NYU Langone Health

Department of Orthopedic Surgery

Navigation/Robotics Technologies in MIS Surgery

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ORTHOMANHATTAN

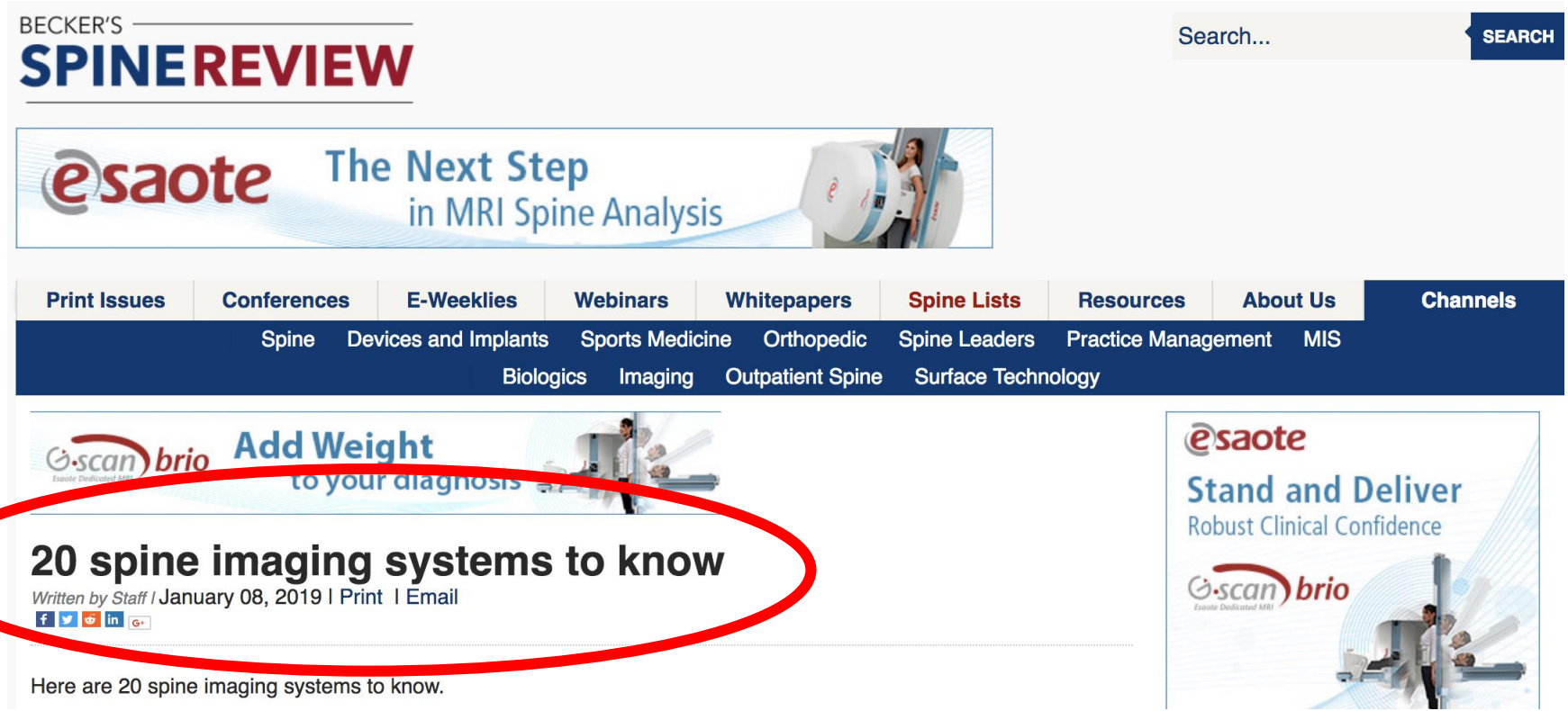
Navigation


0.3m
School Nearby 400 ft
LEFT EXIT 428D
30 WEST
Ft Worth
EXIT ONLY
35E
LIMIT 55
Speed 40mh
I-35E
Arrival 12:49PM
GARMIN

Early Navigation

- Preop CT and Surface Registration
- Intraoperative ISO-C

- **S**lowly
- **T**ouch
- **E**verything
- **A**dd
- **L**ike
- **T**wo
- **H**ours


BECKER'S
SPINE REVIEW
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G-scan brio
Add Weight
to your diagnosis
20 spine imaging systems to know
Written by Staff | January 08, 2019 | Print | Email
Here are 20 spine imaging systems to know.
esaote
Stand and Deliver
Robust Clinical Confidence
G-scan brio

Spinal Navigation

Stryker NAV3i

Medtronic StealthStation S8

BrainLab

CrossMark

Accuracy of Pedicle Screw Insertion Among 3 Image-Guided Navigation Systems: Systematic Review and Meta-Analysis

Jin Peng Du[1], Yong Fan[2], Qi Ning Wu[2], Dai Hua Wang[1], Jing Zhang[1], Ding Jun Hao[2]

World Neurosurg. (2018) 109:24-30.

- 3D FluoroNav, 2D FluoroNav, CT Nav
- 125 papers identified
- 10 articles chosen

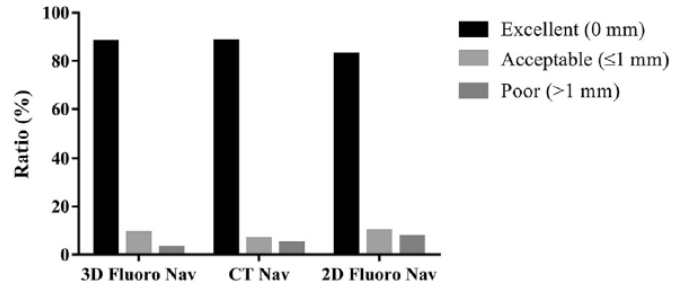
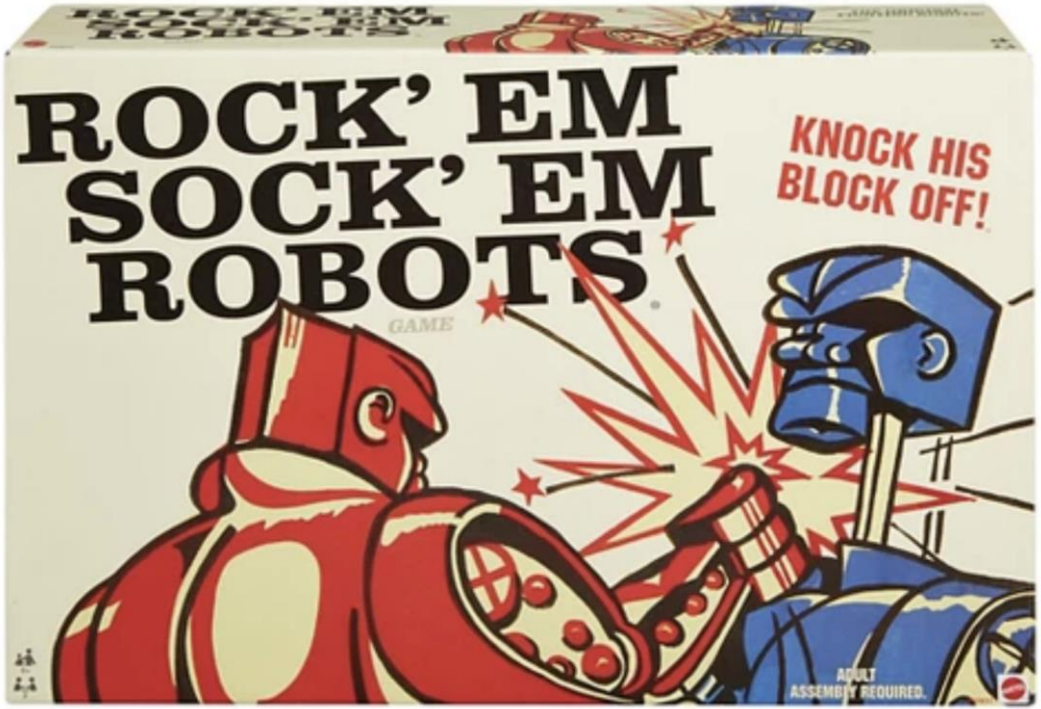


Figure 5. Bar graph showing the overall collective accuracy with each of the 3 modalities of no breach, ≤1 mm breach, and >1 mm breach.

7D Machine-vision Image Guided Surgery (MvIGS)

- Optical-based
- Radiation-free
- Fast (registration in 20 seconds)
- Removes line-of-sight issues with machine vision technology embedded in the attached surgical light
- Requires at least mini-open exposure

Robotics

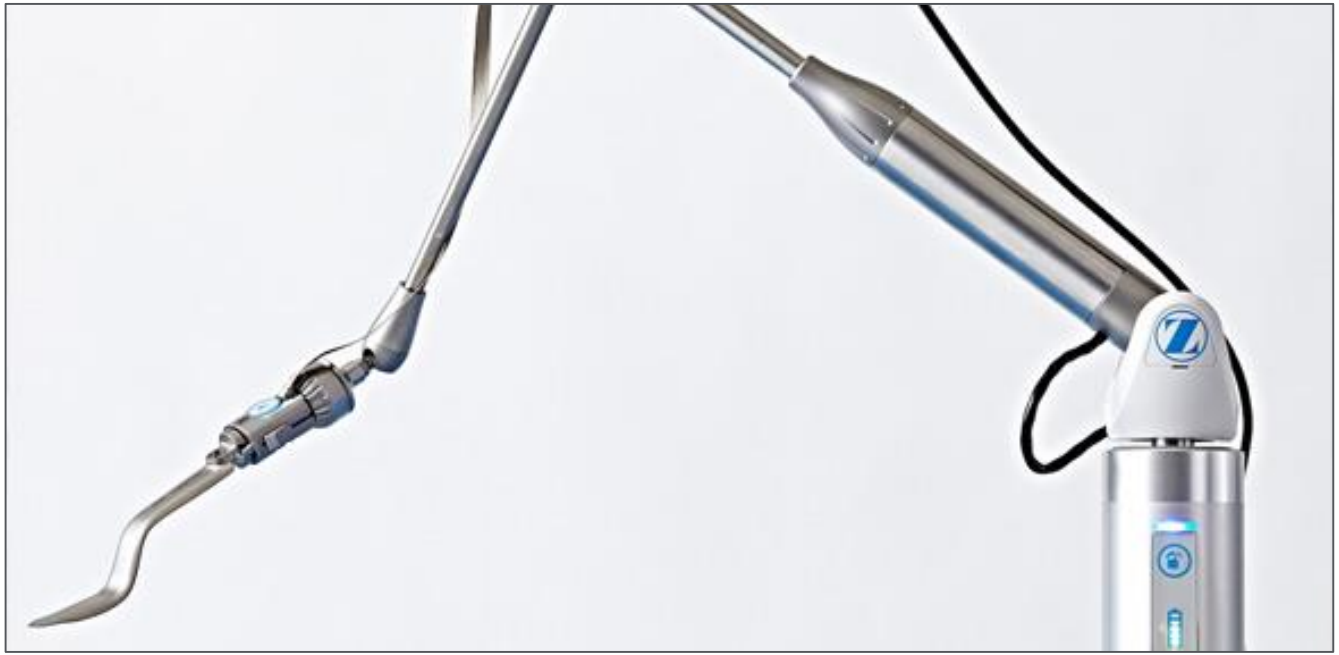

ROCK' EM SOCK' EM ROBOTS
KNOCK HIS BLOCK OFF!
GAME
ADULT ASSEMBLY REQUIRED.

Potential Robotic Advantages

- Truly maximize advantages of navigation
  - Precise maintenance of trajectory
  - Precise depth control
  - Overcome challenges when surface landmarks are obscured
- Allow for optimal preoperative planning
- Minimize radiation
- Shorten OR Time
- Make surgery safer, more efficient and more reproducible

What’s out there?

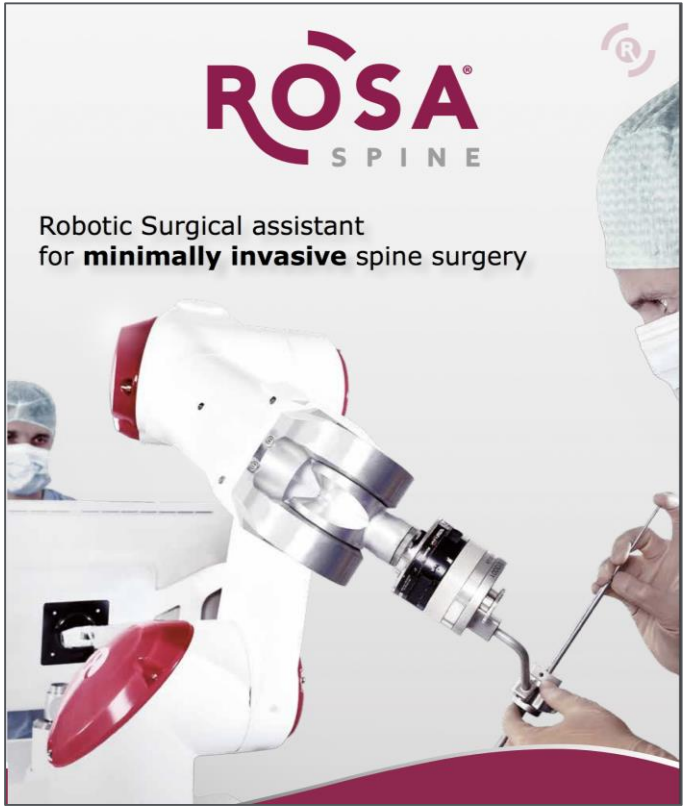
Zimmer/Biomet: Walter Lorenz surgical assist arm



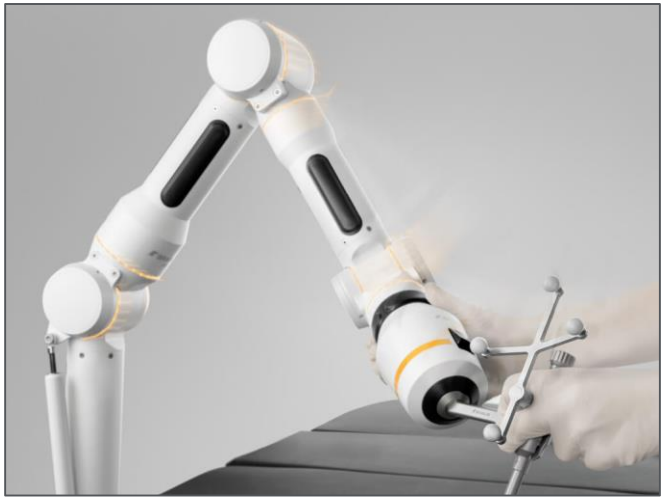
Medtech / Zimmer Rosa

Medtech / Zimmer Rosa

- Intraoperative CT Only
- Dynamic Guidance
  - Robot arm continual readjusts to the patient
- Pending FDA approval
- Applications beyond Spine: Brain/Ortho

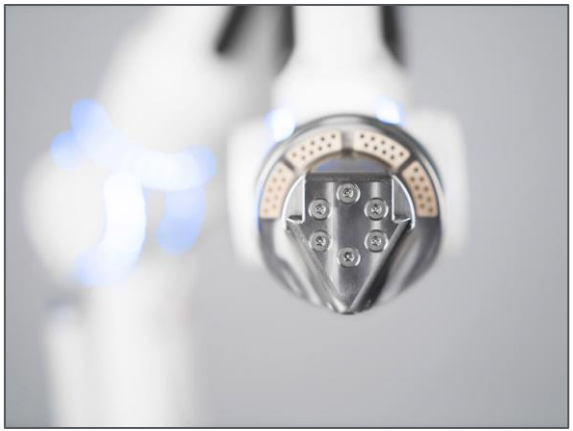


Brain Lab Cirq



Brain Lab Cirq

- Portable, light-weight (approx. 11kg)
- Mounted directly to the O.R. table rail
- Integrated computer unit - no footprint
- Port for different application-specific modules
- Includes tissue protecting trocars for MIS access
- Drill tube stabilization with sharp teeth for anchoring
- Full drilling guidance with snap-on depth-control
- Open Platform
- FDA Approval Pending



Nuvasive Pulse

Integrates:

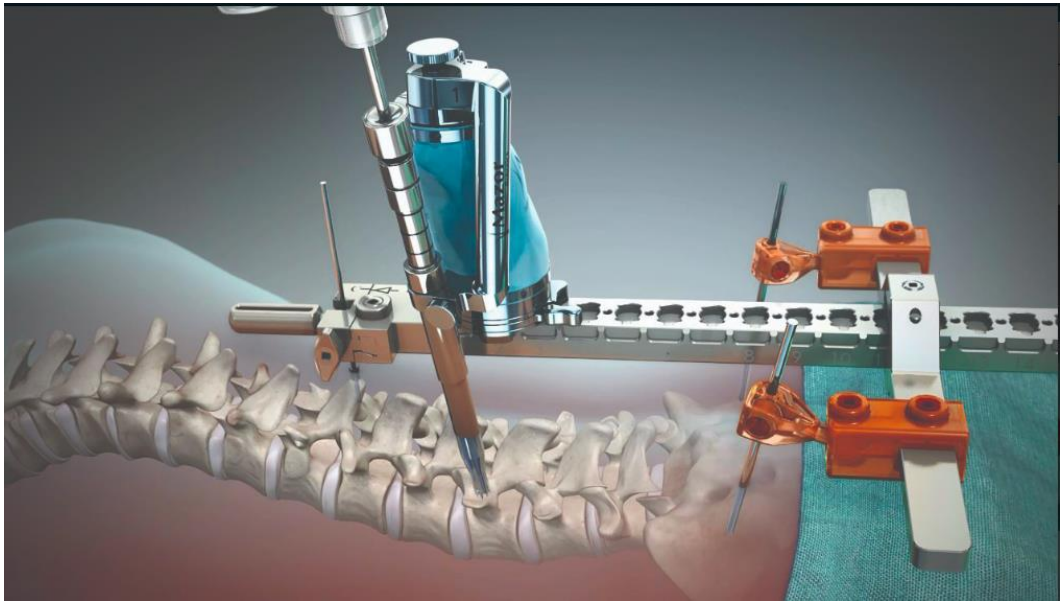
- Navigation (Improved Line-of-Sight)
- Less-Ray
- 2D and 3D Imaging
- Siemens Intraoperative Imaging (ISO-C)
- Neurovision
- Bendini
- Robotics ?

Stryker Mako (Spine Robot in Development)

- Stryker acquired MAKO in 2013
- Well-entrenched in Navigation
- Very little public information available
- Single-step pedicle screw placement ?
- + K2M ?

Actual FDA-Cleared Spinal Robotics:

Mazor Renaissance



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Substantial Advances

CT-Fluoro Sync

Individual Vertebral Registration

Spine

SPINE Volume 43, Number 23, pp 1670–1677

LITERATURE REVIEW

The Arrival of Robotics in Spine Surgery

A Review of the Literature

Alexander Ghasem, MD,* Akhil Sharma, BS,† Dylan N. Greif, BA,† Milad Alam, MD,* and Motasem Al Maaieh, MD*

- 32 articles were selected for study inclusion
- Mazor Renaissance / Spine Assist
- Pedicle screw accuracy was comparable if not superior with robot
- OR time initially longer
- Radiation exposure variable but decreased with learning curve
- Multilevel procedures trended toward earlier discharge in robot patients

Eur Spine J (2018) 27:921–930
https://doi.org/10.1007/s00586-017-5333-y

CrossMark

- 6 studies: 158 patients (688 screws) robot-assisted / 148 patients (672 screws) free-hand
- Grade A accuracy rate in robot-assisted group superior to freehand group

  (RR 1.03, 95% CI 1.00, 1.06; P = 0.04)
- Grade A + B accuracy rate same between the two groups

  (RR 1.01, 95% CI0.99, 1.02; P = 0.29)
- Robot group had significantly fewer proximal facet joint violations vs. freehand

  (RR 0.07, 95% CI 0.01, 0.55; P = 0.01)
- Robot significantly reduced intraoperative radiation time and radiation dosage

  (MD − 12.38, 95% CI − 17.95, − 6.80; P < 0.0001); (SMD − 0.64, 95% CI − 0.85, − 0.43; P < 0.00001)
- Duration was longer in robot vs. freehand

  (MD 20.53, 95% CI 5.17, 35.90; P = 0.009)

Medtronic / Mazor X ‘Stealth Edition’

- Builds on Mazor’s Experience
- Table-Based
- Attaches directly to spine/pelvis
- Enhanced with navigation

Globus ExcelsiusGPS

- Multi-Functional Navigation
- Floor-based unit
- Preop / Intraoperative CT & Fluoro
  Work Flows
- Allows for Free-Hand Navigation
- Exchangeable End-Effector

Initial NYU Experience with Globus ExcelsiusGPS

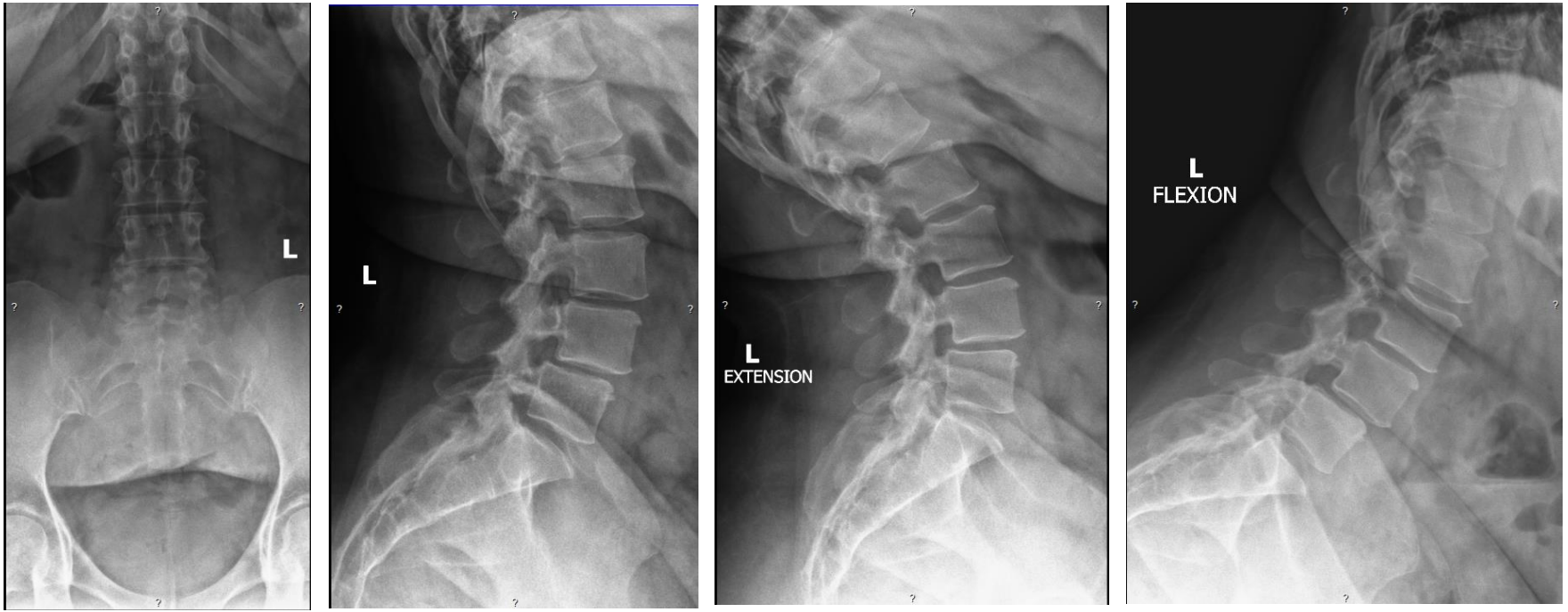
Deeptee Jain, MD, Jordan Manning, BA, Elizabeth Lord, MD, Themistocles Protopsaltis, MD, Aaron Buckland, MD, John Bendo, MD, Charla Fischer, MD, Jeffrey Goldstein, MD

Number of patients	106
Cases aborted prior to screw placement	5
Total screws placed Pedicle Iliac S2AI	636 6 1
Screws not placed with robot	5 (1%)
Planning method Preoperative CT Intraoperative fluoro	 88 13
Method of screw placement Percutaneous Open	86 15
Interbodies ALIF LLIF TLIF	28 12 58
Screw related complications	0
Return to OR for screw revision	0

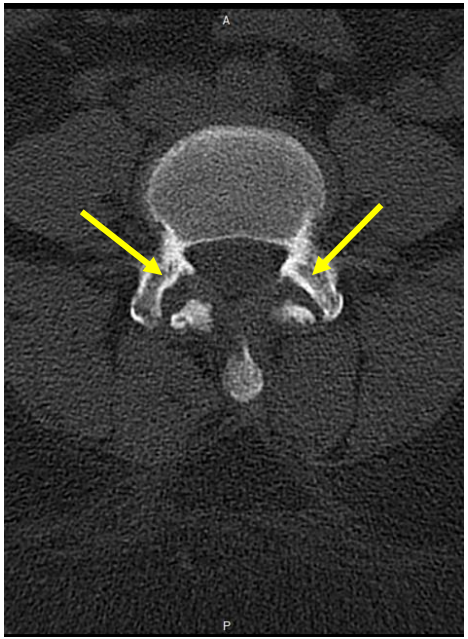
Robotic Pearls and Pitfalls (NYU Experience)

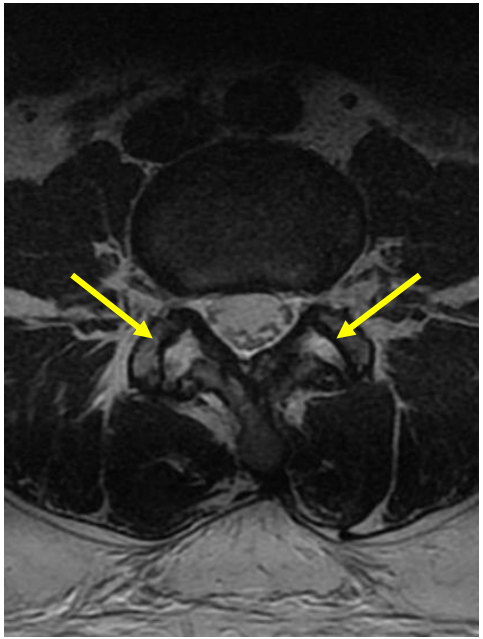
- Bad Merge
- Skiving
- Soft Tissue Pressure
- Spinal Instability
- Patient breathing
- "Noise"

L4-5 Unstable Degenerative Spondylolisthesis



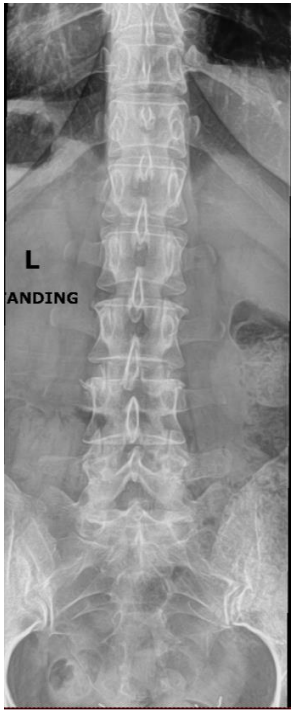
Advanced L4-5 Facet Arthopathy with Instability

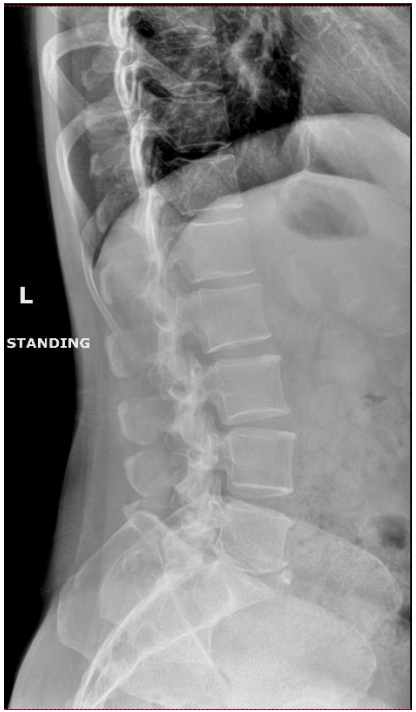




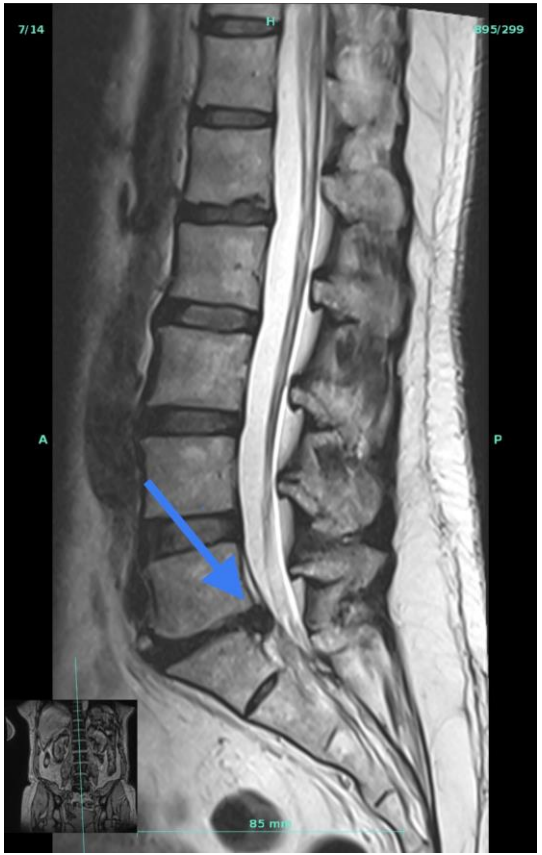
Illustrative Robotic-Assisted Case

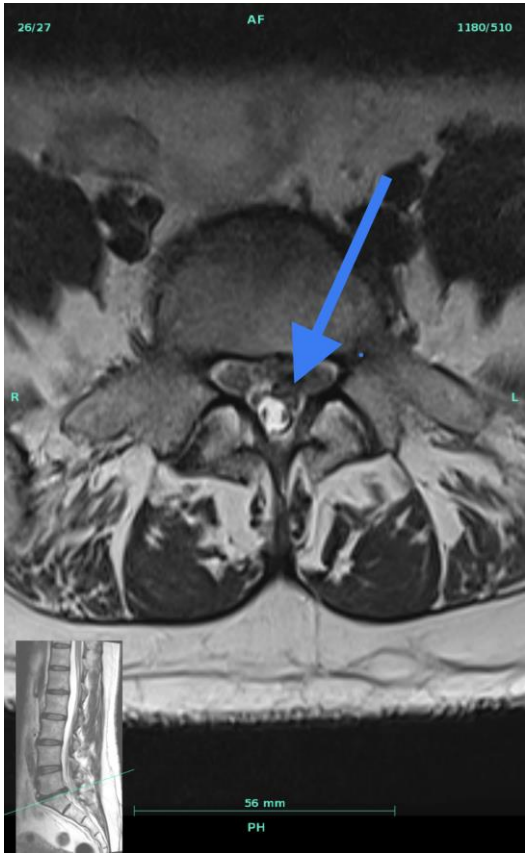
50 yo F c/o Back and LLE pain, L EHL/TA/Hip Abductors 4/5



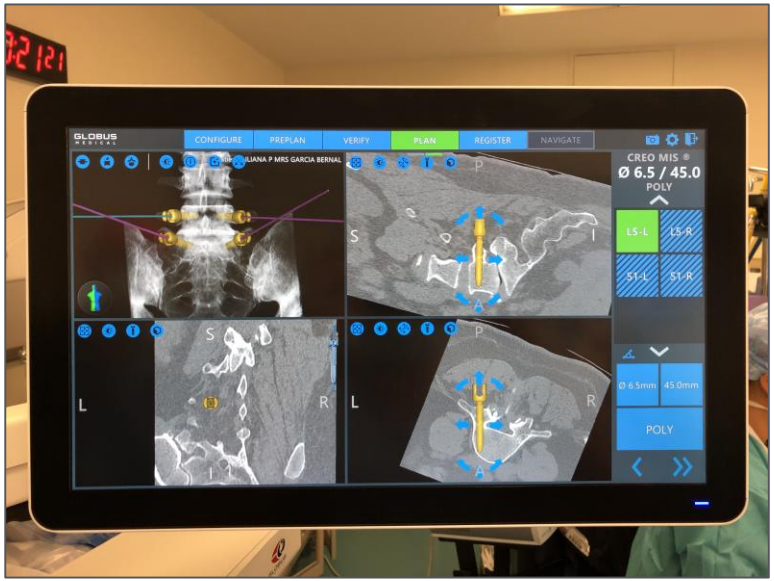



23/49
1555/464
A
P
79 mm
F

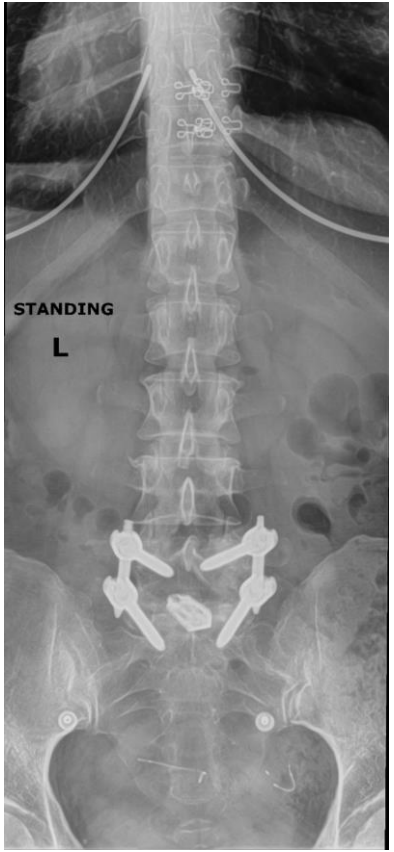

7/14
895/299
A
P
85 mm

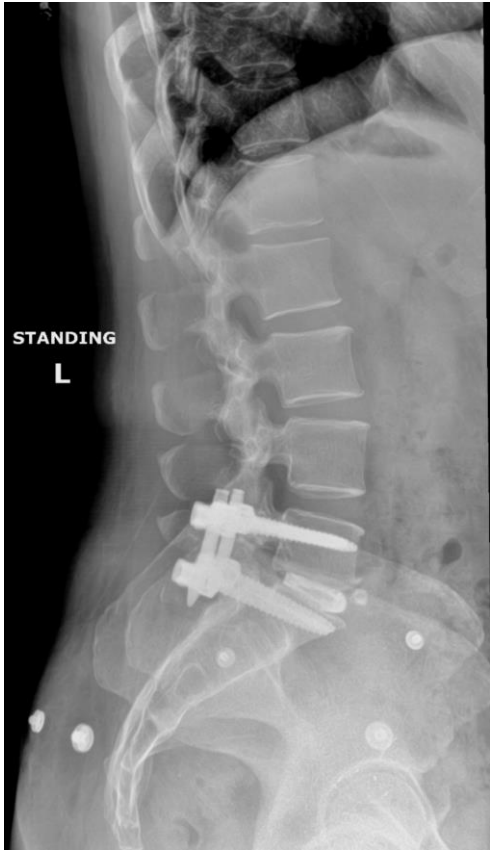

26/27
AF
1180/510
R
L
56 mm
PH

Pre-Op Planning and Setup



L5-S1 Robotically-Assisted MIS TLIF/PSF





Initial Postoperative Follow-up POD#9

Future Capabilities

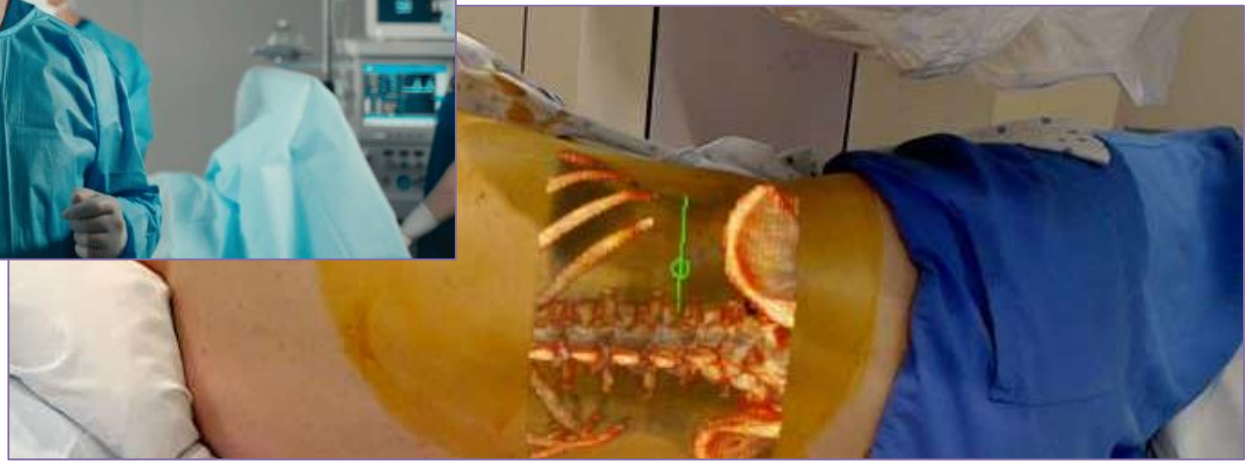
- Navigated Burr
- Tubular guidance and fixation
- TLIF/Interbody Insertion

More Distant Future Capabilities

- Controlled Interbody Prep

Navigation & Robots…
what about Augmented Reality?

AR / Microsoft Hololens



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Thank You

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Department of Orthopedic Surgery

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