



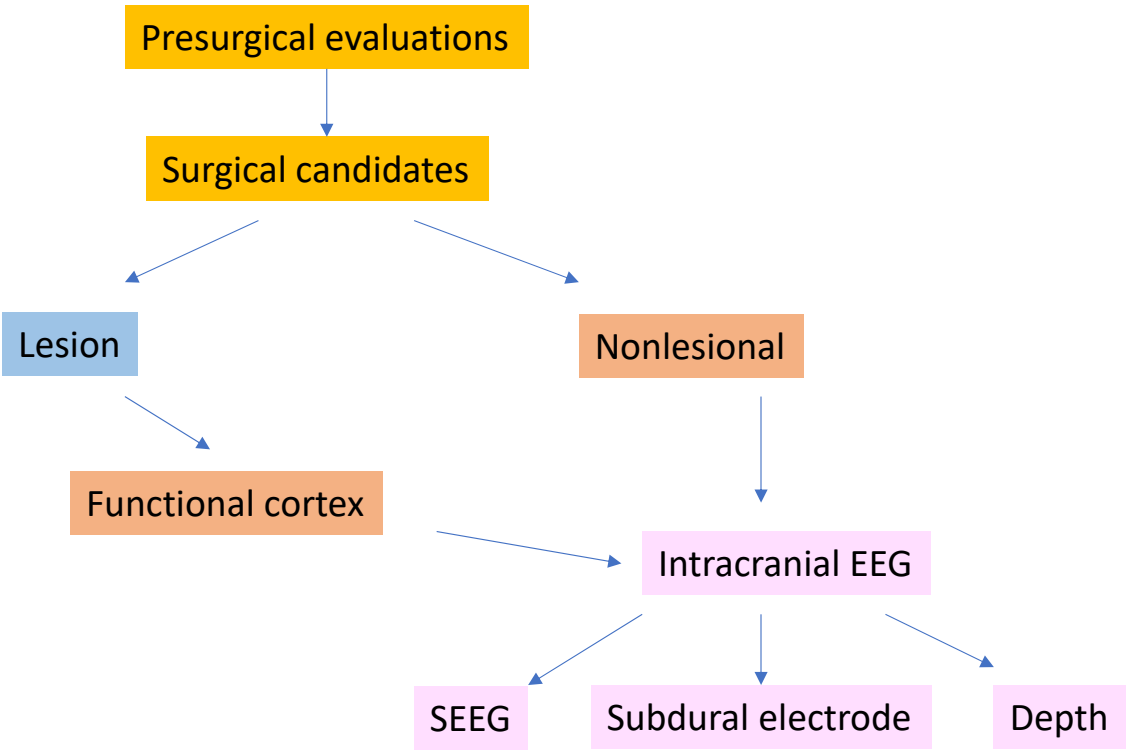
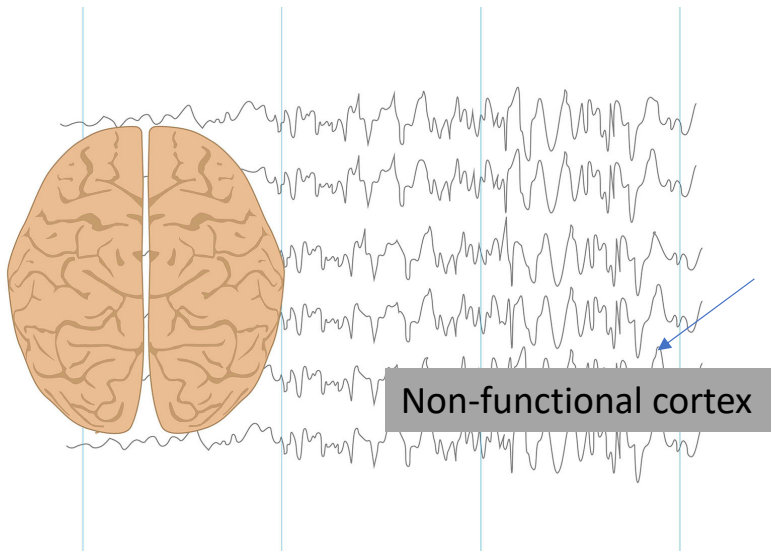
New Technologies in Epilepsy Treatment

Teeradej Srikijvilaikul, MD.
Prasat Neurological Institute

Disclosure

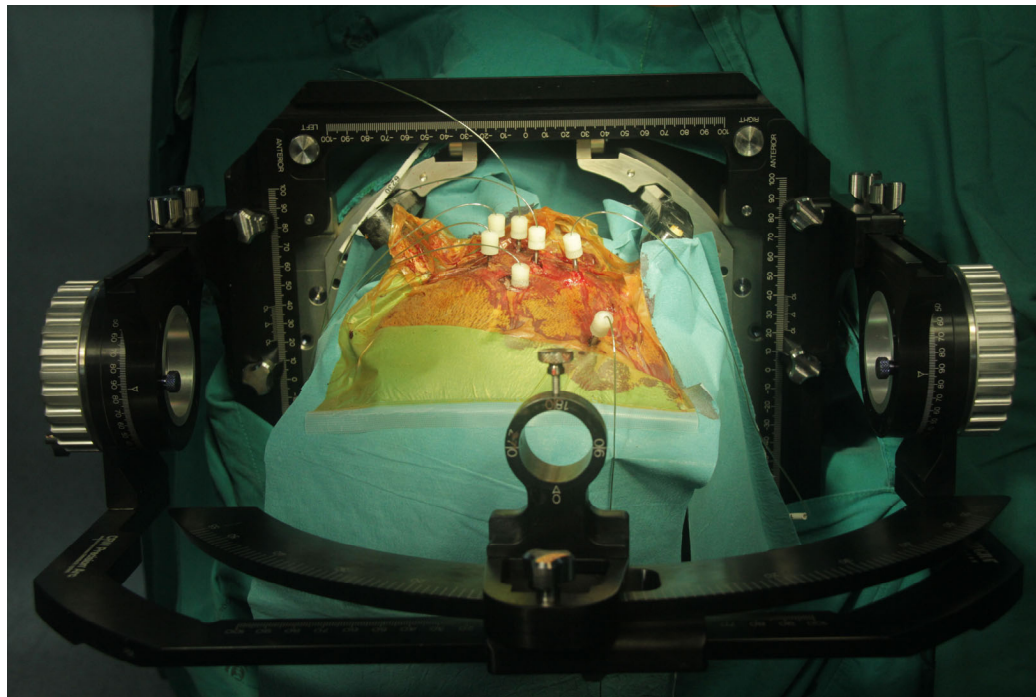
None

Drug-resistant Epilepsy



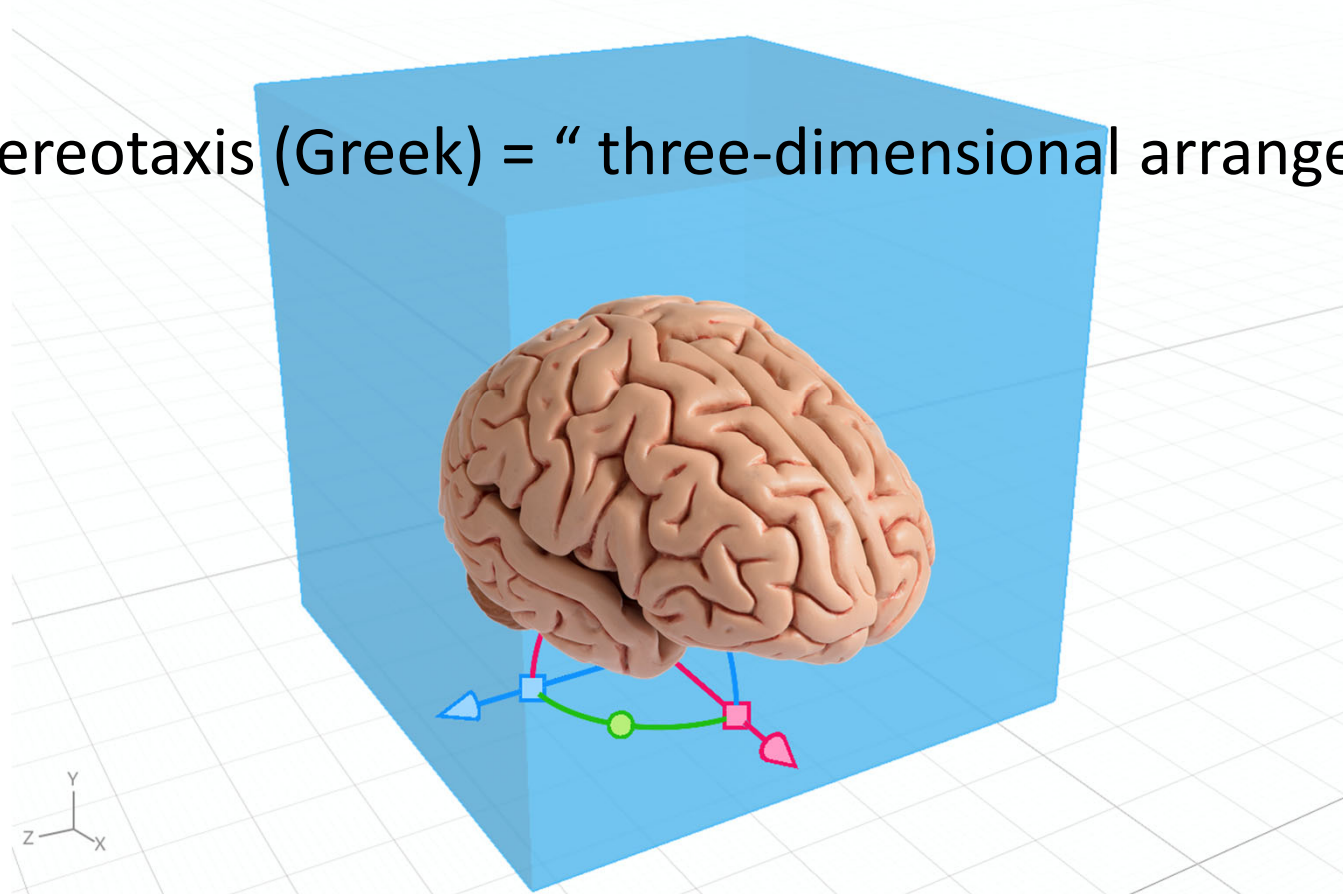
Stereotactic SEEG

First SEEG 17 July 2015



Cartesian coordinate system: any point in space can be determined by 3 coordinates x,y,z

Stereotaxis (Greek) = “ three-dimensional arrangement”



Stereotactic surgery

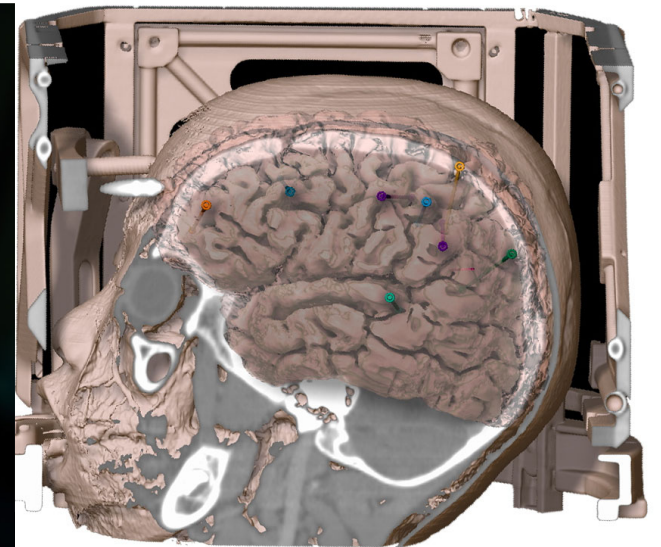
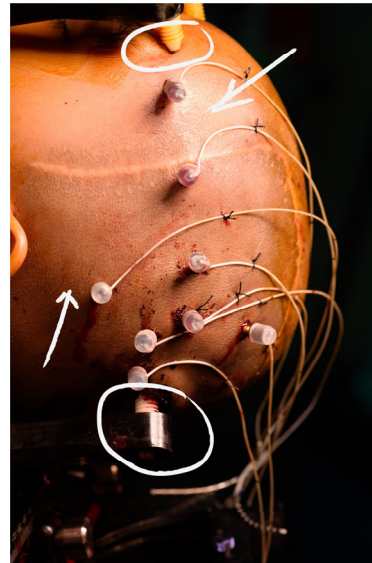
- Epilepsy surgery
 - Stereo-EEG
 - Depth electrode implantation
 - Laser interstitial therapy
- Functional surgery
 - Deep brain stimulation
 - Radiofrequency lesioning
- Biopsies

Stereotactic surgery

- Frame-based surgery
- Frameless surgery
- Robotic assisted surgery

Frame-based stereotactic in SEEG

- Children
- Degree of freedom
- Previous surgery
- Human and equipment errors
- Operative time





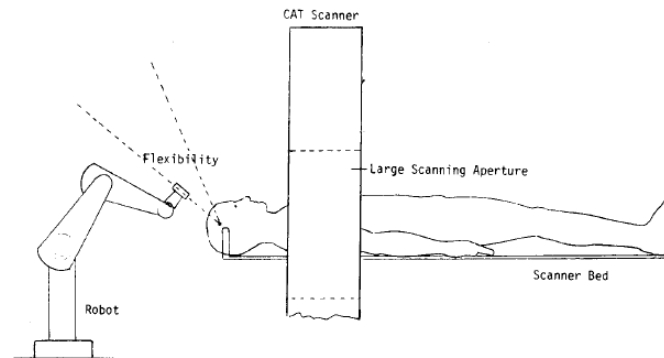
One Day a Robot
Will Perform Surgery on You

TEDxNashville

Dr. Bob Webster III, Sep 26, 2017

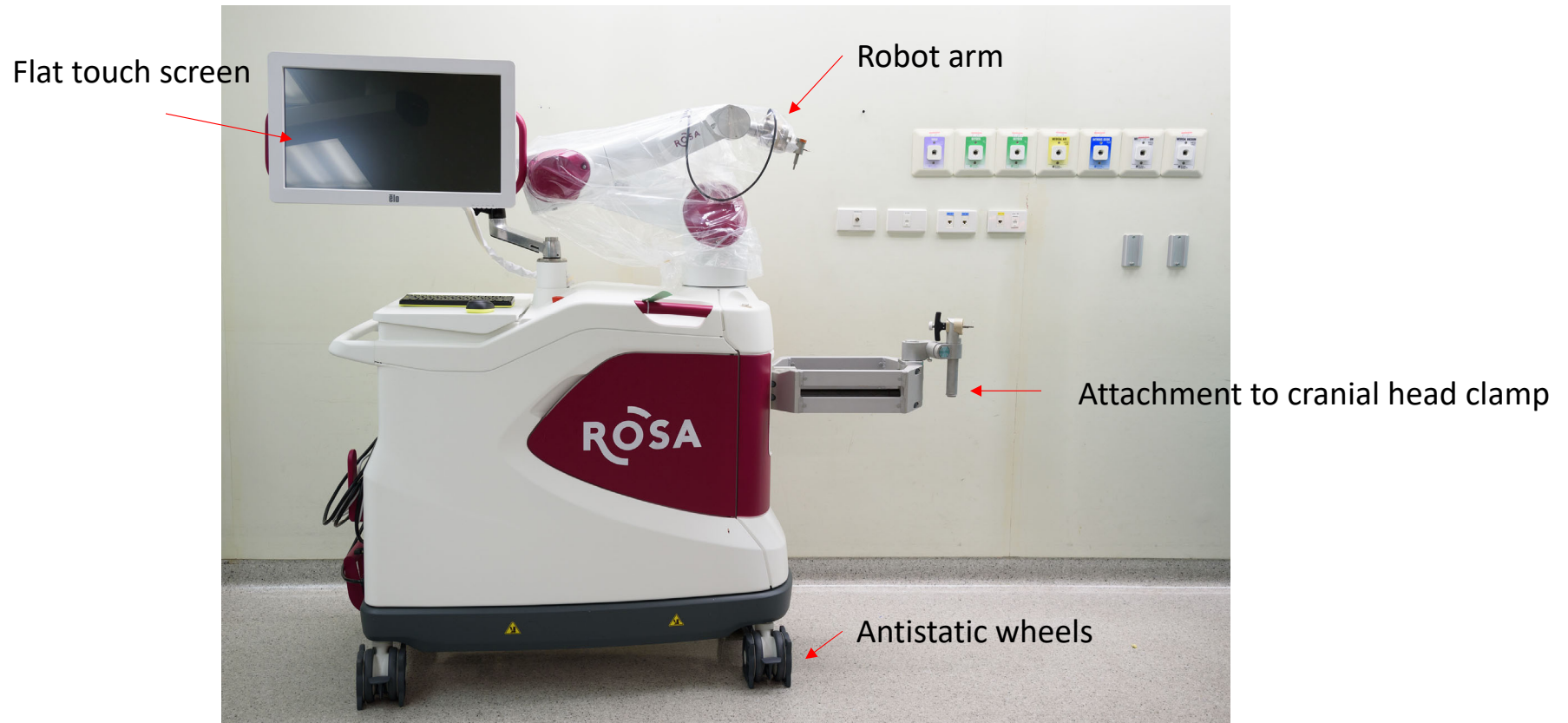
A Robot with Improved Absolute Positioning Accuracy for CT Guided Stereotactic Brain Surgery

YIK SAN KWOH, MEMBER, IEEE, JOAHIN HOU, EDMOND A. JONCKHEERE, SENIOR MEMBER, IEEE, AND SAMAD HAYATI



April 11, 1985 First robotic assisted stereotactic biopsy (Unimation Puma 200)

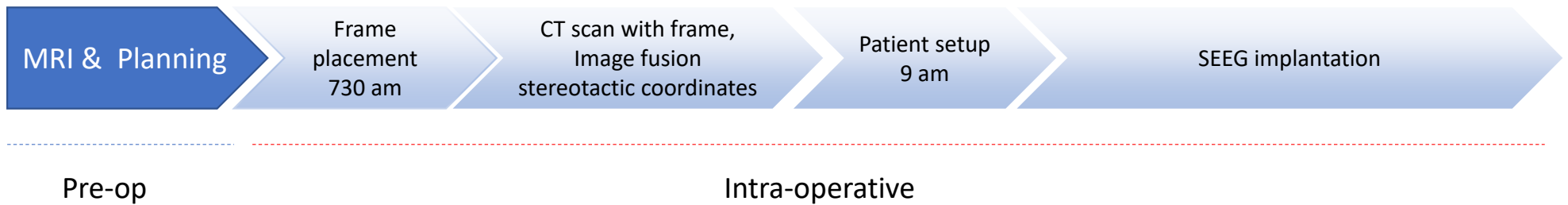
ROSA robot



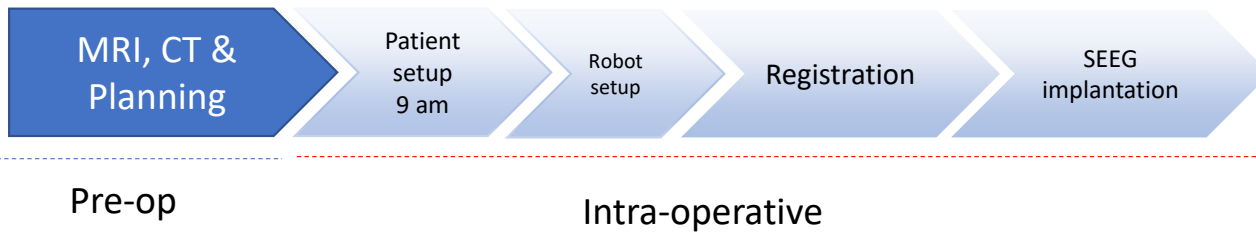
ROSA robotic surgery

- SEEG
- DBS
- Biopsy
- Endoscopic surgery (ventricular surgery, transphenoid surgery)

Frame-based stereotactic SEEG



Robot-assisted SEEG

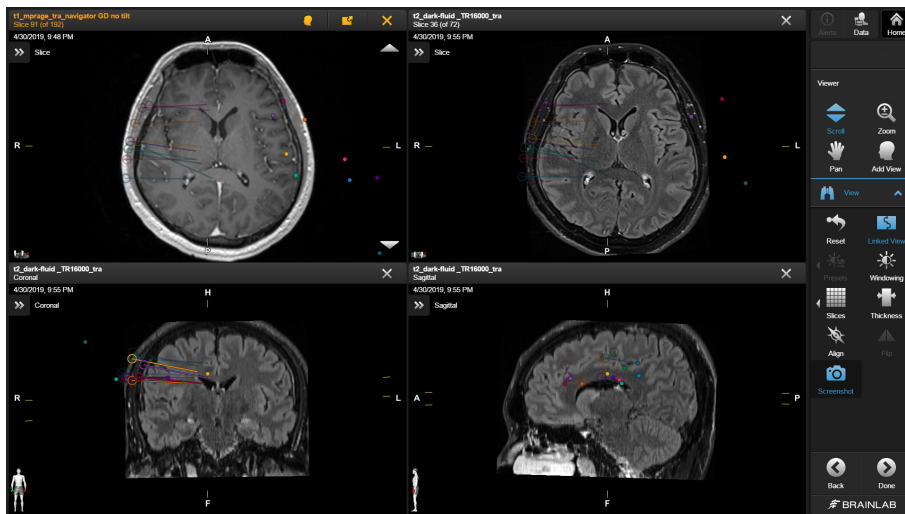


Planning

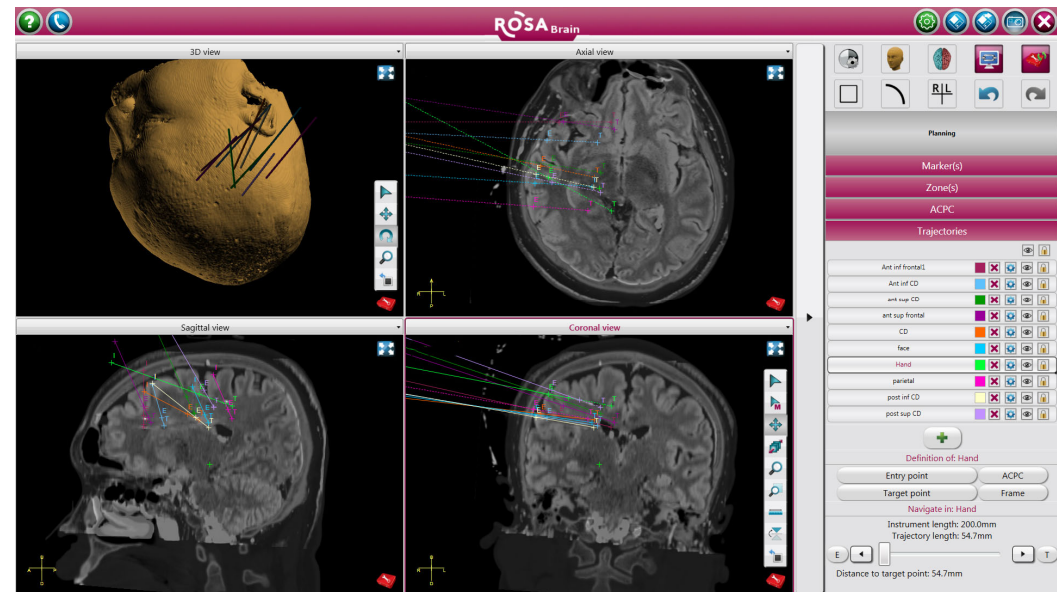


Planning

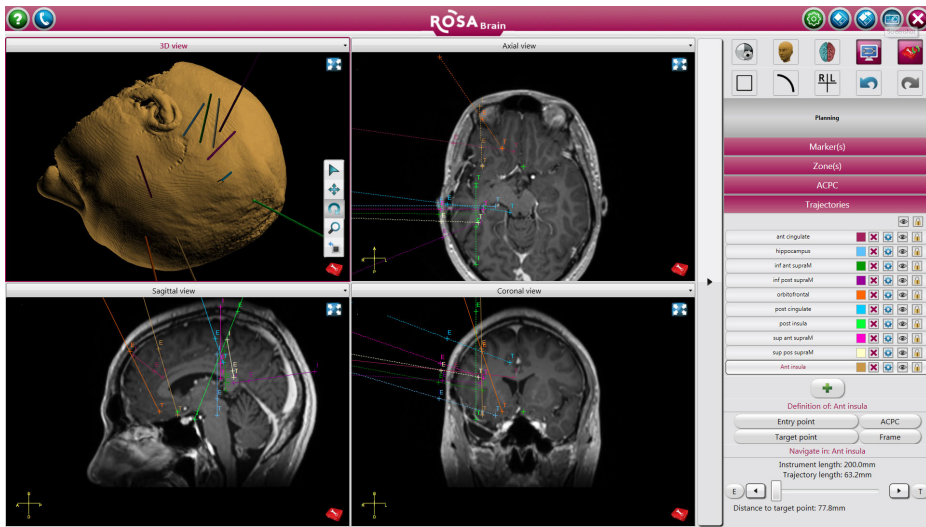
Brainlab



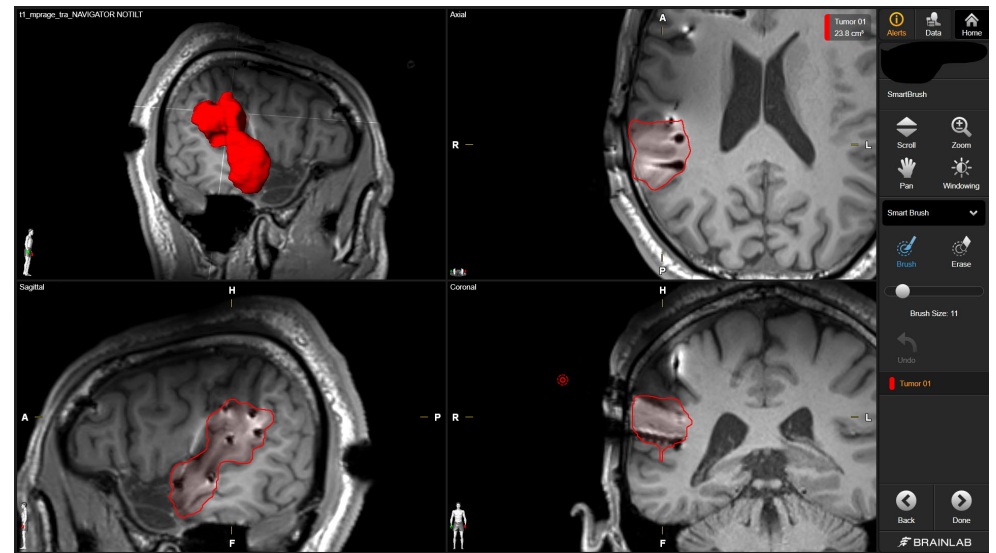
ROSA



Epilepsy surgery



ROSA



Brainlab

OR layout



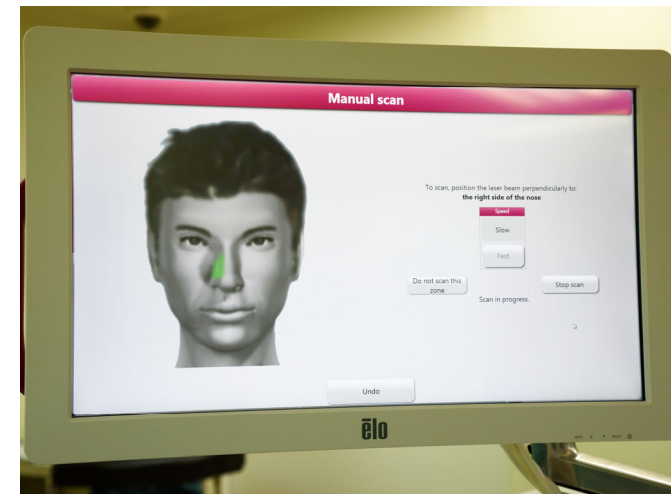
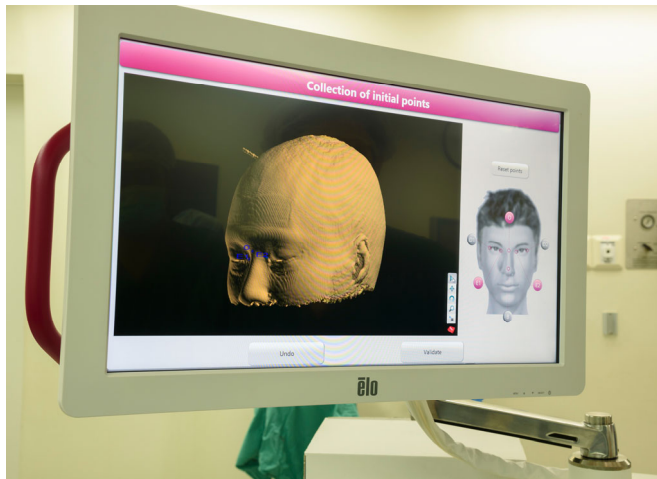
Patient setup



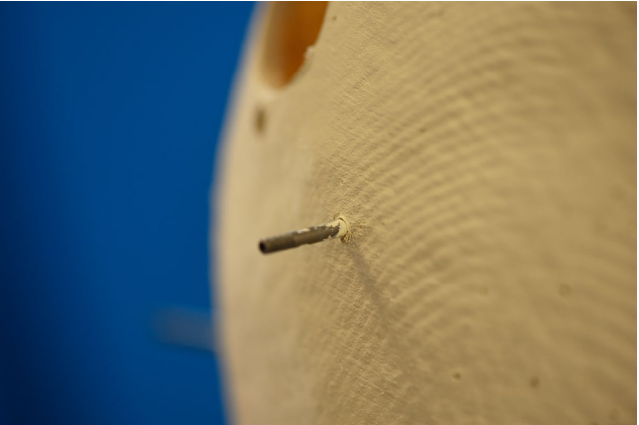
Registration

- Laser surface matching
- Skin, Skull fiducials
- Stereotactic frame

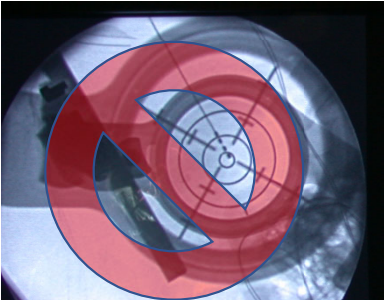
Laser surface registration



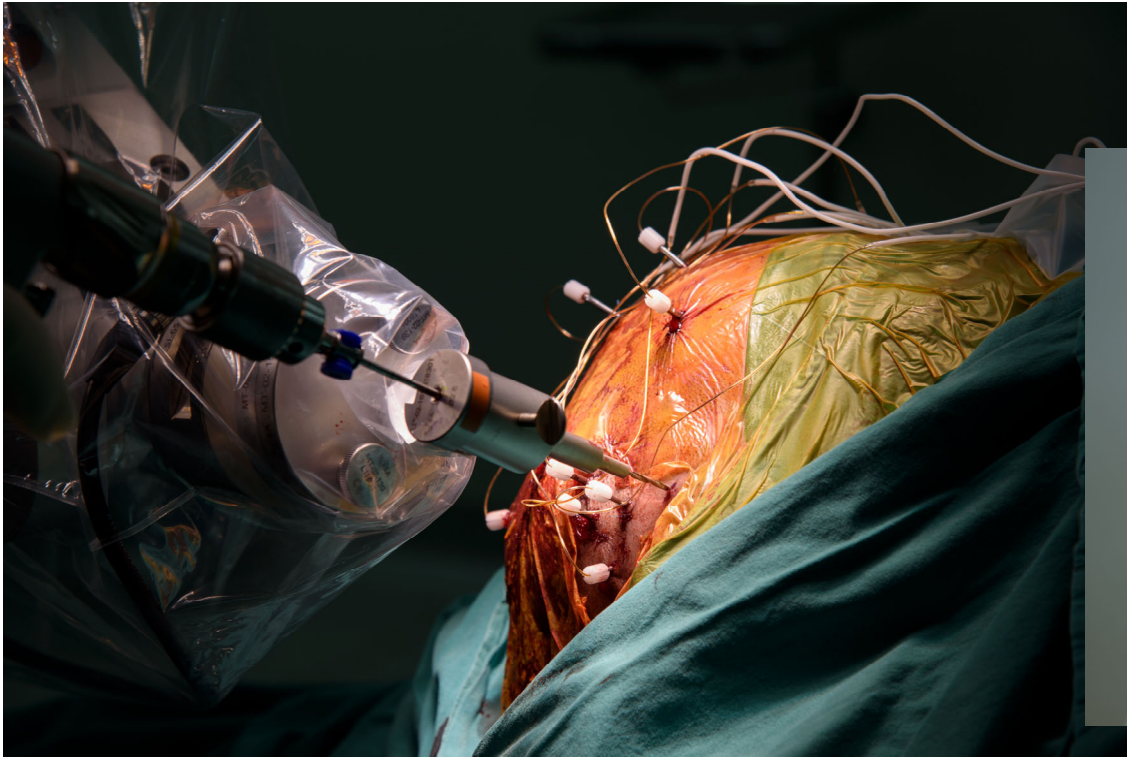
Fiducial markers

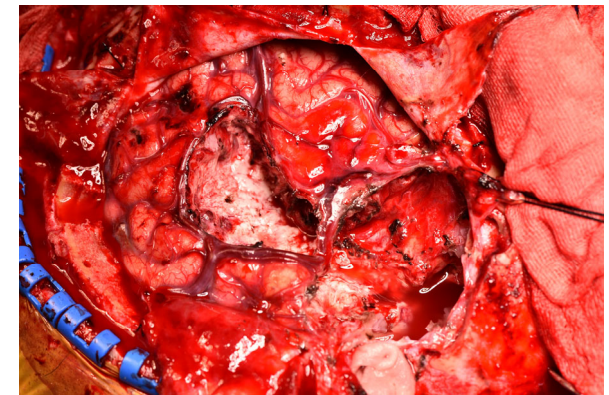
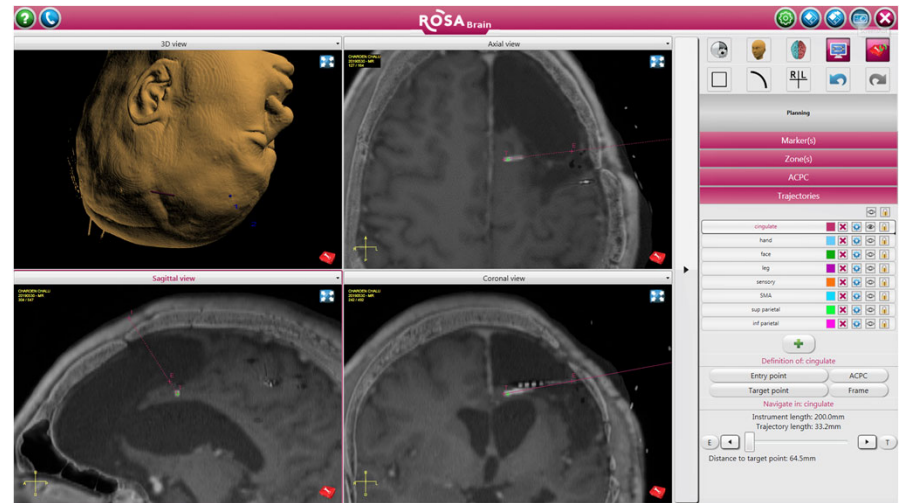
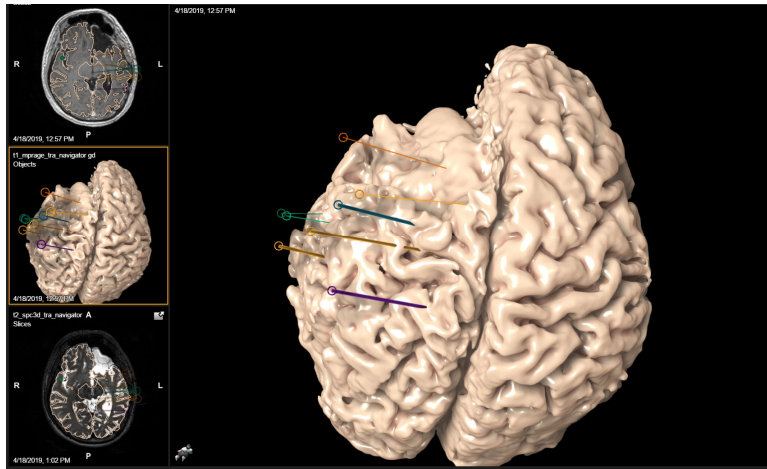


Frame registration



SEEG

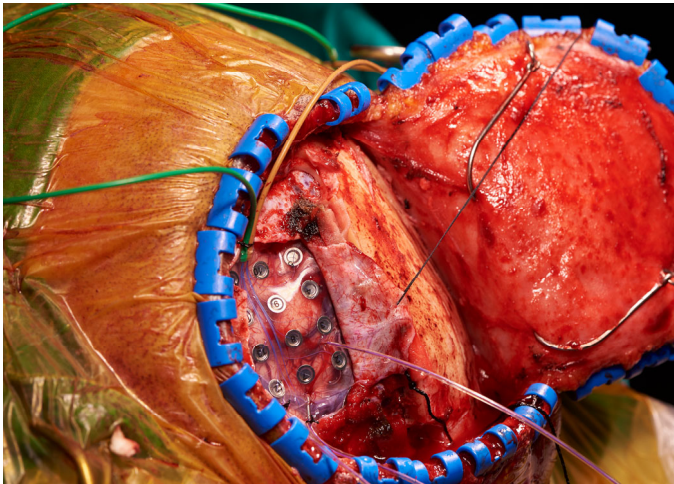
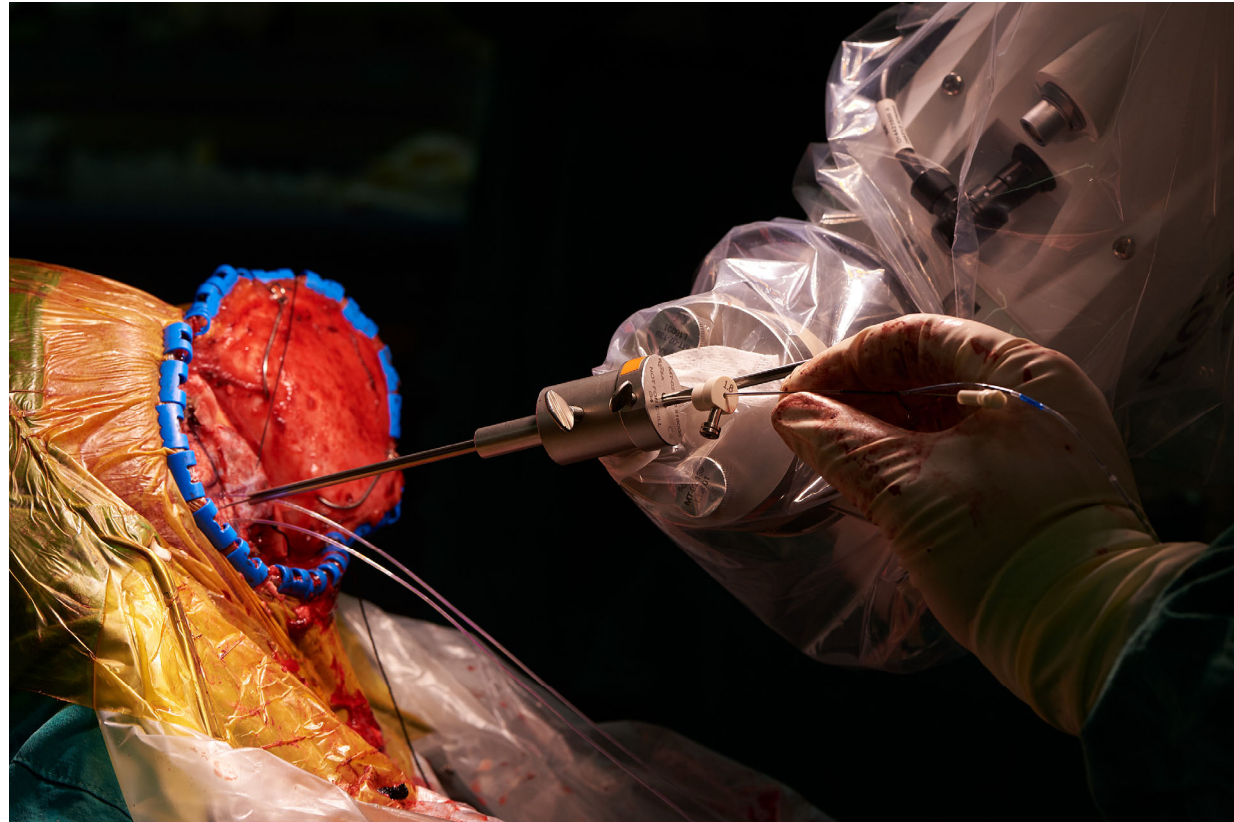




SEEG > Thermocoagulation > Resection



Subdural & depth electrodes



Comparison of main image-guide/robotic devices for cranial surgery

	ROSA	Competitive robot	Navigation	Stereotactic frame
Registration	Markerless, contactless, automatic registration procedure. High (non-user-dependent) accuracy	Frameless procedure requires patient to be implanted a fiducial fixation or markers before MRI/CT scan	Markerless and contactless but requires surgeon intervention involving contact or pointer with patient's skin (user dependent accuracy)	No markerless solution/invasive; Require stereotactic ring on patient. High accuracy
Navigation	Allow free-hand navigation. Navigates surgical instruments mounted on robot arm	Not supported	Requires pointer handled by surgeon	Not supported
Instrument positioning/holding	Rapid, stable and accurate instrument positioning/holding. 6 degree of freedom	Rapid, stable and accurate instrument positioning/holding. 5 degree of freedom	Requires mechanical holder equipped with adequate sensors. Cumbersome, manual setting to be carried by surgeon. Limited accuracy and stability.	Requires surgeon to do manual settings. Hold instruments of limited weight. Limited range of positions.
Instrument manipulation	Offers accurate, safe instrument manipulation, haptic handling. Support complex instrument paths (linear, isocentric,..) Pre-planned motion.	No direct manipulation of instrument by surgeon hand. Fine motion of robot arm requires the use of a remote control	Not supported.	Not supported.

PNI (Robotic assisted surgery)

- Total 20 (May 2019-Aug 2020)
 - Epilepsy 12
 - SEEG 10
 - DBS 1
 - Depth 1
 - Movement disorders 4
 - Biopsy 4

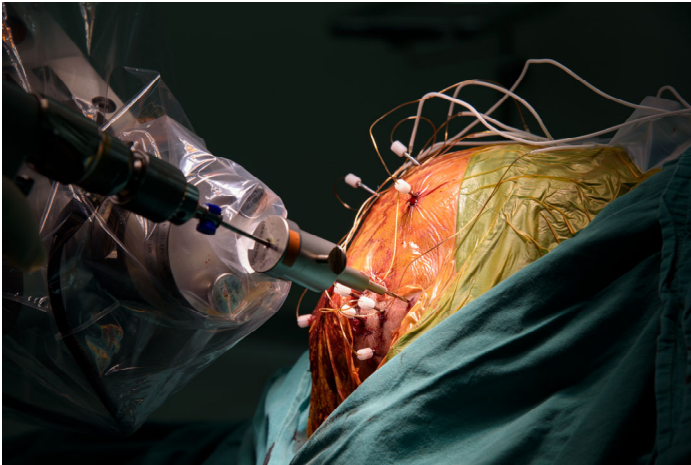
PNI robotic SSEG

- Registration (surface) mean 24 mins (12-39 mins)
- Operative time mean 105 mins (79-151 mins; 420 electrodes)
- Mean 14 mins/electrode

Robotic-assisted SEEG

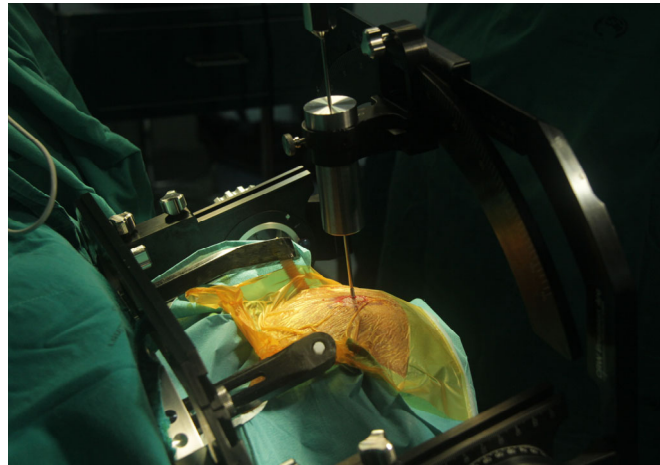
- Planning 30 mins (15-60 mins)
- OR time 130 mins (**222 mins shorter**)
- Median entry point error 1.2 mm (0.78-1.83)
- Median target point error 1.7 mm (1.20-2.3)

Accuracy of intracranial electrode placement for SEEG: A systematic review and meta-analysis. *Epilepsia* 2017; 58:921-932



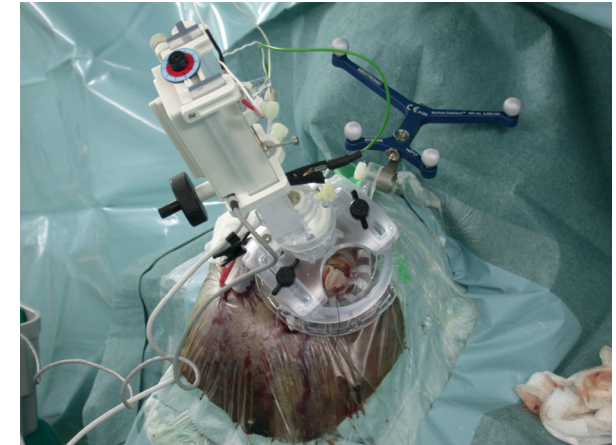
ROBOT

EP error **1.17** mm (0.80-1.53)
TP error **1.71** mm (1.66-1.75)



Frame-based

EP error **1.43** mm (1.35-1.51)
TP error **1.93** mm (1.05-2.81)



Frameless

EP error **2.45** mm (0.39-4.51)
TP error **2.89** mm (2.34-3.44)

Class III evidence

Conclusions

- Robot-assisted surgery
 - Time saving
 - Increased Precision
 - Increased patient comfort (as young as 12 months old)
 - Simplified workflow

Thank you

