Robotics

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Disclosure

• Consulting/Speaking
  – Medtronic
  – Amendia
  – Nutech
  – Mazor *
  – MIS Device
Outline

• Background/Applications
• Advantages/Disadvantages
• Robotic technique
• Clinical evidence
• Cases
My Experience

• 3 years
• 100+ cases
• Initial Motivation
  – Less radiation
  – Optimize comfort with anatomy and screw placement
• Started with larger cases and open cases
• Now I use it for every instrumented case
The Robot fits naturally into MISS

Surgical methods devised to achieve objectives of traditional surgery with minimized damage to peripheral tissues.
Mazor Robotics *Renaissance*

- Only FDA-approved robotic guidance system for spinal surgery
- Tens of thousands of screws placed
- Available about 55 sites in the US, 95 internationally
- The next step in the evolution of spine surgery
Computer Navigation- Intraop Robot

- CT-based 3D planning
- Guided instrumentation
- 1 mm accuracy

System components:

- CT-based 3D Planning Software
- Workstation
- RBT Unit
Renaissance Applications
Spine Surgery

Posterior Surgical Approaches:

- Open
- MIS
- Percutaneous

Thoracic, Lumbar, Sacrum:

- Spinal Fixation
  - Pedicle screws
  - Transfacet, translaminar-facet screws
  - Sacroiliac screws
  - SI fusion
- Spinal Deformities
  - Scoliosis PSF, osteotomies
- Cement Augmentations
  - Kyphoplasty and vertebroplasty
- Oncological Applications
  - Biopsies, Tumor resections
- Revisions
Advantages

• Surgeon
  – Less Radiation!! (34s vs 77s per screw)
  – Increased confidence, improved accuracy
  – Decreased time per screw
  – Marketing

• Patient/Clinical
  – Increased precision, accuracy, safety
  – Some studies show 10% misplaced screws, 1-2% nerve injury

• Hospital
  – Increased volume, marketing

References
1. Kantelhardt et al. Eur Spine J 2010
Radiation Risks

- Ortho Hospital in Italy, 1976-2000
- Ortho – 29% incidence
- Ortho Surgeons 5x increased cancer risk

- In Vitro study
- Open bilateral ped screws T11-S1 on 6 cadavers
- 10-12 X greater than non-spinal MIS procedures

References
Disadvantages

• Surgeon
  – Learning Curve- Minimal
    • First 30 cases-> more conversion to manual but equal accuracy
  – Setup Time- Minimal

• Patient/Clinical
  – Difficult to prove true clinical benefit

• Hospital
  • COST!- Capital cost 750K
  • No increase in revenue per case

References
1. Hu, Lieberman CORR 2013
How it works: step 1

A CT using the Mazor protocol is obtained pre-op.

Plan screw placement to fit anatomy.
Pre-op planning

• Time spent and the exercise is beneficial for every case
• Increases understanding of variability in anatomy
• Notice asymptomatic misplaced screws in revisions
• Intra-Operative plan differs between open, MIS, revisions.
How it works: step 2

Multiple mounting options fit your intraoperative needs.
Mounting

PSIS and spinous process pins placed

Robot bridge attached to pins
Mounting

PSIS and spinous process pins placed
Mounting

Robot bridge attached to pins
HOW IT WORKS – STEP 3

Step 1: Preoperative plan

Step 2: Mount

Step 3: 3D Sync

Step 4: Operate

- Two fluoroscopy images taken intraop
- Synchronized with the CT-based surgical blueprint (independent of anatomy).
- Registers each vertebral body independently for unparalleled accuracy.
Registration

AP and Oblique xrays taken with registration markers
Registration

AP and Oblique xrays taken with registration markers
How it works: step 4

Step 1: Preoperative plan

Step 2: Mount

Step 3: 3D Sync

Step 4: Operate
Operate
Operate
Operate
Clinical Evidence
Mazor Robotics

98.3% Accuracy of 3,271 implants in 635 cases in 14 medical centers
with 49% of implants placed percutaneously
(typically 10%-20% of spine surgeries are MIS)

Compared to freehand surgery, in 112 cases Mazor Robotics-guided surgery significantly:

- **Screw Accuracy**
  94.5% Mazor vs 91.4% Conventional (p<0.05)

- **Reduced X-ray dosage by 56%**

- **Reduced complication rates and LOS**

- **OR time equivalent**

99.7% Clinical Acceptance of 1,815 implants in 120 scoliotic adolescents

Devito DP, Gaskill T, Erikson M, Fernandez M. Robotic based guidance for pedicle screw instrumentation of the scoliotic spine. Presented at Pediatric Society of North America (POSNA); May 2011; Montreal, Canada.
Clinical Evidence
Mazor Robotics

98.9% “successful and accurate” screw placement in 960 screws in 95 patients (deformity and revision surgeries)

Cases

L4-S1 open posterior with high grade spondylolisthesis
Cases

L5-S1 percutaneous posterior after ALIF
Cases

Multi-level percutaneous instrumentation after LLIF
Why Robotic Spinal Surgery?

- Less radiation
- Safety is improved
- Better outcomes with MIS
- Allows safer treatment of complex deformity
- No additional cost to the patient
Thank You