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Evaluating Tibial Component Rotation after Total Knee Arthroplasty Using Augmented Reality Navigation System with Smart Glasses.

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Faculty Disclosure Information

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Background

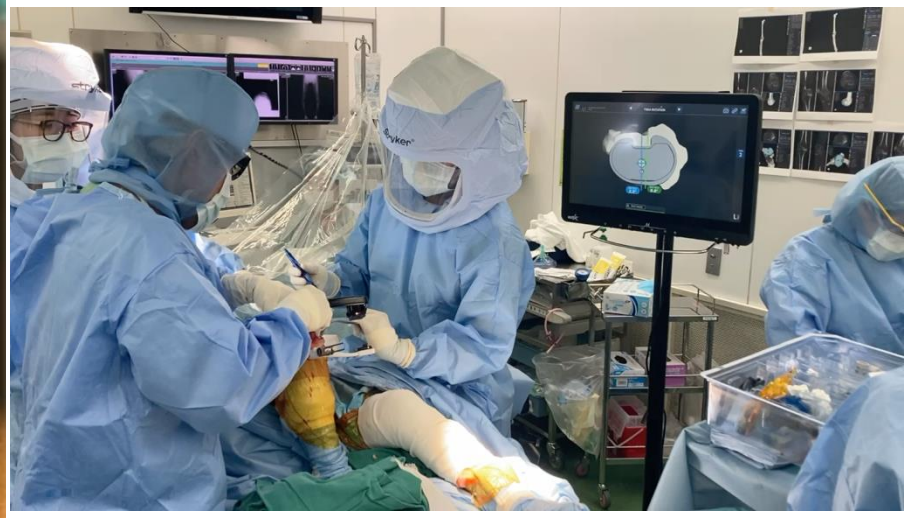
Computer-assisted surgery (CAS) is thought to improve the accuracy of both implant placement and bone resection. However, despite these advancements in technology, achieving precise rotational alignment of the tibial component remains a considerable challenge.

Purpose

This study aimed to evaluate the accuracy of the tibial component's rotational alignment using NextAR, an AR navigation system with Smart Glasses (Medacta, Switzerland) that provides surgeons with real-time feedback

NextAR SMART GLASSES

The View Through the Glasses



Surgeons no longer need to alternate their gaze between the monitor and the patient's knee.

Methods - Patient Demographics

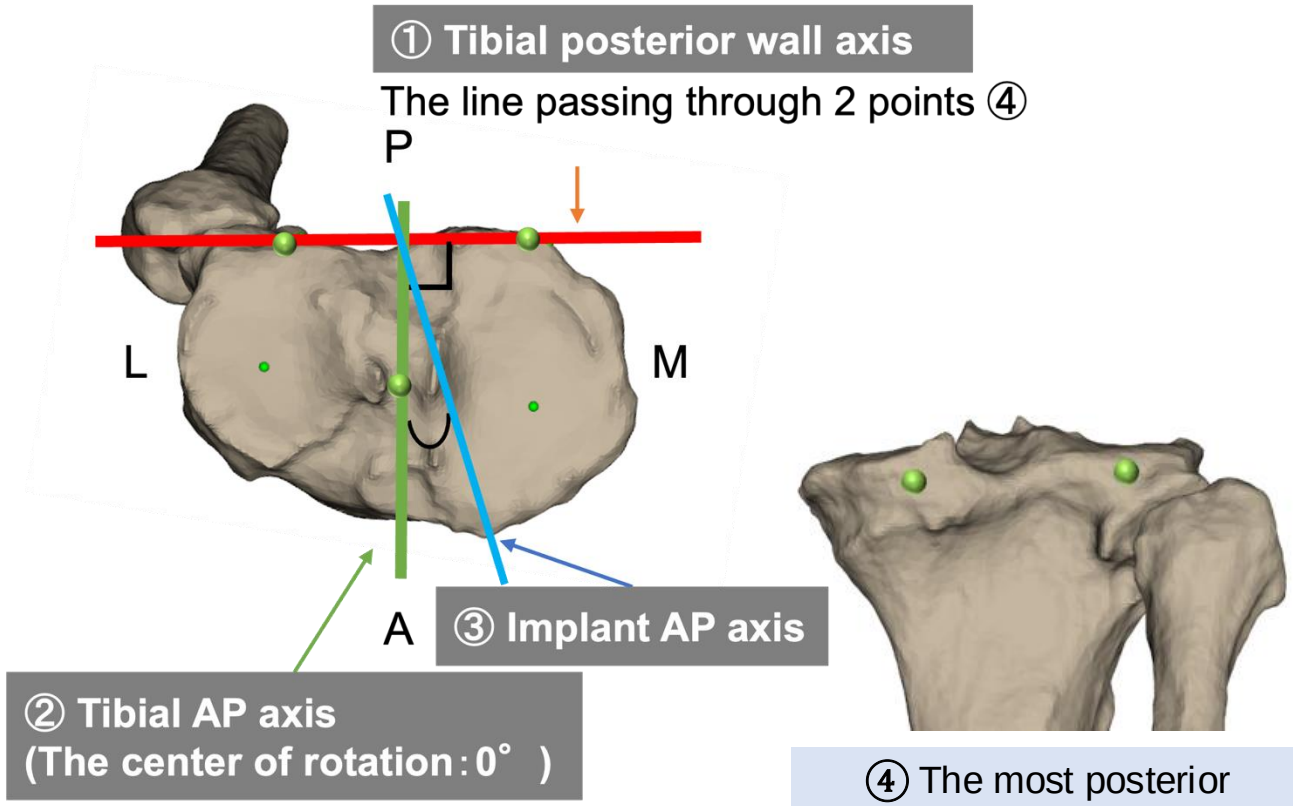
We retrospectively examined patients who had TKA using GMK Sphere implants and underwent whole-leg CT scans before and after surgery.

2022 January- 2024 July	NextAR	Conventional	
n	47 patients 70 knees	10 patients 14 knees	
Gender (Female/ Male)	33 /14	5 /5	(p=0.061)
Age (y.o.)	76.7 ± 8.0	74.2 ± 5.7	(p=0.226)
Height (cm)	155.3 ± 11.2	158.3 ± 16.3	(p=0.345)
Weight (kg)	63.3 ± 13.1	73.7 ± 22.4	(p=0.139)
BMI (kg/m^2)	26.8 ± 5.5	28.7 ± 4.8	(p=0.151)
Pre-OP planning software	MyKnee (Medacta)	ZedKnee (Lexi)	
Tibial rotational reference	Tibial AP axis	Akagi line	
Implant	GMK Sphere (Medacta) for both group		

No statistical differences between the two groups in Gender, Age, height, weight, and BMI.

Tibial Rotationl reference for each group

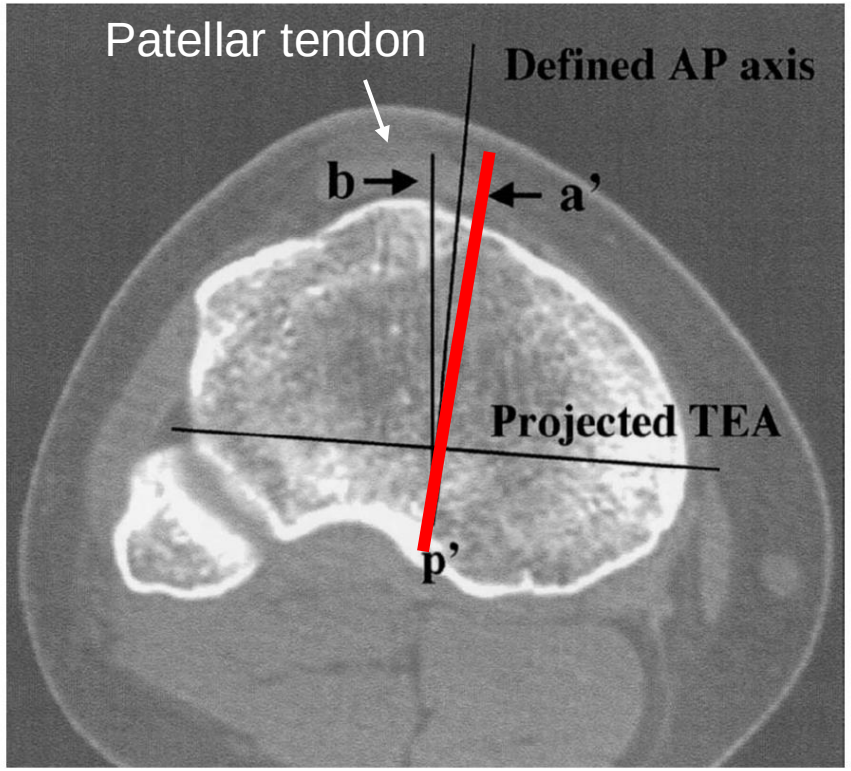
NextAR group- Tibial AP axis



The line that is perpendicular to the tibial posterior wall axis

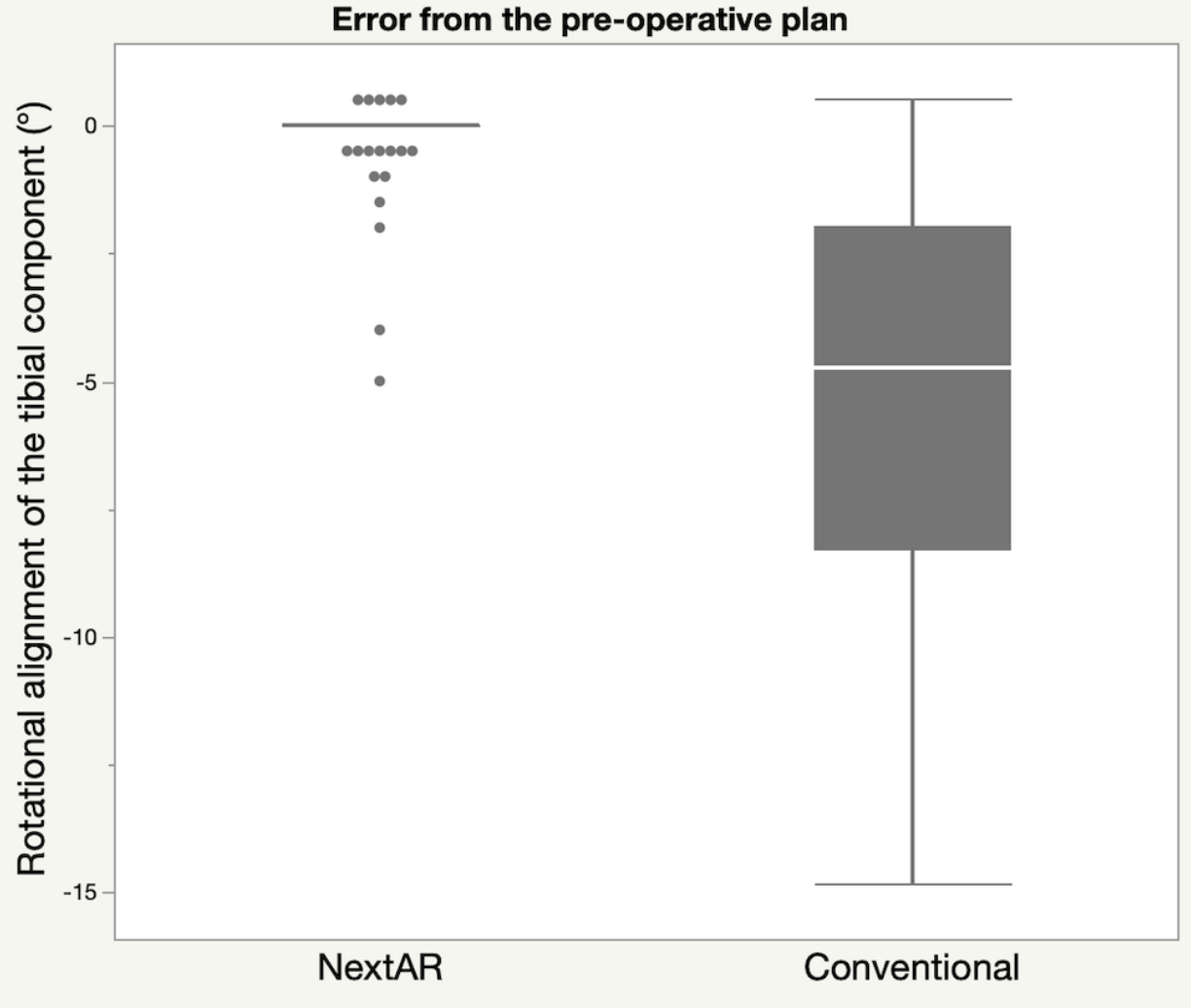
④ The most posterior points of the tibial medial and lateral compartment

Conventional Group- Akagi line



"the line connecting the middle of the PCL and the medial border of the patellar tendon attachment" [1]

Results- Error compared with the pre-operative plan



Rotational alignment error angle of the tibial component **compared to the pre-operative plan**, respectively

NextAR; 0.15 ± 0.74° IR

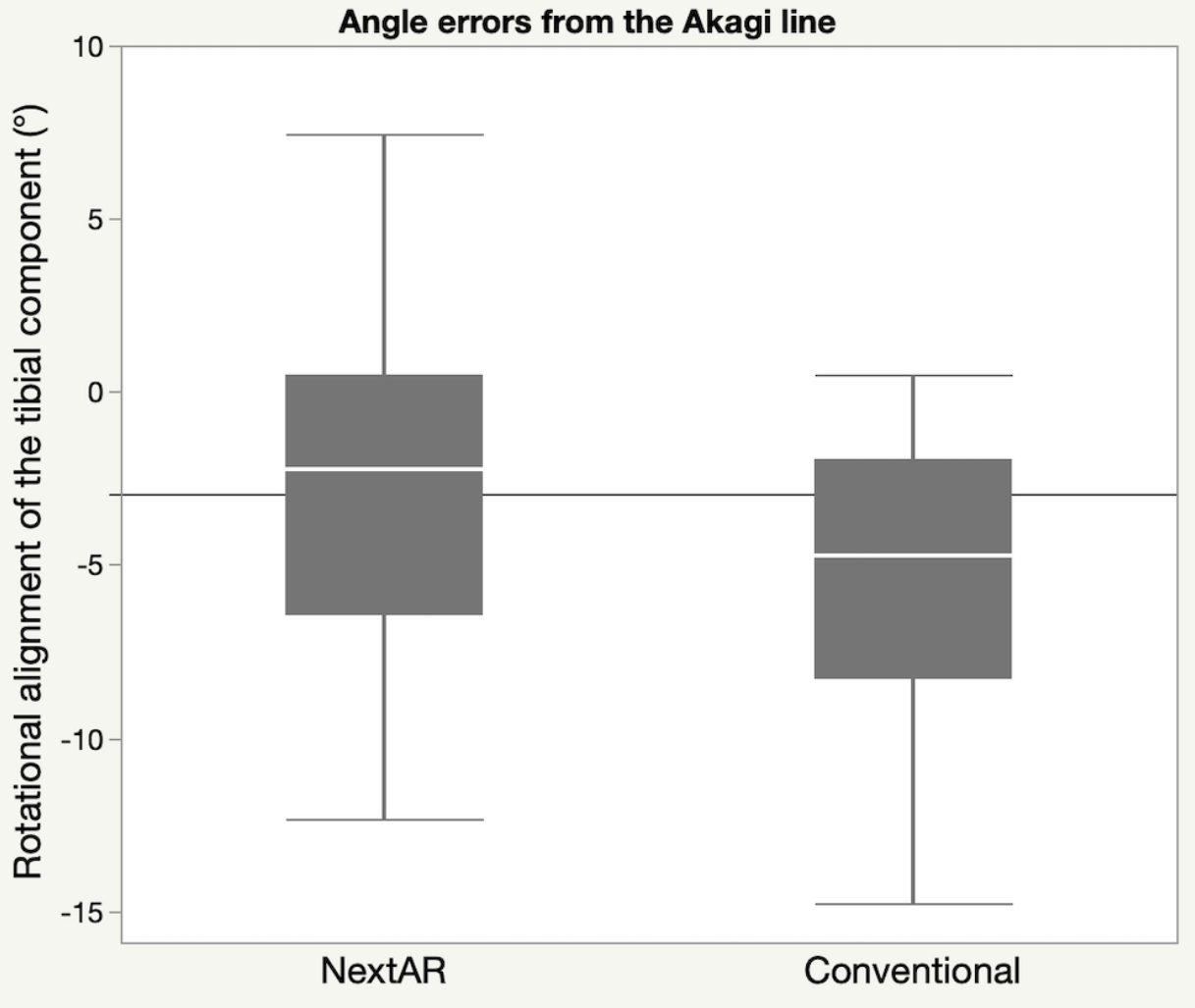
Conventional; 5.4 ± 4.6° IR

(P< 0.0001)

Mann-Whitney U test

⇨ **NextAR system provided more accurate rotational alignment**

Validation of feasibility of the tibial AP axis of NextAR



Rotational alignment of the tibial component **compared to the Akagi line** that had been planned preoperatively;

NextAR; 2.5 ± 4.5° IR

Conventional; 5.4 ± 4.6° IR

(P= 0.0644)

Mann-Whitney U test

⇨ **Myknee rotational alignment is comparable to the Akagi line**

Discussion

- The Akagi line has been used as one of the most reliable references for tibial rotation in TKA. However, once the tibia is cut, positioning the tibial component accurately on the Akagi line can be challenging due to the lack of clear anatomical landmarks.

⇨ Our previous study [2] indicated that the tibial components were implanted with greater internal rotation (6.5 ± 7.4°) than the pre-OP planning based on the Akagi line despite utilizing a CT-free navigation system and 3D planning software ZedKnee (LEXI, Japan).

Discussions

- Navigation systems that integrate CT-based preoperative planning with intraoperative image-free navigation significantly enhance the rotational alignment of the tibial component in TKA [3].

⇨ Our results suggested that the NextAR group showed significantly smaller errors compared to the preoperative plan. And, NextAR group also showed smaller, but not significant, even than the plan based on the Akagi line.

Limitations

- Retrospective study design and small sample size
- NextAR can only display every 0.5 degrees
- NO PROMs evaluated
- Intra-/ interobserver variations of the measurements have yet to be performed.

Conclusion

- In this study, the tibial rotational alignment using NextAR was closer to both the preoperative plan and the Akagi line compared to the conventional group.

  ⇨ **This indicates that NextAR could assist surgeons in consistently implanting the tibial component with greater accuracy.**

Future direction

- Correlation between MyKnee and ZedKnee data to validate the post-OP tibial rotational alignment and other parameters more accurately.
- Correlation between accuracy of tibial component's rotational alignment and PROMs

References

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3) Mitsuhashi S, Akamatsu Y, Kobayashi H et al. Combined CT-based and image-free navigation systems in TKA reduces postoperative outliers of rotational alignment of the tibial component. Arch Orthop Trauma Surg. 2018 Feb; 138(2) : 259-266.