North Sydney Orthopaedic Research Group

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Robotic-Assisted Total Knee Arthroplasty Improves Accuracy and Reproducibility of the Polyethylene Insert Thickness Compared to Manual Instrumentation or Navigation: A Retrospective Cohort Study.

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Disclosures

Dr Matt Lyons

- Royalties received from DePuy
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- Board of Directors member for Arthroplasty Society of Australia

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Introduction

- Navigation assisted and robotic assisted tools have been developed to assist accuracy and precision of surgical technique which is essential to deliver optimal and predictable results of TKA
- Robotic systems have demonstrated improved radiologic accuracy, compared to conventional instrumentation, reducing limb alignment outliers[1-5]
- Little data has been published on the results with the Velys Robotic-Assistance System which is a recently distributed image-free semi-assisted robotic-arm TKA system.
- A cadaveric study of 40 specimens found smaller resection errors and less outliers in Velys RA-TKA compared to manual TKA[6]

Polyethylene Thickness

- The required polyethylene (PE) thickness for TKA is primarily dictated by the thickness of resected bone, the initial soft tissue laxity and the need for ligament releases.
- Divergence from plan and the use of a thicker PE may indicate a more technically complex procedure
- As such, PE thickness is an important marker of TKA accuracy.
- Thicker tibial bearings are associated with greater revision rates, using cutoffs varying between ≥13mm* and ≥16mm (Khan et al Knee 2021, Rajamäkiet al KSSTA 2023, Berend et al J Arthroplasty 2010)

*Equivalent to a 9mm polyethylene thickness in the Attune Knee System

Aims

1. To compare the accuracy of 3 TKA techniques, using polyethylene tibial insert thickness as a surrogate

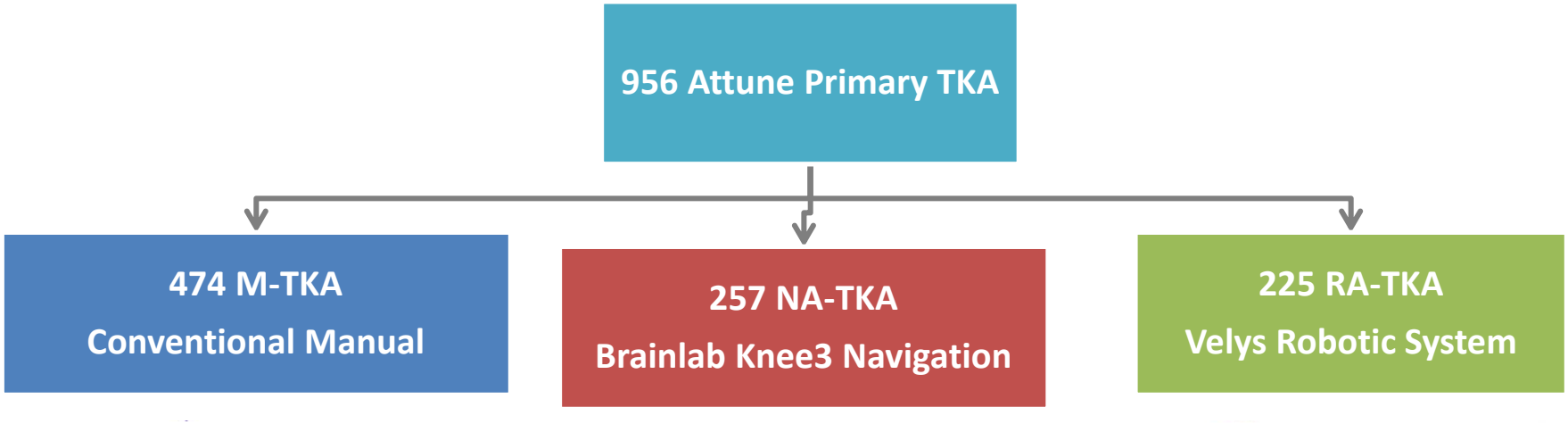
- Robotic Assisted TKA (RA-TKA)
- Navigation Assisted TKA (NA-TKA)
- Manual Instrumentation TKA (M-TKA)

2. To evaluate the learning curve needed to become precise with Robotic Assisted TKA

Study Groups

Subjects were identified from our prospective database

- Primary TKA for osteoarthritis
- Attune TKA prosthesis
- Surgery between June 2015 and April 2023 Dr Matt Lyons
- All types of polyethylene inserts were included (cruciate retaining, posterior stabilized and medial stabilized)

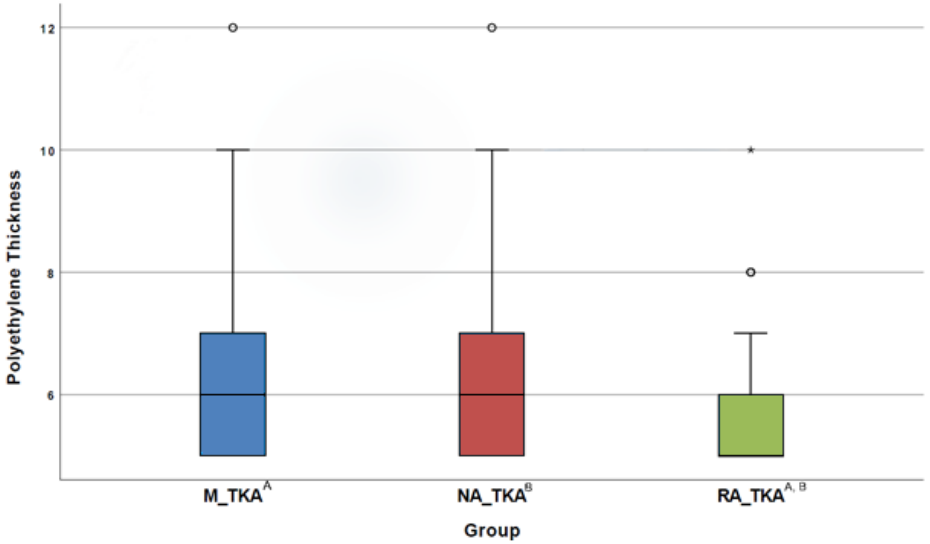


Baseline Characteristics

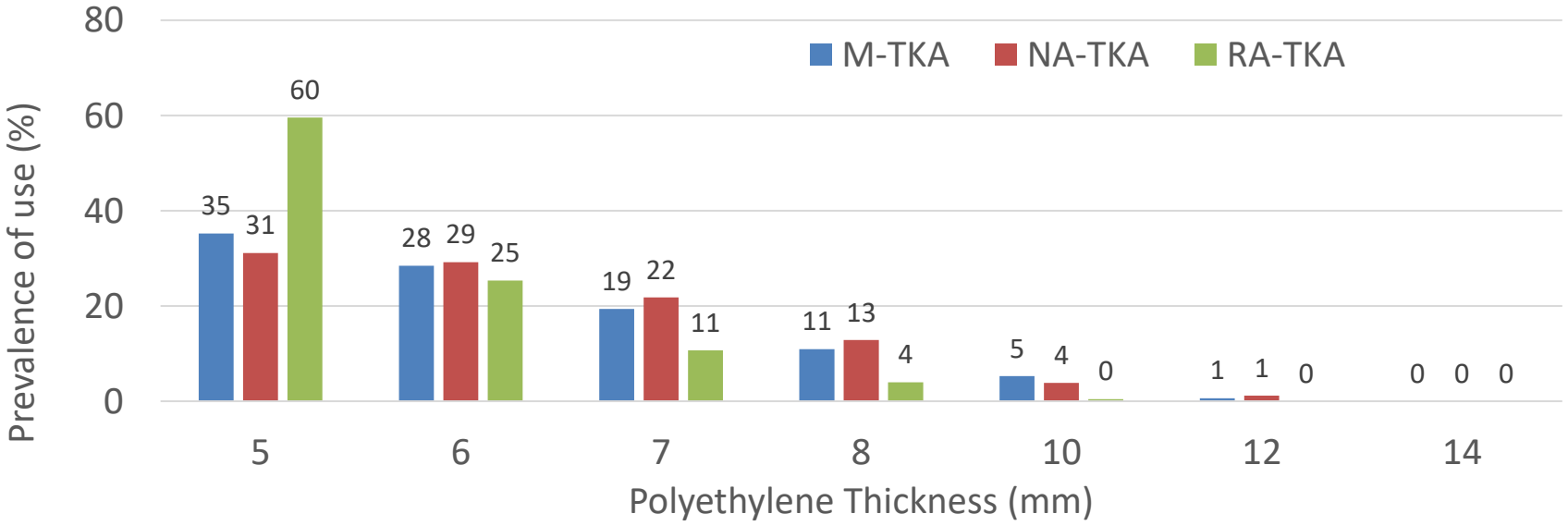
	M-TKA n=474	NA-TKA n=257	RA-TKA n=225	p
Median age, yrs (IQR)	68.6 (62-74)	68.2 (62-75)	69.6 (63-75)	0.103
Women, n (%)	256 (54.0)	123 (47.9)	116 (51.6)	0.282
Left side, n (%)	227 (47.9)	125 (48.6)	105 (46.7)	0.909
Median BMI, kg/m^2 (IQR)	30 (27–34)[a]	29 (27–34)	29 (27–32)[a]	0.046*
ASA grades 3 and 4 (%)	121 (33.8)	78 (30.7)	63 (28.1)	0.345

*,[a] BMI was higher in the M-TKA compared to the RA-TKA group, but the magnitude was small, so of questionable clinical significance
(Kruskal-Wallis test followed by post-hoc pairwise comparison)

Distribution of PE Thickness

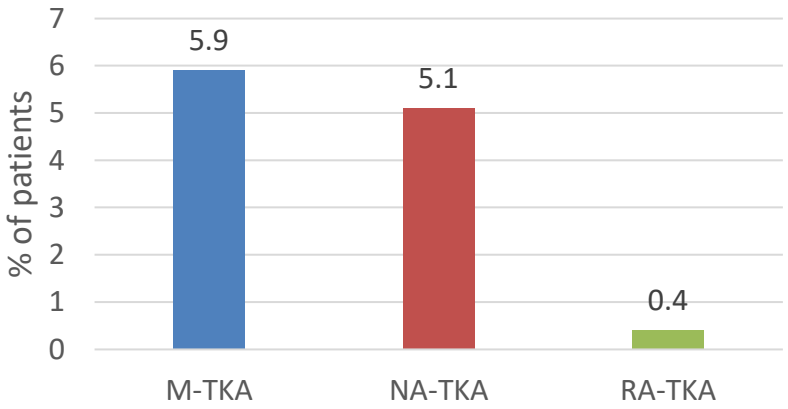


- RA-TKA had significantly thinner median PE thickness than both M-TKA and NA-TKA (P<0.001)
- There was no significant difference between MA and NA-TKA groups

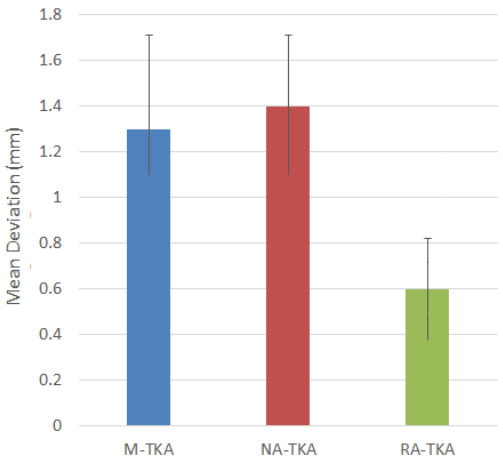


Accuracy Assessment

PE thickness ≥ 9mm (%)

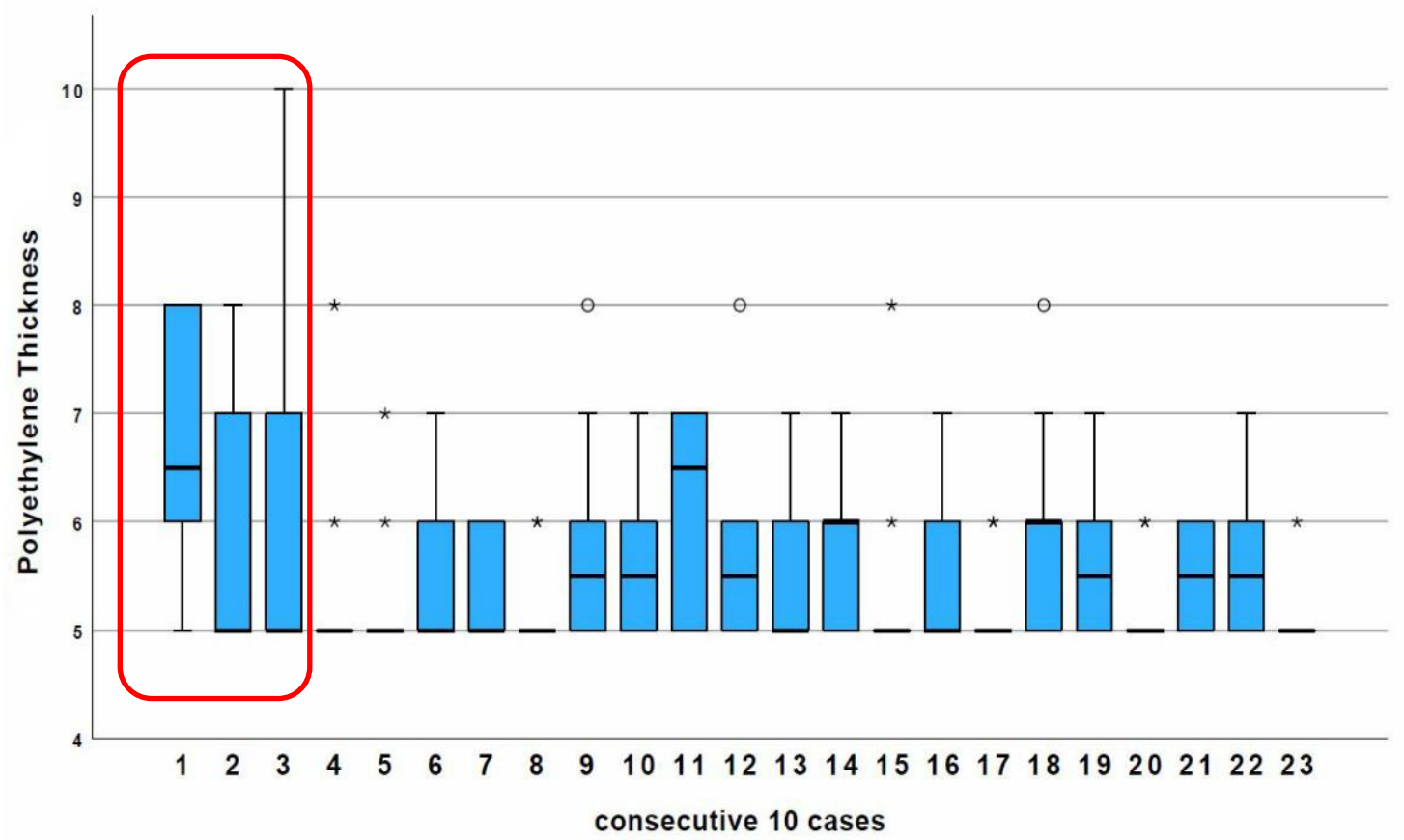


Mean PE thickness Plan Deviation (mm)



- The % PE thickness (p=0.004) and mean deviation from planned thickness (p≤0.001) were lower in the RA-TKA group compared to both other groups
- On logistic multiple regression increased polyethylene thickness (≥9 mm) was associated with
  - M-TKA (OR=14.8, 95%CI 2-110, *p*=0.008) versus RA-TKA
  - NA-TKA (OR=11.6, 95%CI 2-90, *p*=0.019) versus RA-TKA
  - male (OR=2.0, 95%CI 1-4, *p*=0.039) versus female
  - left surgery (OR=2.0, C.I. 1.1 to 3.9, *p*=0.033) versus right

Learning Curve Robotic Technique



Limitations

- Bias due to chronological nature of study - minimized with large sample and inclusion of learning curves for the three techniques
- Single surgeon, single implant and single robotic-assistance and navigation-assistance systems → limits external validity
- Assumption that preoperative alignment is consistent across groups

Conclusion

- RA-TKA was more accurate than M-TKA or NA-TKA
  - 12-15 times lower odds of PE thickness outliers, as well as the lower deviation from planned thickness, when compared to the 2 other groups.
- No difference was found between the NA-TKA and M-TKA techniques
- The learning curve to reach high levels of reproducibility with RA-TKA is relatively short.
- Published 2024

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