Robotics in the unicompartimental arthroplasty

The standardization of the procedure

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Curriculum Vitae Dr Bollars Peter

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- Knee Sport and Shoulder St Trudo Hospital since 2012 BELGIUM
- First NAVIO Robotic case in March 2018 UKA
- 600 TKA and UKA NAVIO / CORI experience
- First published clinical paper : accurancy in Robotics Navio TKA 2020
- Second published clinical paper : joint awarness after Robotics TKA 2022

Introduction

- Total knee arthroplasty (TKA)
  - Highly succesful procedure
  - 81 – 92 % survival at 15 years

Ranawat CS, Flynn WF, Saddler S, et al. Long term results of the total knee arthroplasty. Clin Orthop Rel Res 286:94-102

How well does TKA do ?

- **Almost 20% of TKA patients dissatisfied**

  Patient satisfaction after TKA: who is satisfied and who is not?
  Bourne RB, et al. Clin Orthop 2010;468:57

Only 82% to 89% of primary TKA patients are satisfied

J Bone Joint Surg Br. 2010 Sep;92(9): Scott CE, Howie CR, MacDonald D, Biant LC

Unicompartmental knee arthroplasty (UKA)

Clinical results are often described as superior to those of TKA.

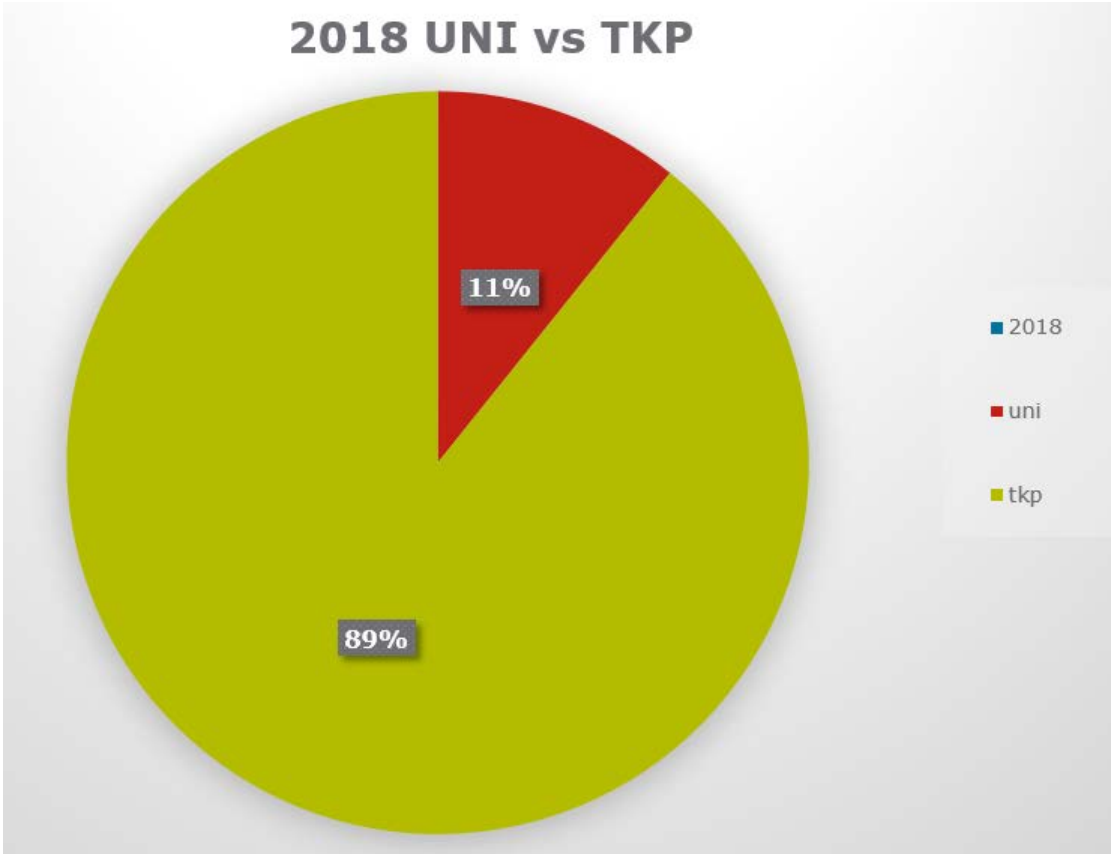
Conclusion: Patients who underwent UKA had higher FJS, HFKS, and satisfaction rate when compared with patients who underwent TKA, indicating that UKA facilitated less knee awareness and better function and satisfaction than TKA.

Differences in Patient-Reported Outcomes Between Unicompartmental and Total Knee Arthroplasties: A Propensity Score-Matched Analysis

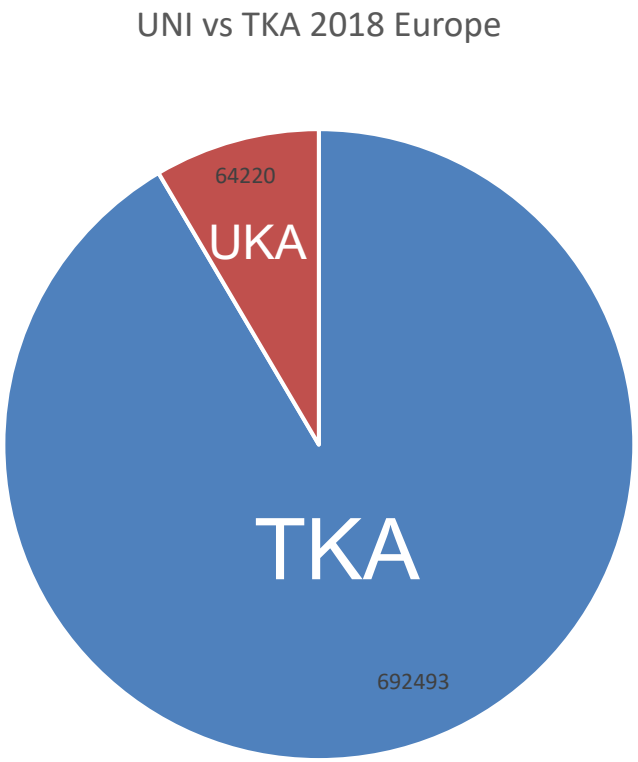
Man S. Kim, MD, In J. Koh, MD, PhD, Young J. Choi, MD, Jong Y. Lee, MD, Yong In, MD, PhD *

The Journal of Arthroplasty 32 (2017) 1453–1459

Knee Market BELGIUM 2018



Knee Market Europe 2018



Eucomed Data

Why not more UNIs ?

- Patient selection/indication ?
- Technical difficult procedure ?
- Fear for failure or outliers ?

Higher revision rate UKA vs TKA

- **Suboptimal implant position**
  can cause failure of the UKA
  - Femorotibial osteoarthritis of opposite compartiment
  - Tibial component loosening

Table 4 Comparison of reasons of failure in the Swedish registry, Australian registry, and present study, in the overall populations.

Overall population (%)	Swedish registry $n = 1576$	Australian registry $n = 2882$	Present study $n = 418$
Loosening	37.3	48.3	44.0
Disease progression	27.4	21.2	15.1
Wear	13.5	1.7	12.7
Technical problems	–	3.8	11.5
Pain	4.8	11.5	5.5
Fractures	2.0	2.7	3.6
Infection	2.3	4.6	1.9
Other	12.7	6.2	5.7
Total (%)	100	100	100

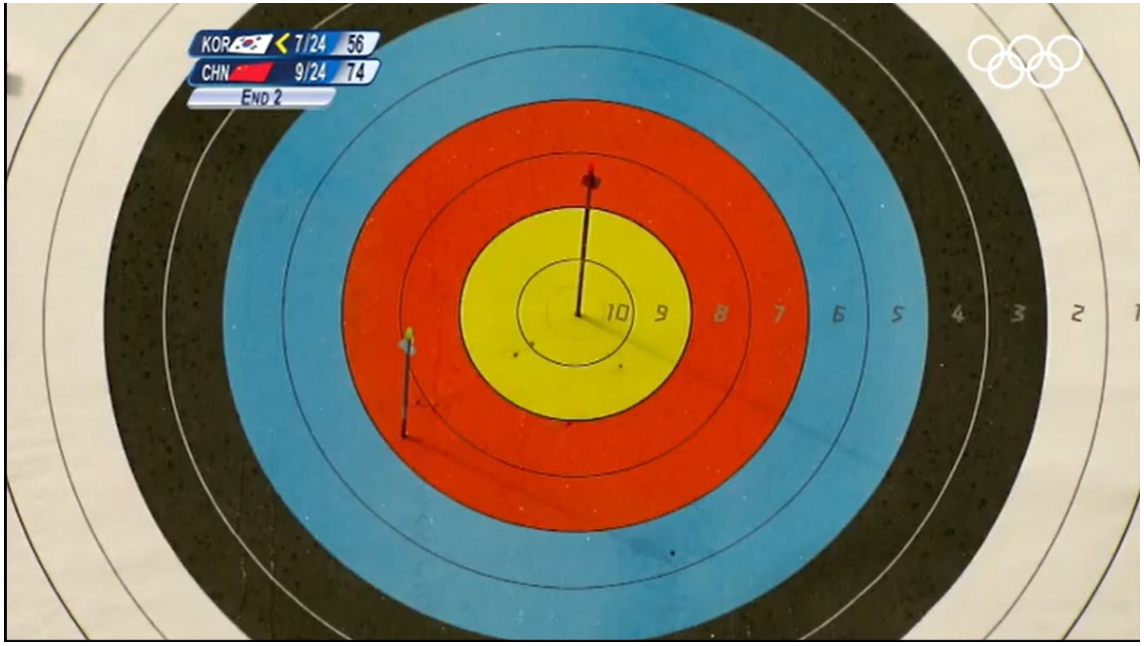
Epinette JA, Brunschweiler B et al. (2012). Unicompartimental knee arthroplasty modes of failure. Orthop Traumatol Surg Res 98:S124-130

Factors of a successful UKA

- Patient selection
- Component design
- Surgeon experience/volume
- Optimal pain protocol and rehab
- Accuracy of implantation
- Soft Tissue Balancing

What do we need ?

Special thanks Prof J Bellemans



We need ACCURACY / PRECISION / ECAXTNESS

Introduction of Robotic and assisted techology ??

Say ‘Hi’ to CORI™

- Semi-active Robotic Assistance
- CT-Free medical device
- Dedicated platform for S&N implants
- Reproducible
- Approachable cost
- Small footprint in OR
- User friendly

CORI™

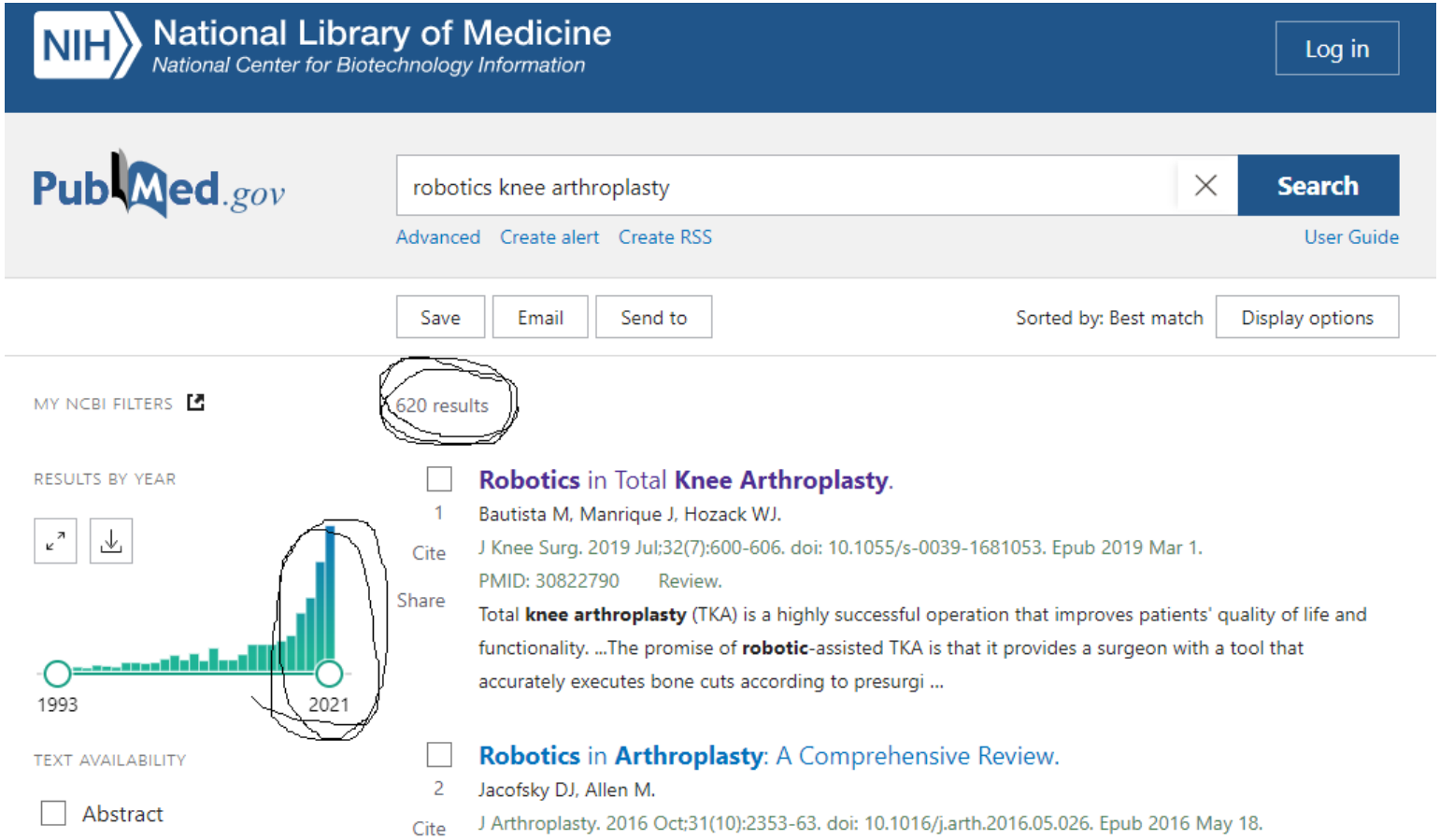
- Real-Time FEEDBACK during the procedure
  - Bone resection
  - Implant position
  - Ligamentous balance
  - Allow to do a fully **resurfacing** prodecure

CORI™

- Recent advances in robotics provide a tool **to assist** surgical planning

- Increase the **accuracy** of implant position
- Allow the surgeon to stay in the **native soft tissue envoloppe**

Evidence ?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620 results
RESULTS BY YEAR
1993
2021
TEXT AVAILABILITY
Abstract
Robotics in Total Knee Arthroplasty.
1
Bautista M, Manrique J, Hozack WJ.
Cite
J Knee Surg. 2019 Jul;32(7):600-606. doi: 10.1055/s-0039-1681053. Epub 2019 Mar 1.
PMID: 30822790 Review.
Share
Total knee arthroplasty (TKA) is a highly successful operation that improves patients' quality of life and functionality. ...The promise of robotic-assisted TKA is that it provides a surgeon with a tool that accurately executes bone cuts according to presurgi ...
Robotics in Arthroplasty: A Comprehensive Review.
2
Jacofsky DJ, Allen M.
Cite
J Arthroplasty. 2016 Oct;31(10):2353-63. doi: 10.1016/j.arth.2016.05.026. Epub 2016 May 18.

CORI™ UKA:

SURGICAL WORKFLOW IN BALANCING AND ALIGNMENT

1

* Pre-operative set up CORI™
* Determine the landmarks
* 3D Mapping
* Shape Matching
* Gap balancing and alignment

2

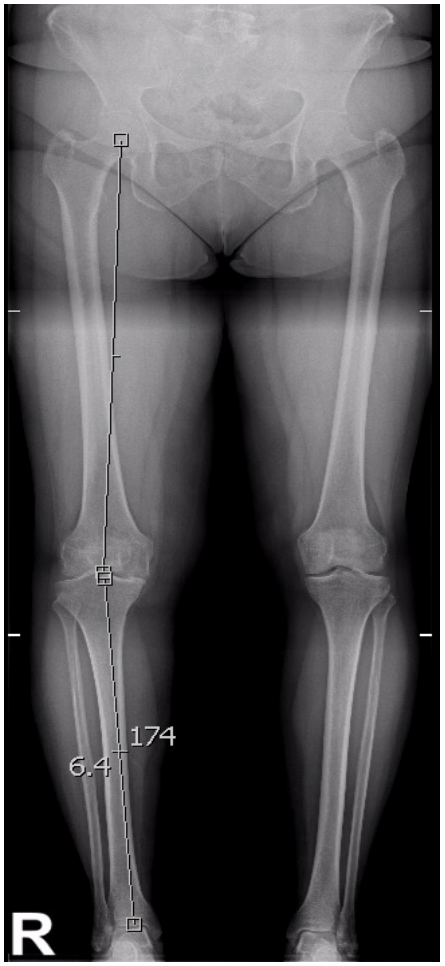
* Surgical bone preparation and cut/bur

3

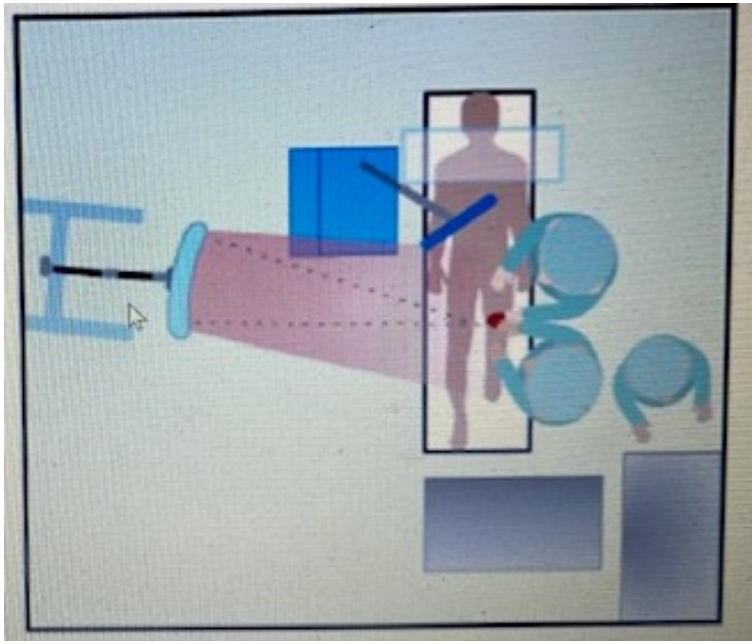
* Control balance and alignment UKA

Case Presentation

Case Presentation



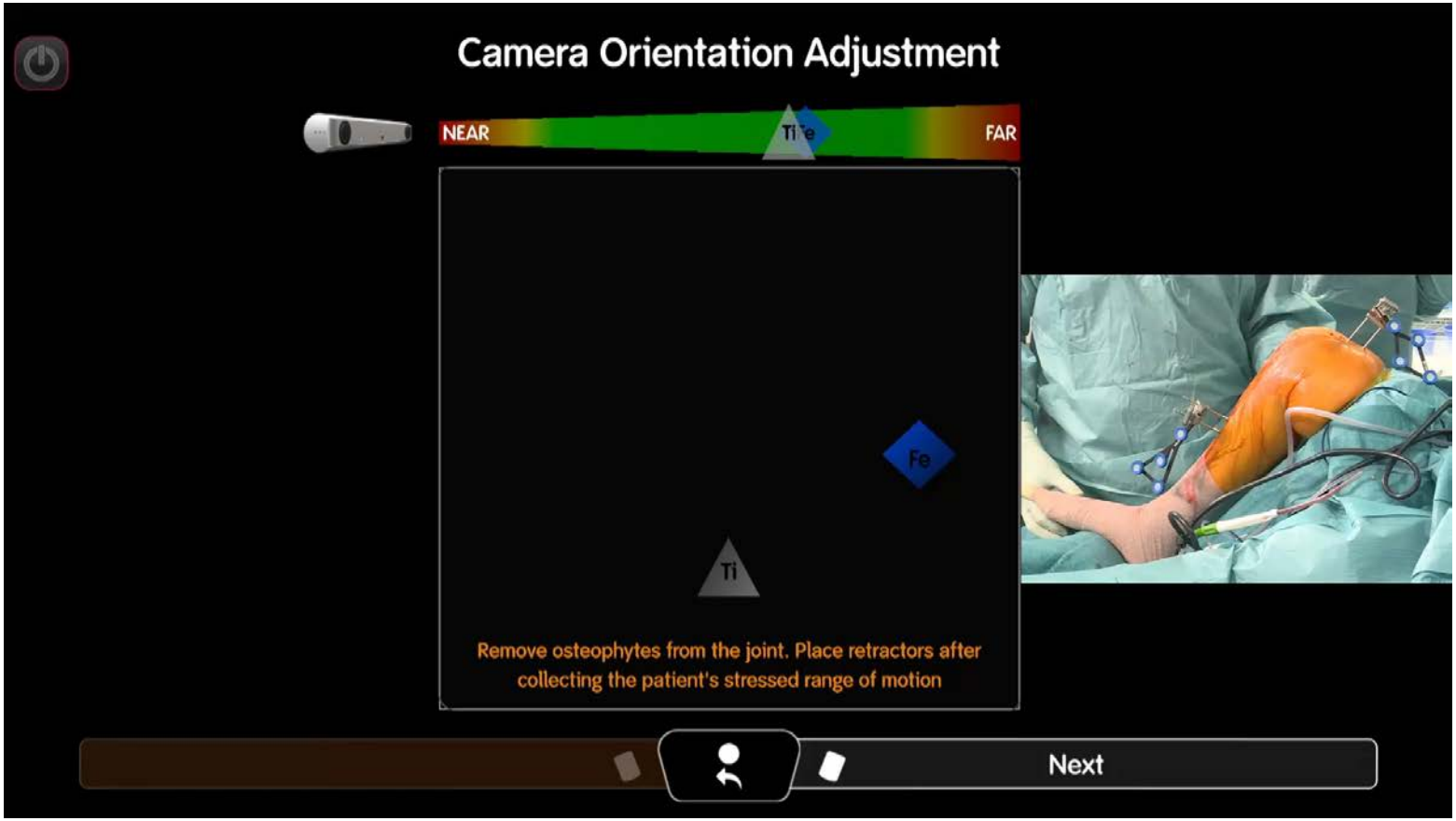
OR Set-up



CORI™ : Approach

CORI™ : Installation trackers

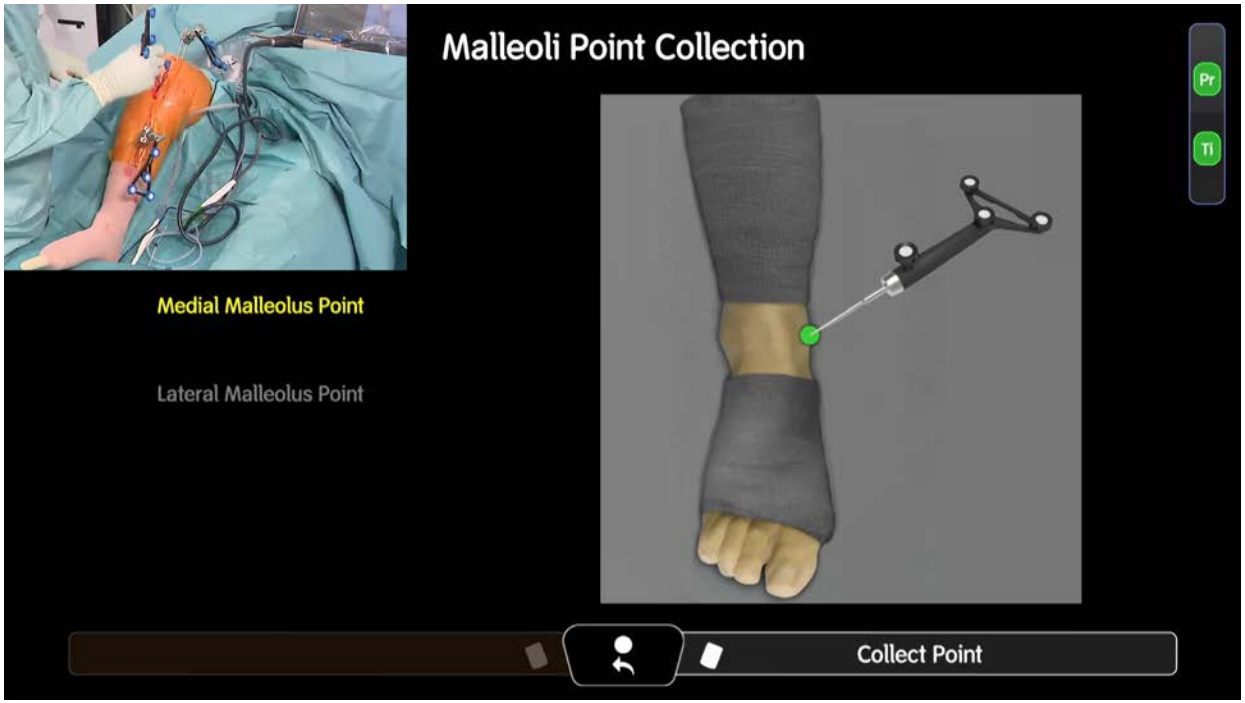
CORI™ : Camera Orientation



CORI™ : Determine the landmarks

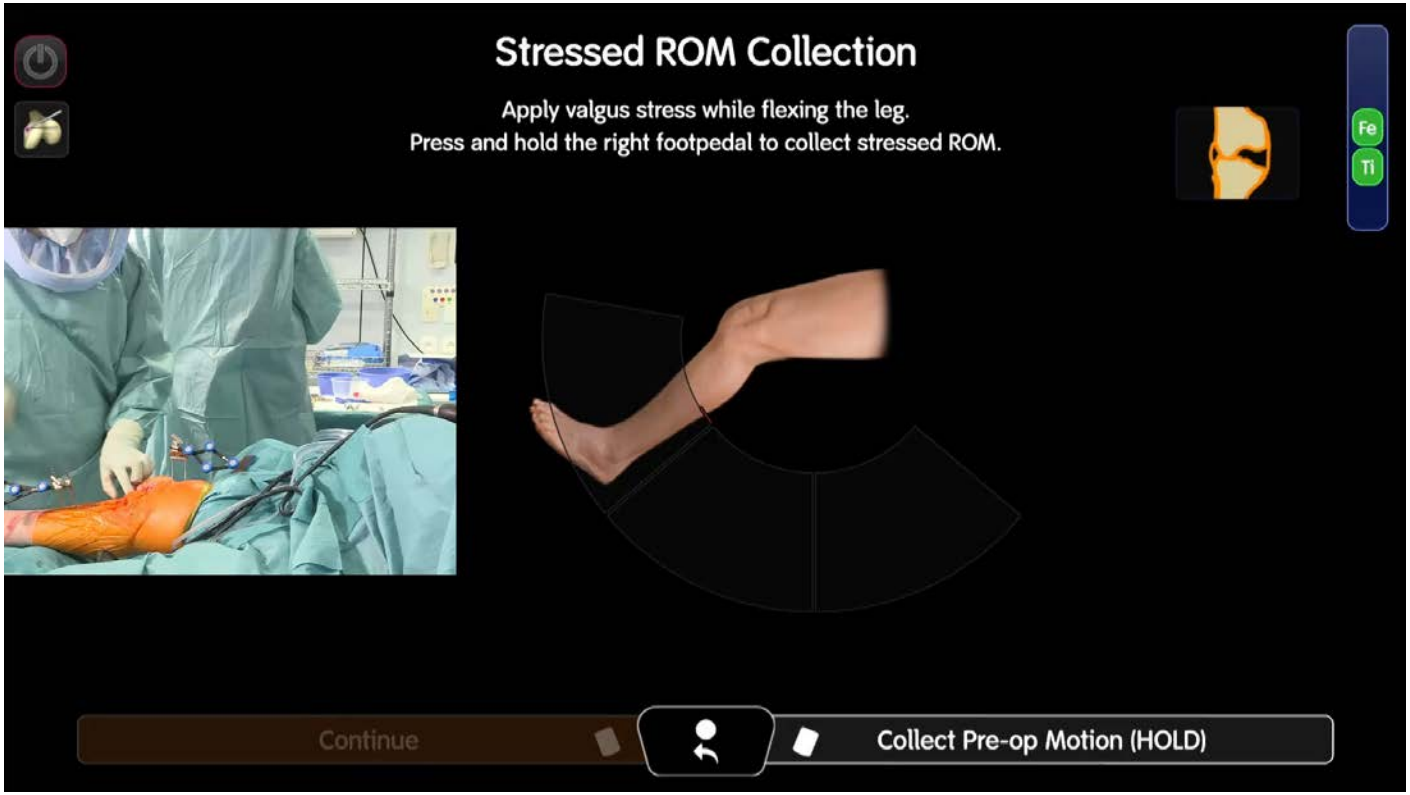
Anatomic Landmarks

- Alignment
- Extension
- ROM



CORI™ : Determine the landmarks

Stressed ROM : Z retractor Continuously same strength ROM

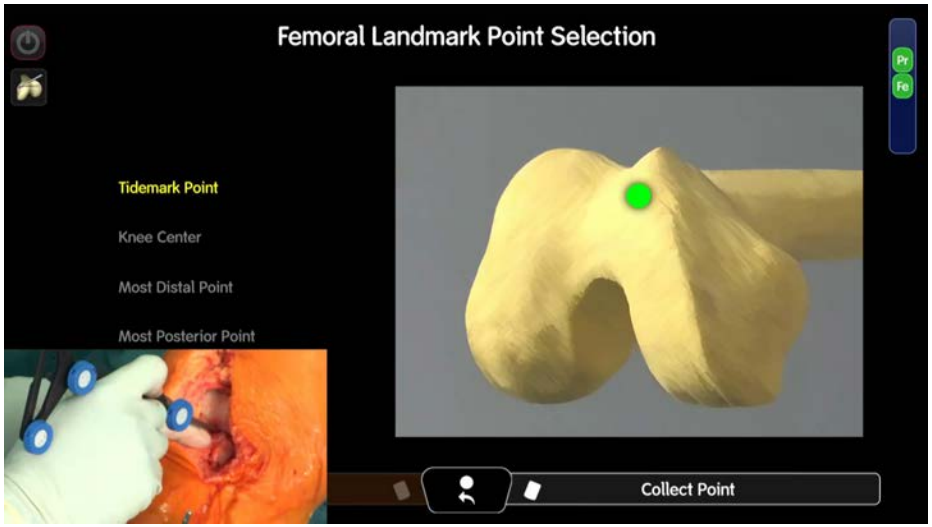


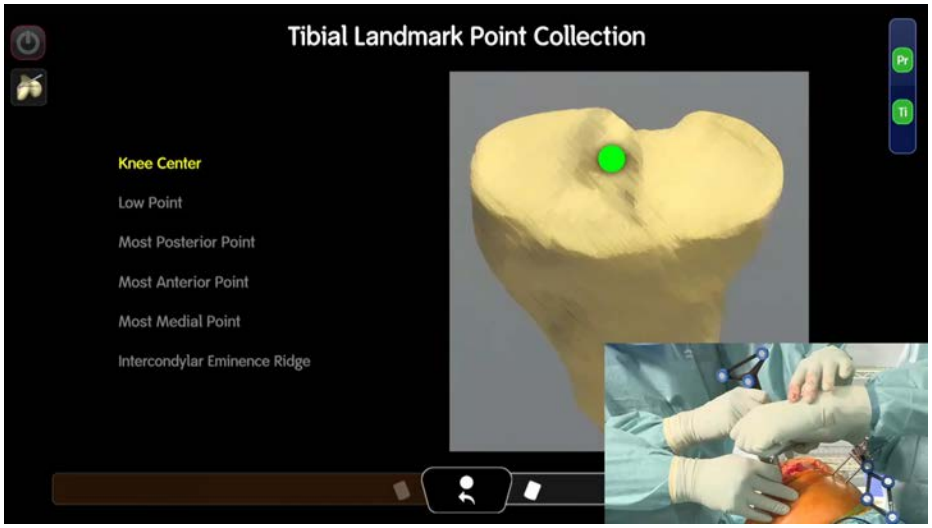
CORI™ : 3D Mapping

SURGICAL MAPPING

Reference points femur and tibia

3D mapping of the knee





CORI™ : 3D Shape Matching and Balancing

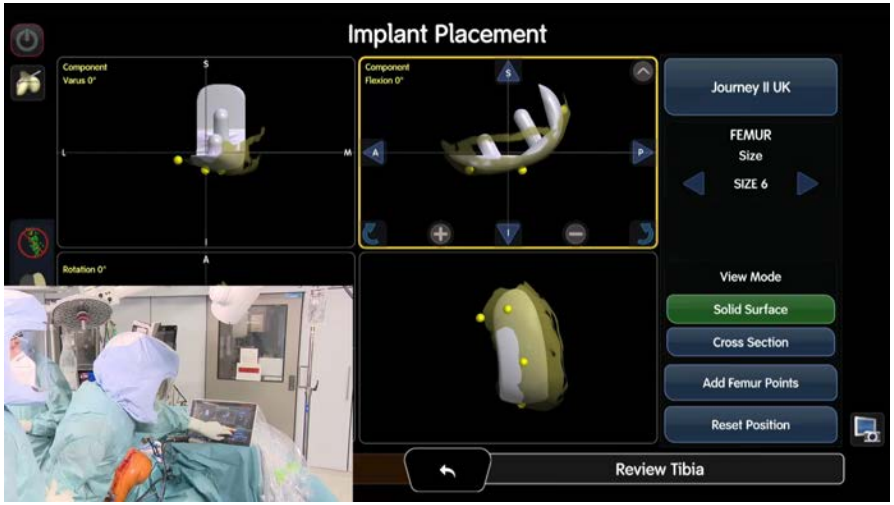
CORI™ : 3D shape matching

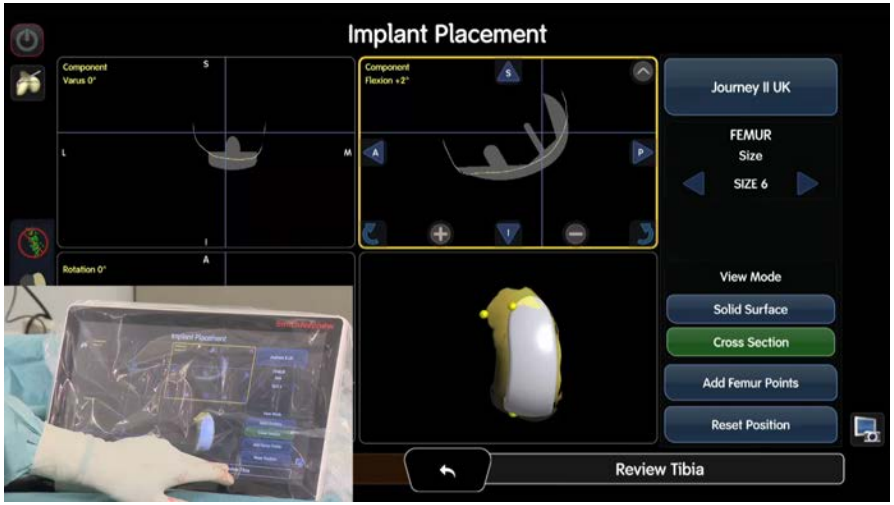
SHAPE MATCHING

CORI suggest position and size

→ Correct positioning of the prosthesis

Depending :
* bony alignment and landmarks





CORI™ : Shape Matching and Balancing

SHAPE MATCHING AND BALACING

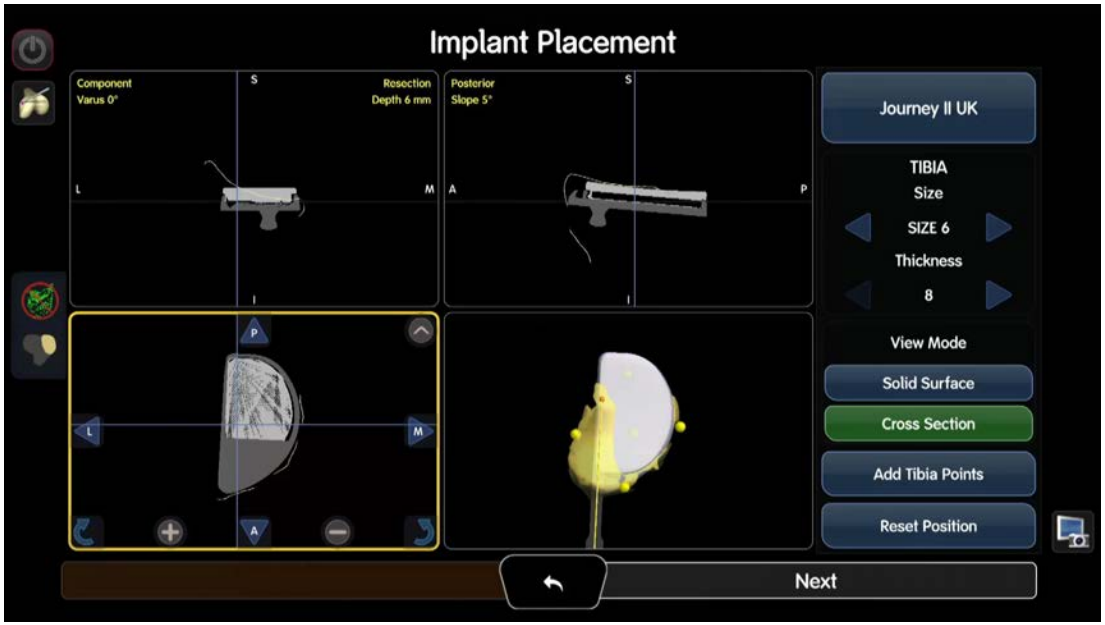
Full 3D control to adapt the position of the components on patient anatomy, depending :

-bony alignment and landmarks
-soft tissue tension

'six degrees of freedom'

Visualize virtual bone cuts to evaluate implant fit before cuts

100% surgeon controlled
= feedback



CORI™ : Shape Matching and Balancing

GOAL TO ACHIEVE

GOOD POSITIONING IMPLANTS

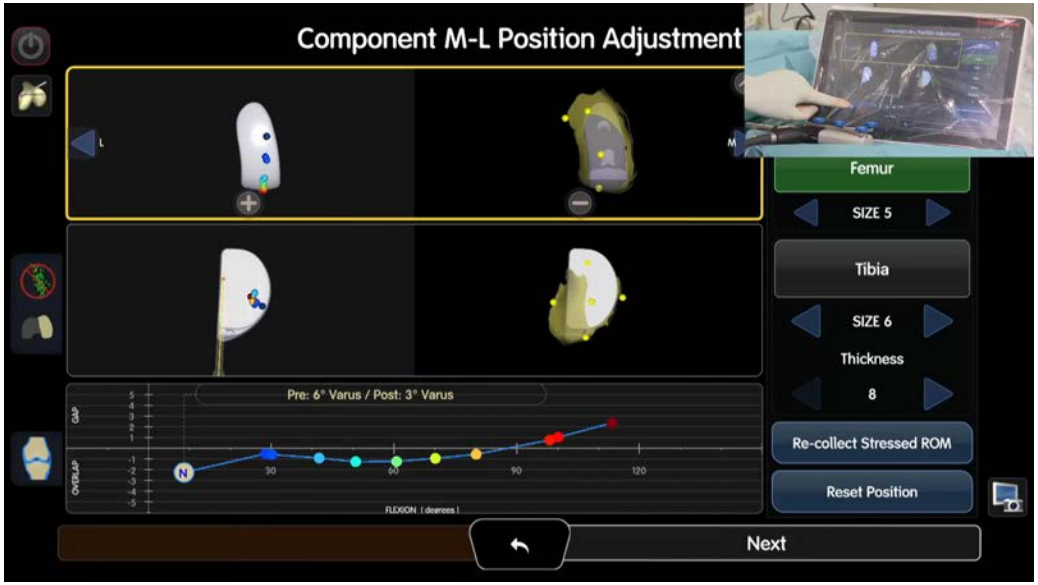
WELL BALANCED

Surgeon personal preference

Individualization patient

HYBRIDE PERSONALIZED ALIGNMENT

Outcome (bony position, alignment and ligament balance) known before first cut



CORI™ : Bone preparation and cut

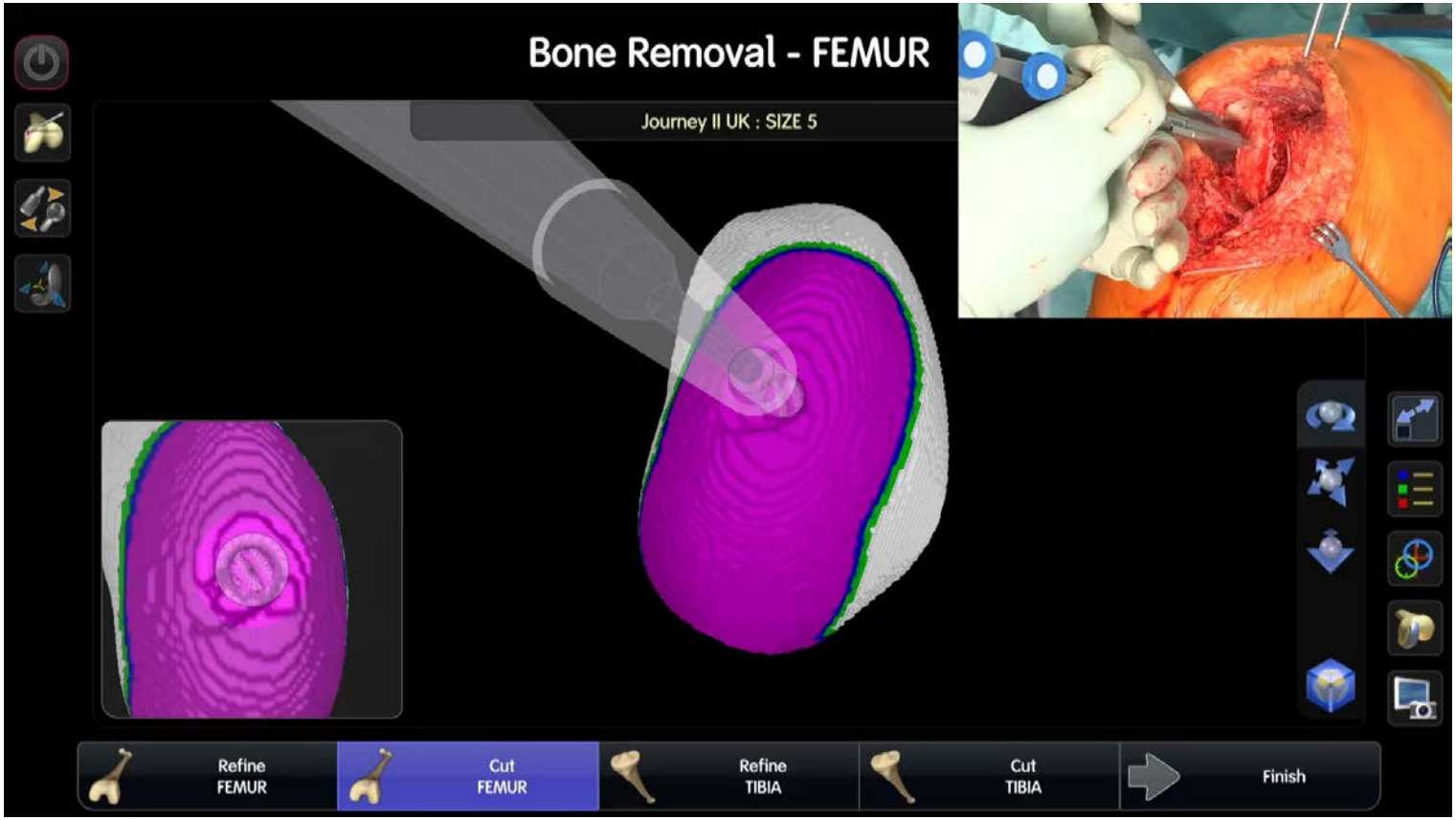
CORI™ UKA : Bone preparation and cut

- Bone removal

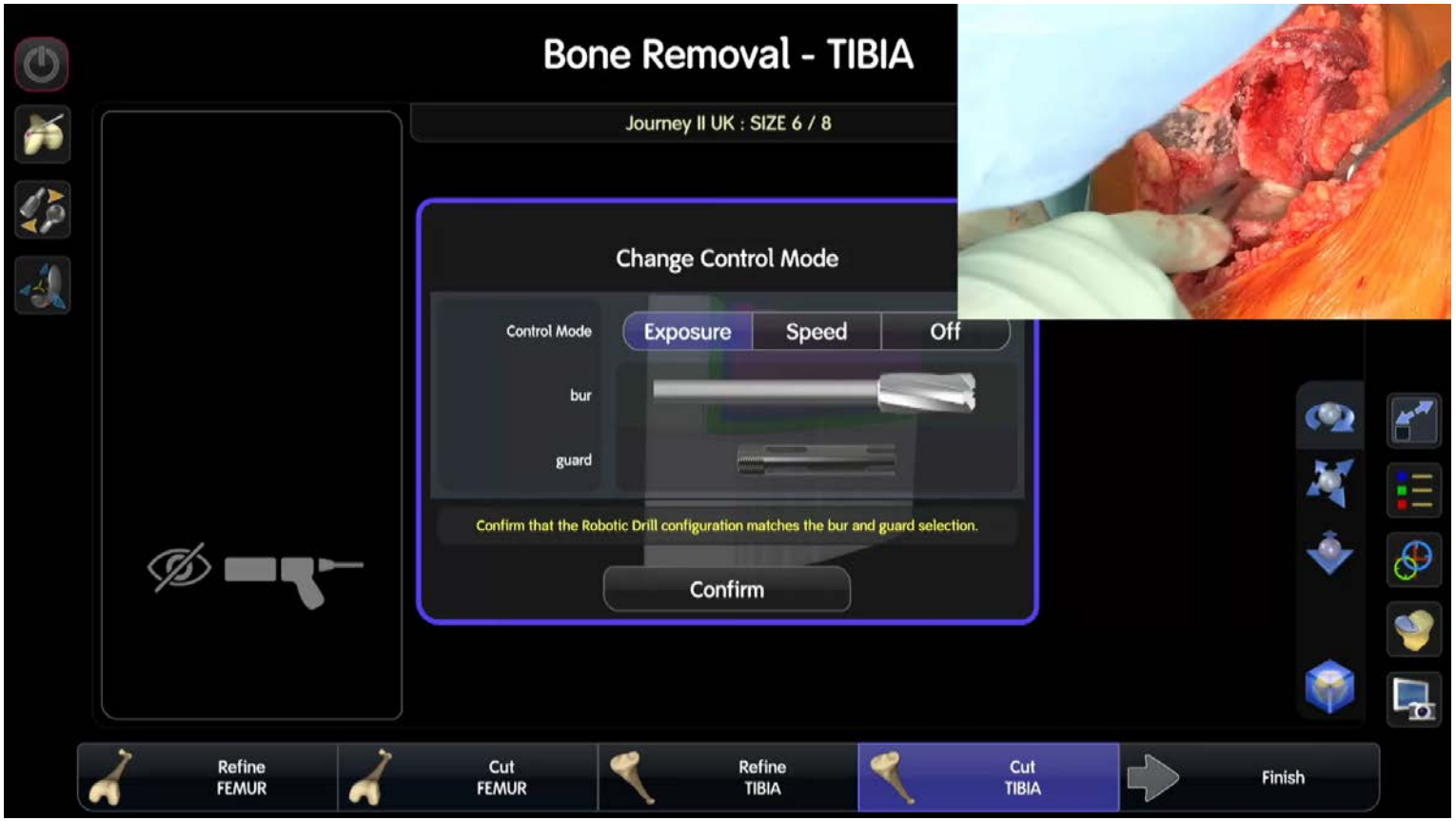
Surgeon preference

*Fine tune bone preparation with robotic-assisted burr control.

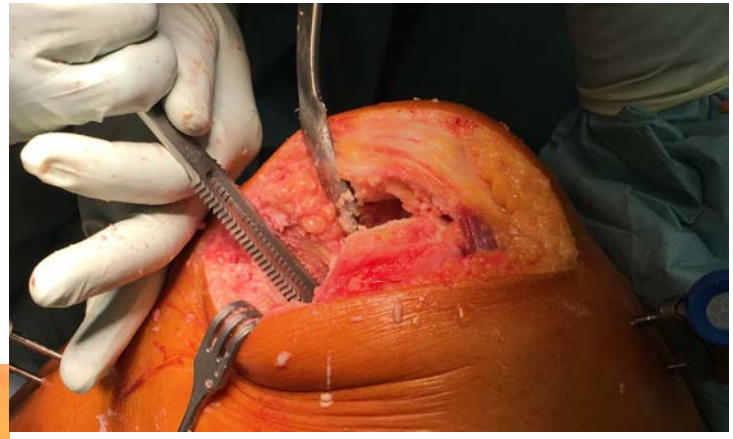
CORI™ UKA : T&T Bone preparation

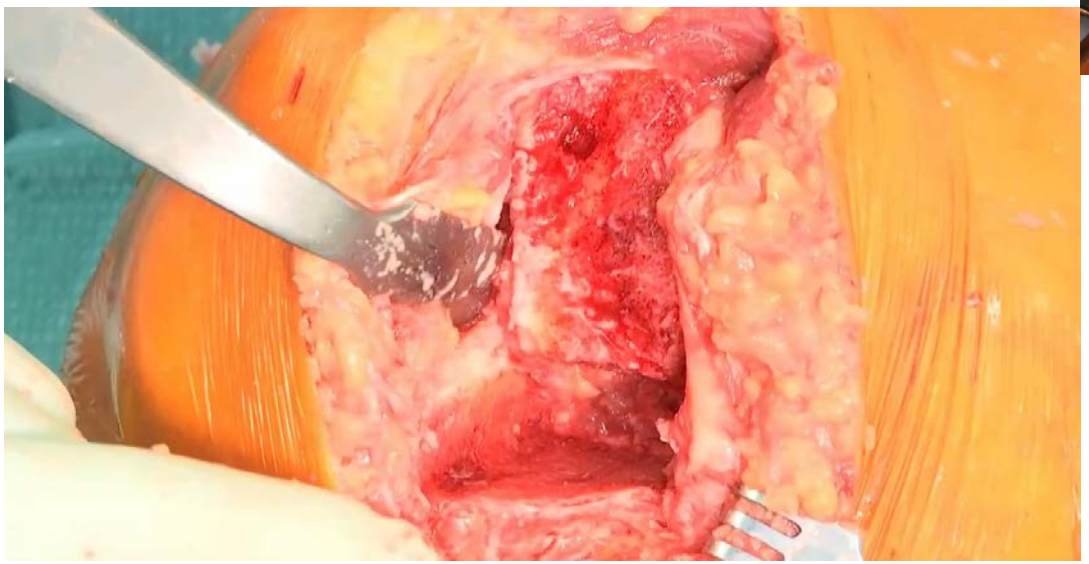


CORI™ UKA : T&T Bone preparation

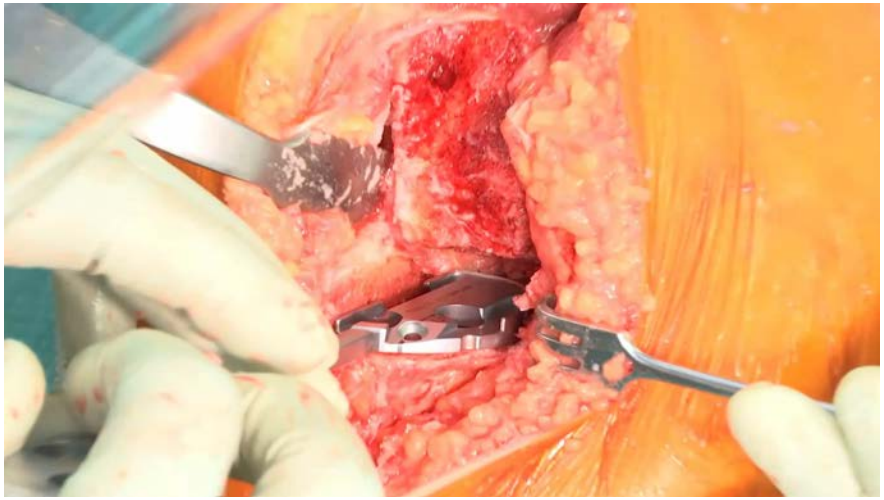


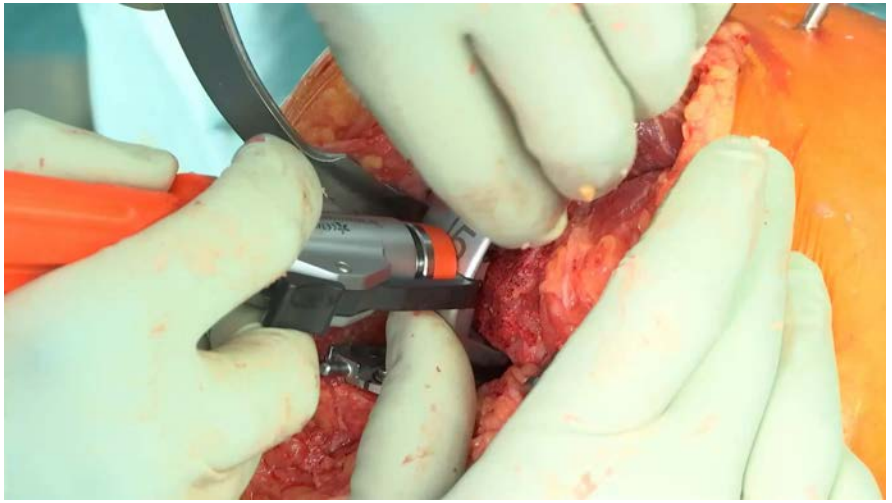
Tip and Tricks





Tip and Tricks : implantation trial

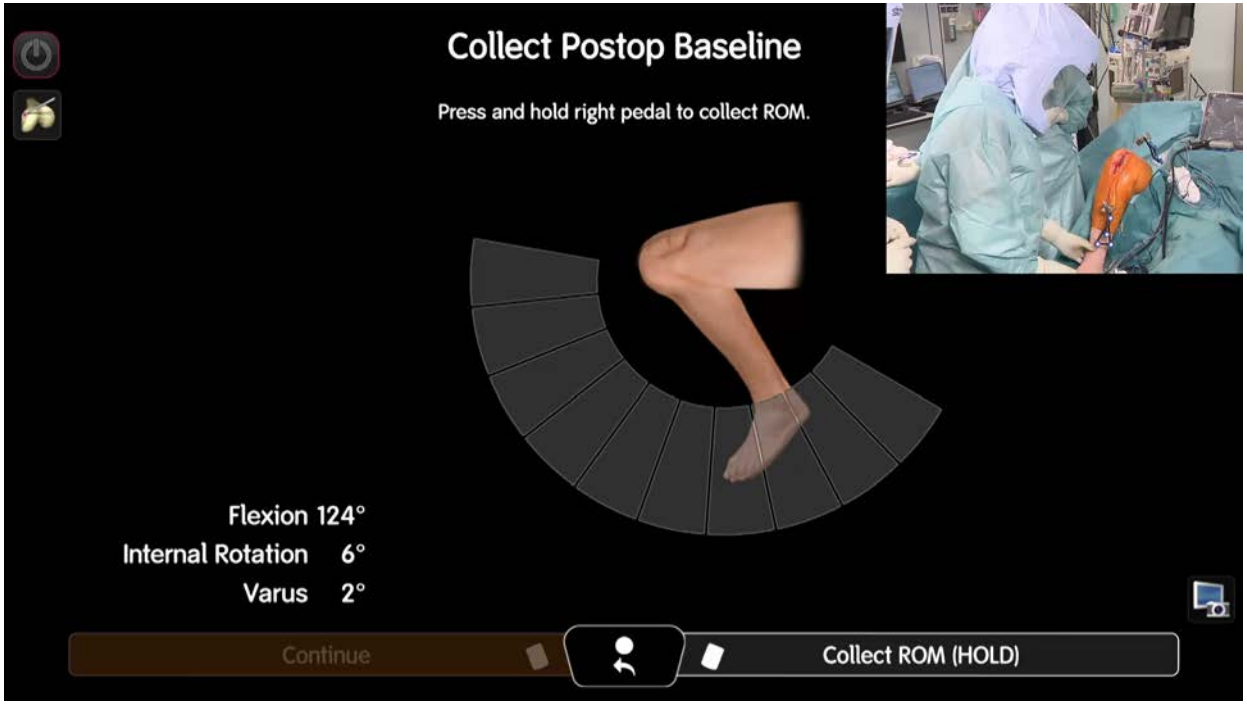




CORI™ :
Control balance and alignment

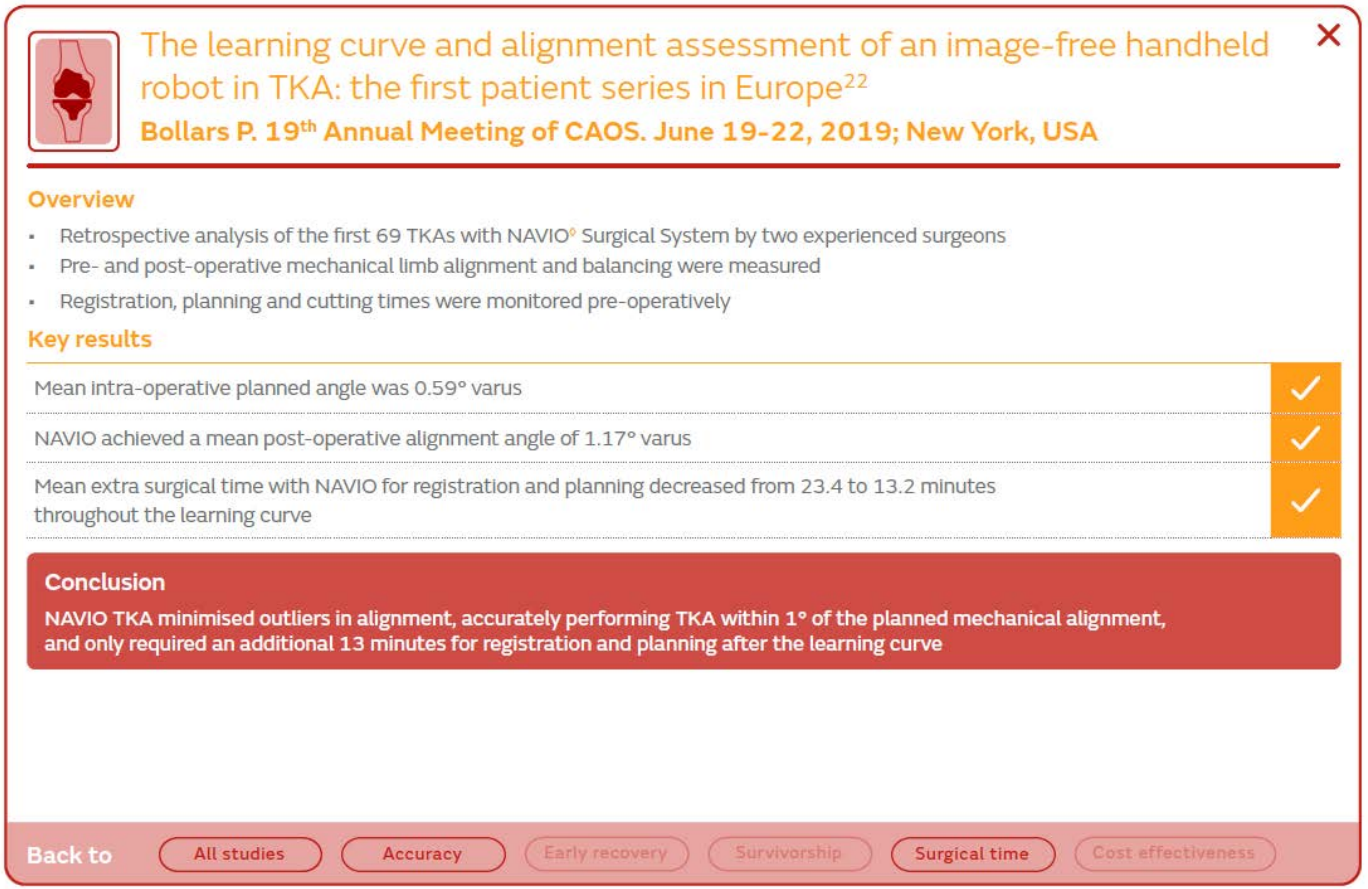
CORI™:
Control balance and alignment

- Assessment of post operative gap in comparison to the planned gap throughout flexion/extension both the medial components



Case Presentation

NAVIO™ learning curve



The learning curve and alignment assessment of an image-free handheld robot in TKA: the first patient series in Europe[22]

Bollars P. 19th Annual Meeting of CAOS. June 19-22, 2019; New York, USA

Overview

- Retrospective analysis of the first 69 TKAs with NAVIO® Surgical System by two experienced surgeons
- Pre- and post-operative mechanical limb alignment and balancing were measured
- Registration, planning and cutting times were monitored pre-operatively

Key results

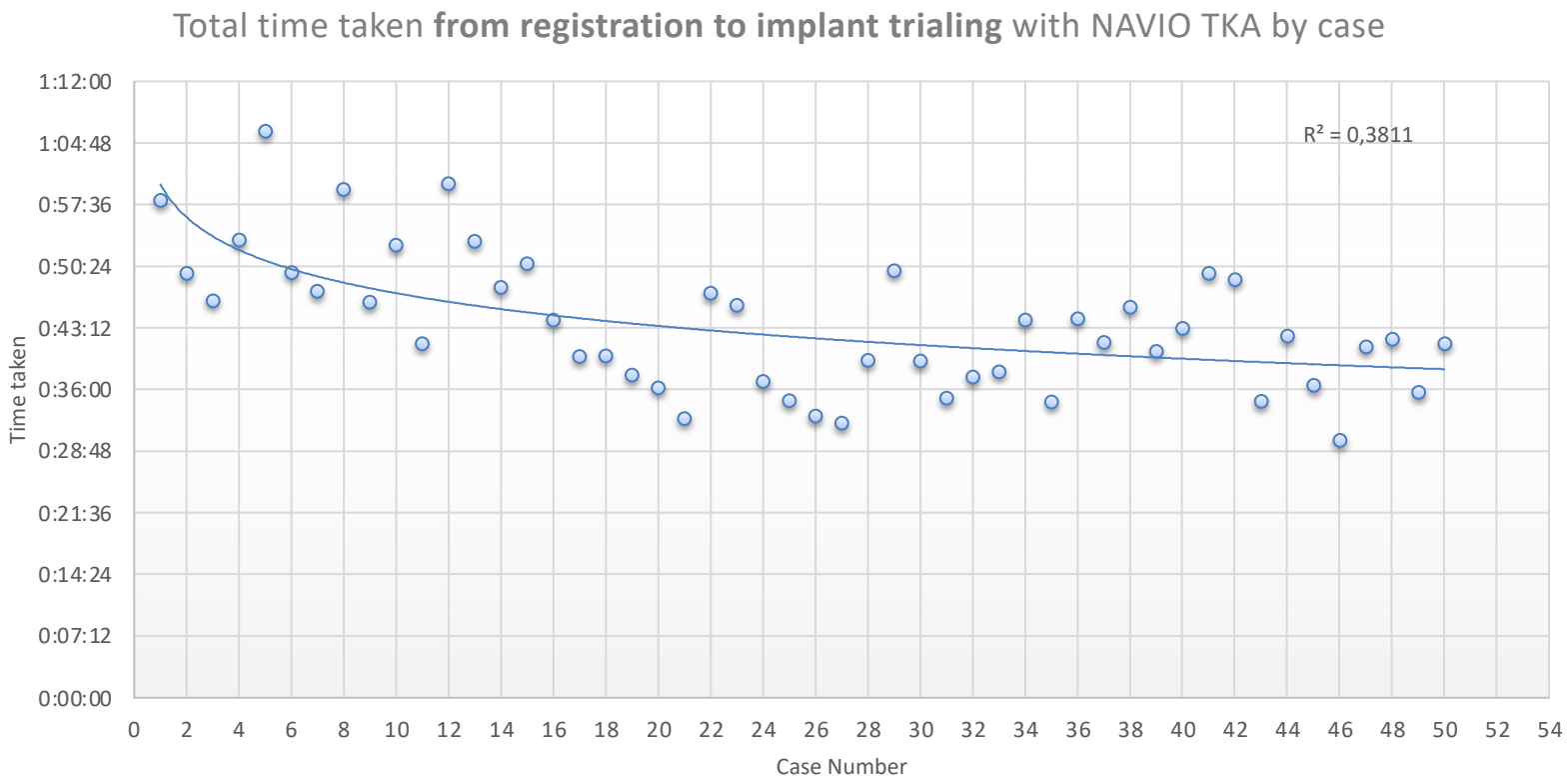
Mean intra-operative planned angle was 0.59° varus	✓
NAVIO achieved a mean post-operative alignment angle of 1.17° varus	✓
Mean extra surgical time with NAVIO for registration and planning decreased from 23.4 to 13.2 minutes throughout the learning curve	✓

Conclusion

NAVIO TKA minimised outliers in alignment, accurately performing TKA within 1° of the planned mechanical alignment, and only required an additional 13 minutes for registration and planning after the learning curve

Back to | All studies | Accuracy | Early recovery | Survivorship | Surgical time | Cost effectiveness

NAVIO™ learning curve



Take home message

- Feedback system
- Resurfacing potential
- Respect soft tissue
- Increased accuracy in aligment/positionig

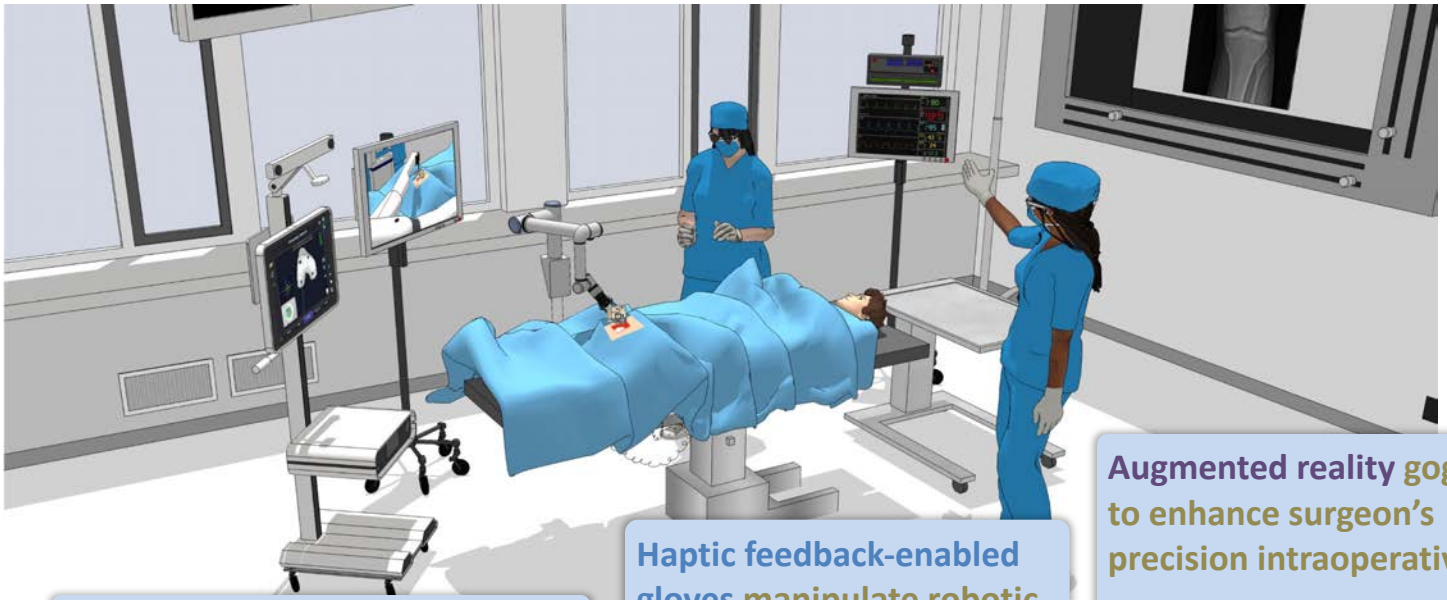
- Future : scientific evidence PROMs?

"Robotic surgery is here to stay and will occupy a key place in the future of trauma and orthopaedics"[11]

Karuppiah K, Sinha J. Robotics in trauma and orthopaedics. Ann R Coll Surg Engl. 2018;100(6_sup):8-15.

Real intelligence CORI platform

Vision of a robotic ecosystem



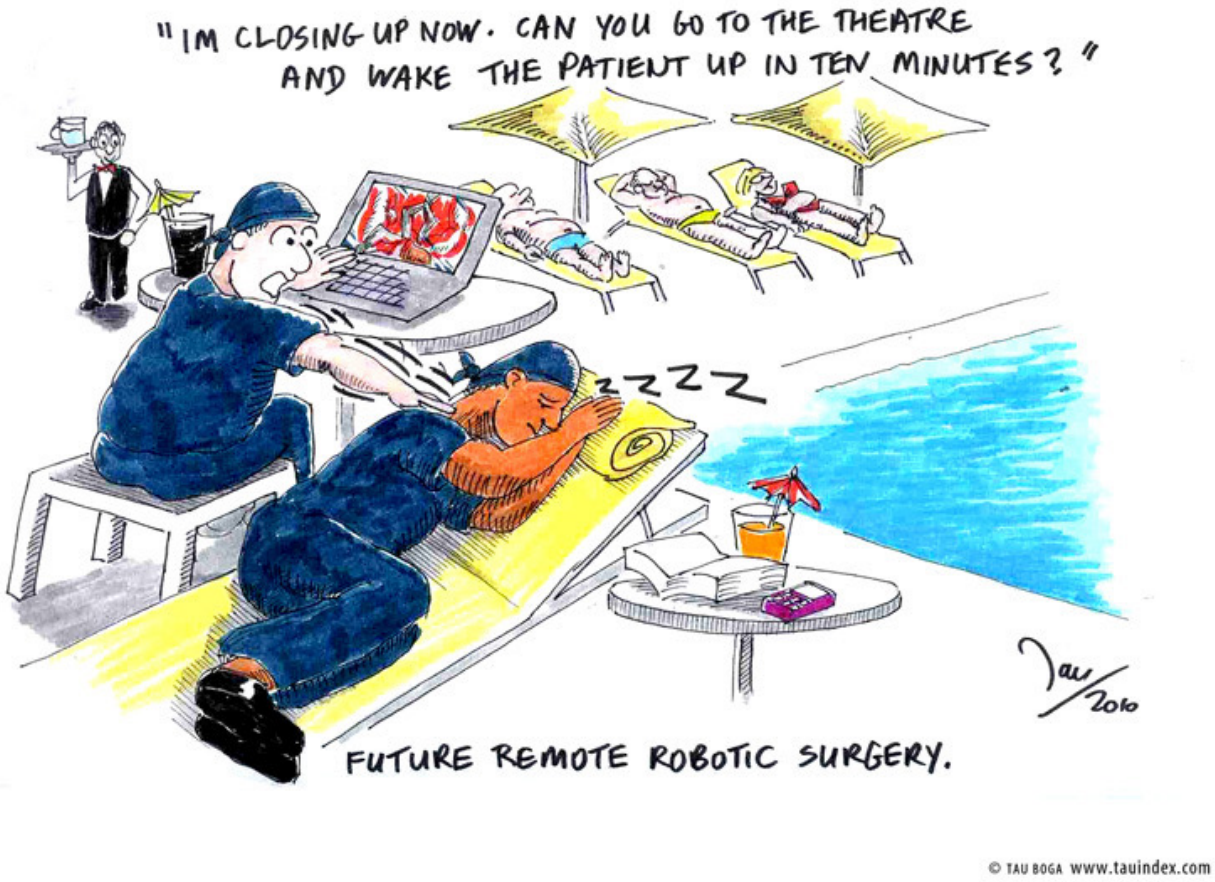
Next-gen **robotics** with surgical navigation capabilities (e.g., digital tissue segmentation)

Haptic feedback-enabled gloves manipulate robotic arm with high surgical precision

Augmented reality goggles to enhance surgeon's precision intraoperatively

Let’s not miss the train …..

Thank you for your attention



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