^0, knee ROM upto 70^0. (Fig. 1b, 1c, 1d) He was investigated with knee x-rays (Fig. 1a). Challenges were 1) To remove the implant with broken screws that too 30 year old 2) To achieve ligament balancing with such gross deformity.

Different options for such cases are 2 stage surgery (implant removal, TKA with rods on femoral and tibial side to avoid stress fracture at screws site), surgery using hinged or revision prosthesis. We planned robotic assisted surgery using NAVIO system and avoided removal of implant or planned to remove 1 or 2 screws of proximal tibia and distal femur if that interfere with bone cuts or prosthesis placement.

A well written informed consent taken before the surgery. Patient was explained in detail regarding procedure, possible outcomes and complications of the surgery. Surgery was done under spinal plus epidural anaesthesia in Shashwat hospital, Pune in November 2018.

Surgical procedure
Anterior midline incision, medial parapatellar approach used. Patella everted laterally. Osteophytes removed from upper end of tibia and medial femoral condyle.

Tibial and femoral tracker pins put on femur and tibia. Sensor attached. Hip center, knee center, ankle center marked with robotic to get mechanical axis. Mapping of knee ROM, valgus–varus stress ROM mapping done for ligament laxity assessment.

Keysteps of robotic knee surgery
1. **Registration:** Data gathered intraoperatively is used to generate a computer model of the patient's anatomy and kinematics. Limb alignment, anatomic surface and soft tissue laxity are collected to assist the surgeon during implant component placement.
2. **Planning:** Planned implant position is combined with ligament laxity information under varus/ valgus stress through full range of motion to calculate postoperative joint balance. Component placement is planned virtually using cross-section and three dimensional surface views. (Fig. 2a)
3. **Bone preparation:** Fine cuts can be made with the burr using Exposure or speed Control mode, where the bur extends or retracts/stops to prepare the bone surface for the implant as planned (Fig. 2b,c). MCL pie crusting done to balance the knee in flexion.
4. **Confirmation:** Postoperative range of motion is evaluated by collecting alignment data while moving

the leg through flexion/ extension. Varus/valgus balance is assessed to confirm the achieved long-leg alignment. (Fig. 2d)

We removed only 2 screws from tibia and 1 screw from femur without any difficulty as it was obstructing prosthesis placement. We were able to achieve 0^0 varus alignment as compared to 23 degree preoperative varus. FFD correction done with posterior osteophytes removal and capsular release. (Fig. 3) Intraoperative we got knee ROM upto 100 degree. We achieved a well-balanced knee with flexion and extension graph matching throughout range of motion (Fig. 2d). Tourniquet time for the surgery was 60 minutes.

Full weight bearing walking with walker started on day 1. Patient was put on CPM machine. Knee static exercises, knee ROM exercises immediately started. Patient was discharged on Day 3 after commod training and wound inspection which was dry. On Day 7 Patient was advised to walk full weight bearing using stick support. Sutures removed on day 15^{th} without any wound complications. Patient was followed up for 6 months. Knee ROM upto 90 degree possible at 6 month follow up. (Fig. 3c).

Fig. 1 a): Preoperative x-ray showing osteoarthritic knee with old implants around the knee; **b):** Varus of 23 degree; **c):** Knee rom upto 70 degree d) 15 degree FFD

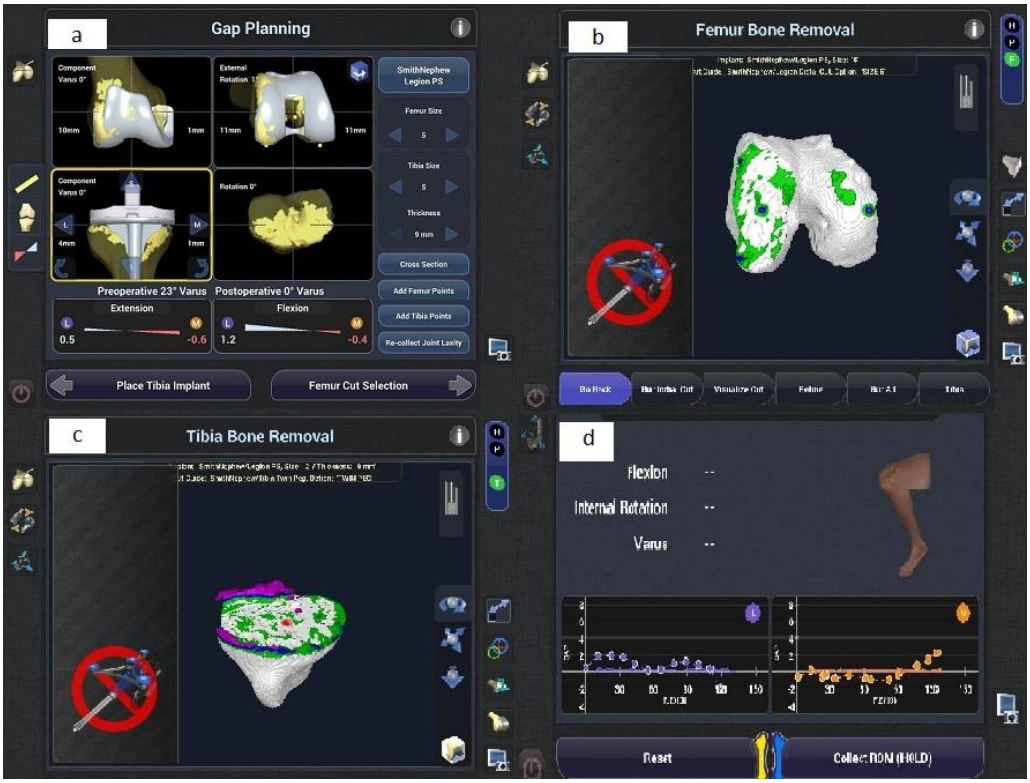

Fig. 2 a): Gap planning screen shows flexion /extension graph balancing; **b)**: Femoral distal cut, minimal medial condyle cut **c)**: Proximal tibial cut; **d)**: Post op graph balanced throughout knee range of motion

Fig. 3 a): Post op x-rays **b):** Varus deformity corrected **c):** Knee range of motion at 6 month post op; **d)**: FFD correction.

Discussion

Careful preoperative planning holds the key when we plan TKA with previous implants around the knee.[6] Preoperative planning in this case includes 1) extramedullary system for femur preparation as femur plate removal with broken screws is difficult 2) plan minimal tibial and femoral cuts and to address gross coronal plane deformity 3) minimal implant removal to put tibial and femoral component placement. Above issues can be solved by robotic assisted surgery in which intramedullary femoral jig is not required, minimal cuts can be planned with correction of deformity and screws which will interfere the planned cuts can be removed beforehand. A study by Danielle Y Ponzioet al[7] demonstrated that Robotic knee replacement surgery produces more conservative bone resection compared to conventional TKA.

Other option for such case is to remove whole implant with screws and plan conservative TKA along with long rods beyond the last screw hole to avoid stress fracture /periprosthetic fractures but that require extensive soft tissue handling which increase the chances of infection.[8]

The main advantage of using this technology is to increase the precision of surgery and precisely execution of planned bony cuts. Clinical studies of cobb et al[2] and Dundar NJ[9] et al involving these robotic systems reported superior accuracy results in terms of implant positioning when compared to conventional instrumentation.

A study by Jess H Lonner showed that robotic knee replacement not only increase precision but also saves time and avoid radiation. He anticipated improved mid term and long term outcome because of improved component alignment and quantified soft tissue balance achieved with this technology.[10]

Conclusion

Robotic knee replacement surgery definitely helpful for proper planning and execution of difficult cases. It gives us freedom to deal with complex deformity cases without using revision/constraint prosthesis. Technology is the future in medical field to make our task easier.

Acknowledgement

None.

Patient's Consent

A well written, informed consent taken from the patient for publication of case report including clinical pictures, intraoperative datas.

Conflict of interest

"The authors declare that they have no competing interests".

Ethical clearance

Not required

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References

1. Keene G, Simpson D, Kalairajah Y: Limb alignment in computer-assisted minimally-invasive unicompartmental knee replacement. *J Bone Joint Surg Br* 2006;88:44-8.
2. Cobb J, Henckel J, Gomes P. Hands-on robotic unicompartmental knee replacement: A prospective, randomised controlled study of the acrobot system. *J Bone Joint Surg Br* 2006;88:188-97.
3. Lonner JH: Indications for unicompartmental knee arthroplasty and rationale for robotic arm-assisted technology. *Am J Orthop* 2009;38(suppl 2):3-6.
4. Sinha R K. Outcomes of robotic arm-assisted unicompartmental knee arthroplasty. *Am J Orthop* 2009;38(suppl 2):20-2.
5. Lonner J H, Smith JR, Picard F. High degree of accuracy of a novel image-free handheld robot for unicondylar knee arthroplasty in a cadaveric study. *Clin Orthop Relat Res* 2015;473:206-12.
6. Gregory M. Georgiadis and William C. Skakun. Total Knee Arthroplasty with Retained Tibial Implants: The Role of Minimally Invasive Hardware Removal. *Am J Orthop* 2016;E:481-6.
7. Danielle Y. Ponzio and Jess H. Lonner. Robotic Technology Produces More Conservative Tibial Resection than Conventional Techniques in UKA. *Am J Orthop* 2016;E:465-8.

8. Civinini R, Carulli C, Matassi F, Villano M, Innocenti M. Total knee arthroplasty after complex tibial plateau fractures. *Chir Organi Mov* 2009;93(3):143-7.
9. Dundar NJ, Roche MW, Park BH. Accuracy of dynamic tactile guided unicompartmental knee arthroplasty. *J Arthroplasty* 2012;27(5):803–8.
10. Jess H. Lonner. Robotically Assisted Unicompartmental Knee Arthroplasty with a Handheld Image-Free Sculpting Tool. *Oper Tech Orthop* 2015;25:104-13.

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