

# Relieving Back Pain With Robotic-assisted Spine Surgery

Alan Villavicencio, MD

Boulder Neurosurgical & Spine Associates  
303-653-9572



**BOULDER**

**NEUROSURGICAL & SPINE**

**ASSOCIATES**

# Introduction

## **Medical training:**

- ❖ Harvard Medical School
- ❖ Neurological Surgery Residency: Duke University Medical Center
- ❖ Fellowship in Orthopedic Spine Surgery: Cedars-Sinai Medical Center





Boulder  
Neurosurgical  
& Spine  
Associates





# Introduction



**200+**  
**presentations**



**100+ Peer-reviewed  
journal publications  
and book chapters**



**Principal Investigator  
for 30+ FDA-  
controlled clinical  
trials**



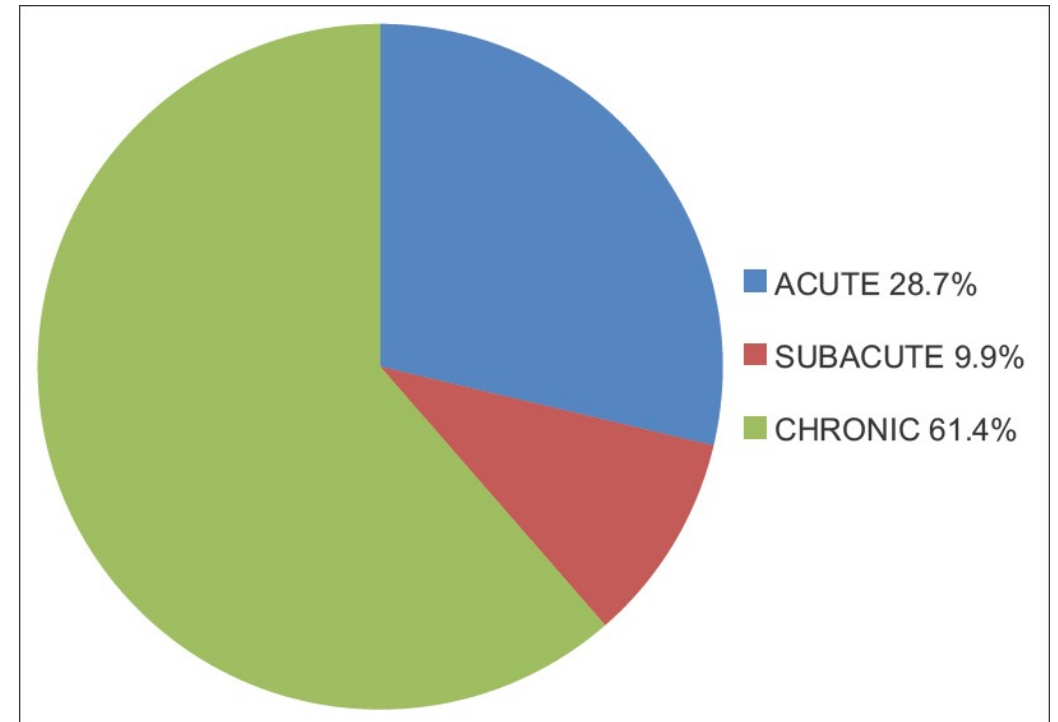
# Back Pain

- ❖ More than 65 million Americans suffer from low back pain each year.
- ❖ Up to 80% of adults experience low back pain at some point during their lives.
- ❖ Most episodes resolve spontaneously.
- ❖ Second most common reason for physician visit.



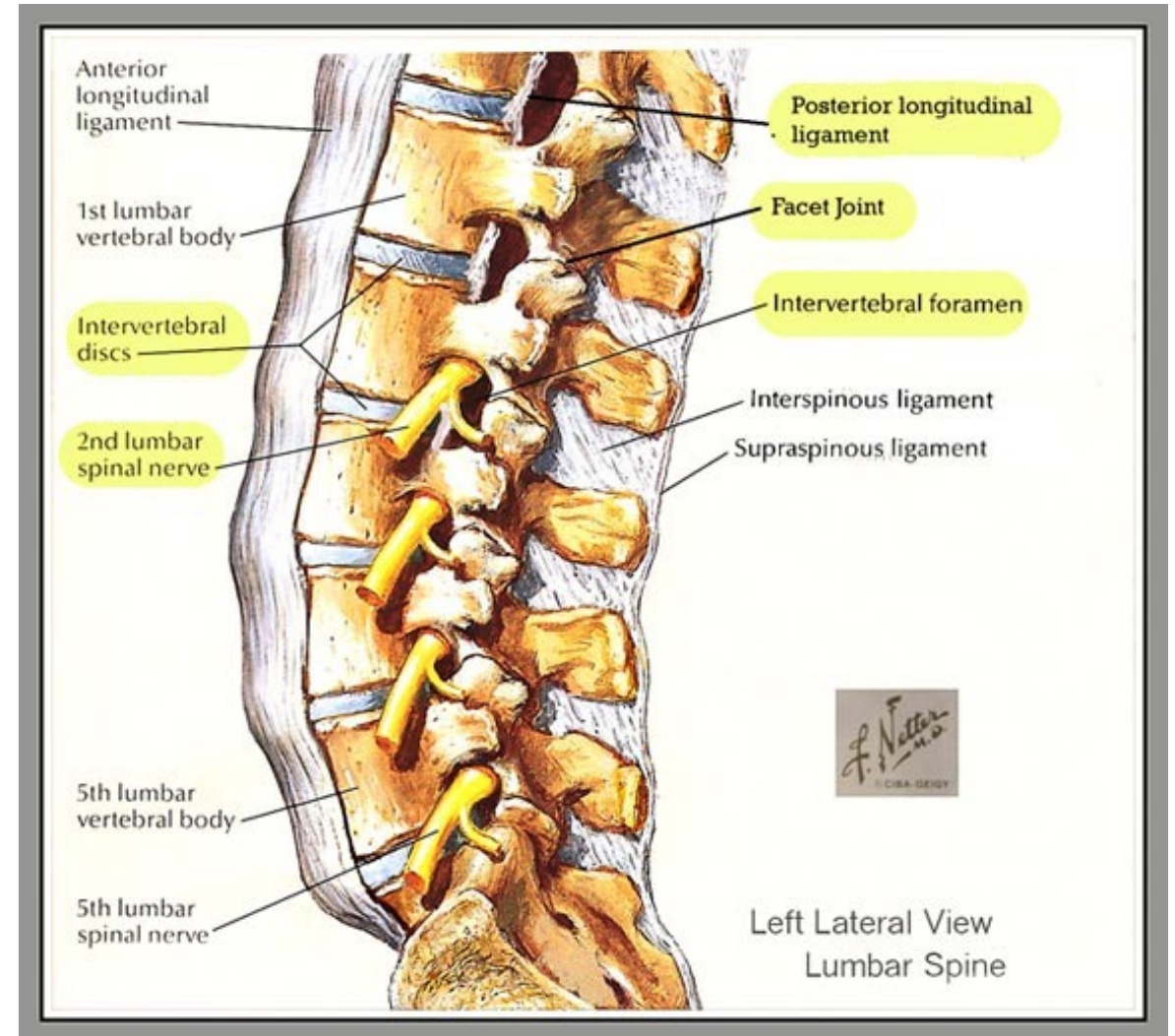
# Types of Back Pain

- ❖ **Acute back pain ~30%**
  - ❖ Sudden, intense pain
  - ❖ Usually resolves within a few days or weeks
- ❖ **Chronic back pain ~60%**
  - ❖ Deep, dull or aching pain lasting for 3 months or more
  - ❖ Located in one area or travel down the legs





- ❖ Vertebra
- ❖ Intervertebral discs
- ❖ Facet joints
- ❖ Spinal nerve
- ❖ Epidural space



- ❖ **Irritated nerves**

- ❖ In ~90% of LBP, a nerve gets pinched or irritated, the muscle tenses up and pain results

- ❖ **Inflamed joints**

- ❖ Nerve endings in facet joints
  - ❖ Excessive capsule stretch activates pain receptors

- ❖ **Herniated discs**

- ❖ Present in 1/3 of adults > age 20

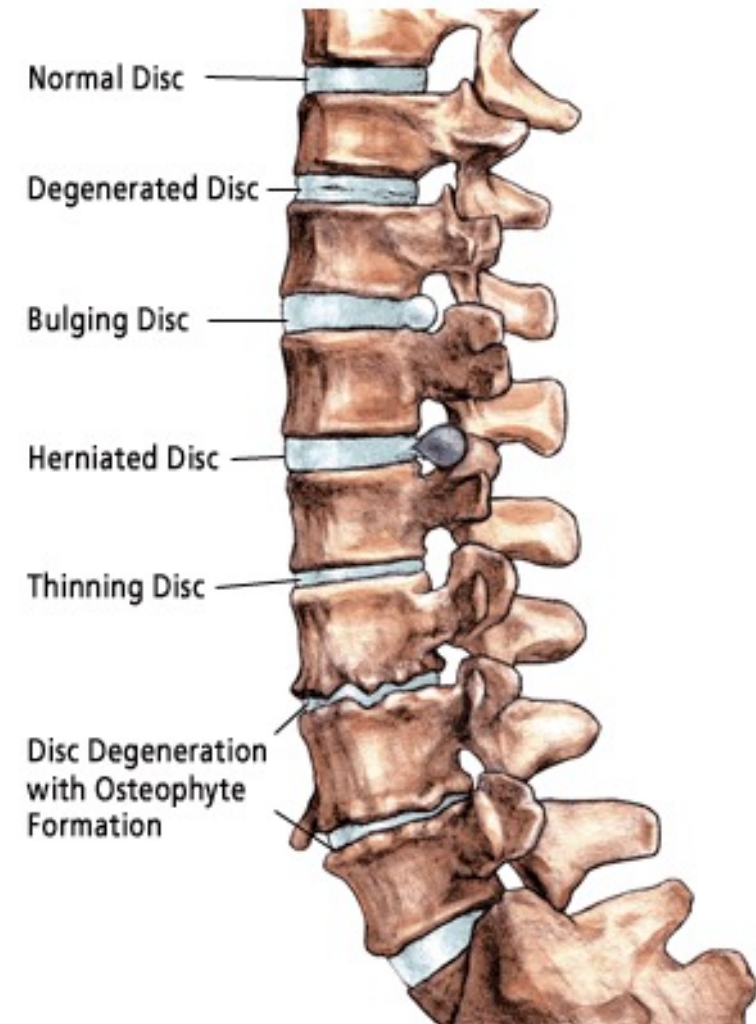
- ❖ **Ligaments**

- ❖ **Bones**

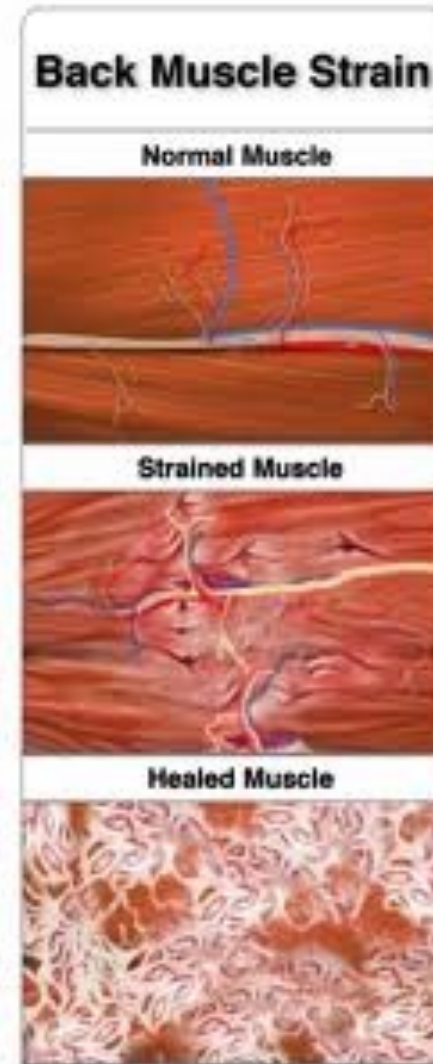


# Common Spinal Conditions

- ❖ Facet joint osteoarthritis
- ❖ Spinal stenosis
- ❖ Degenerative disc disease
- ❖ Spondylolisthesis
- ❖ Disc herniation
- ❖ Osteoporosis
- ❖ Piriformis syndrome
- ❖ Tumor
- ❖ Infections



- ❖ The **majority** of back pain is caused by muscle strains.
- ❖ Usually **heals** with conservative treatments and time.





## ❖ Pain

- ❖ Burning or shooting pain starting in the low back or buttock and radiating down the front or back of the thigh and leg and/or feet

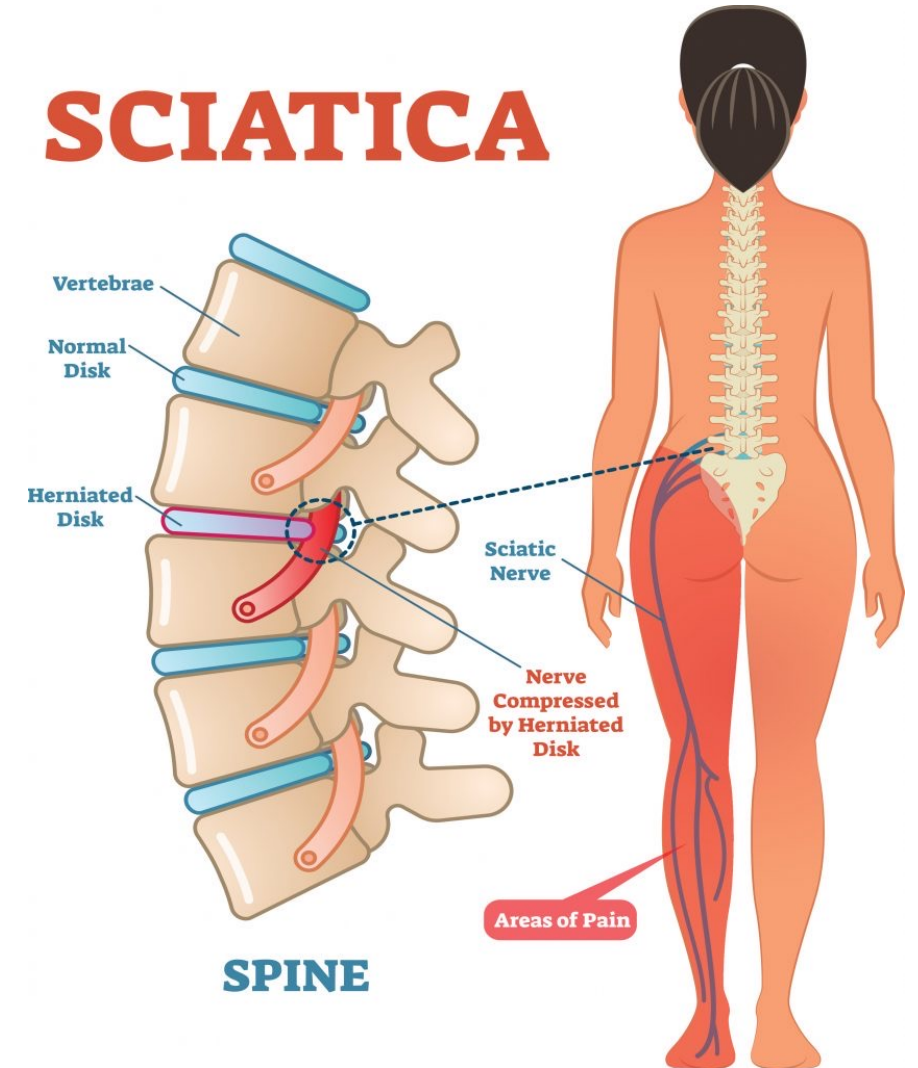
## ❖ Numbness

- ❖ Sometimes associated with tingling and/or weakness

## ❖ Unilateral symptoms

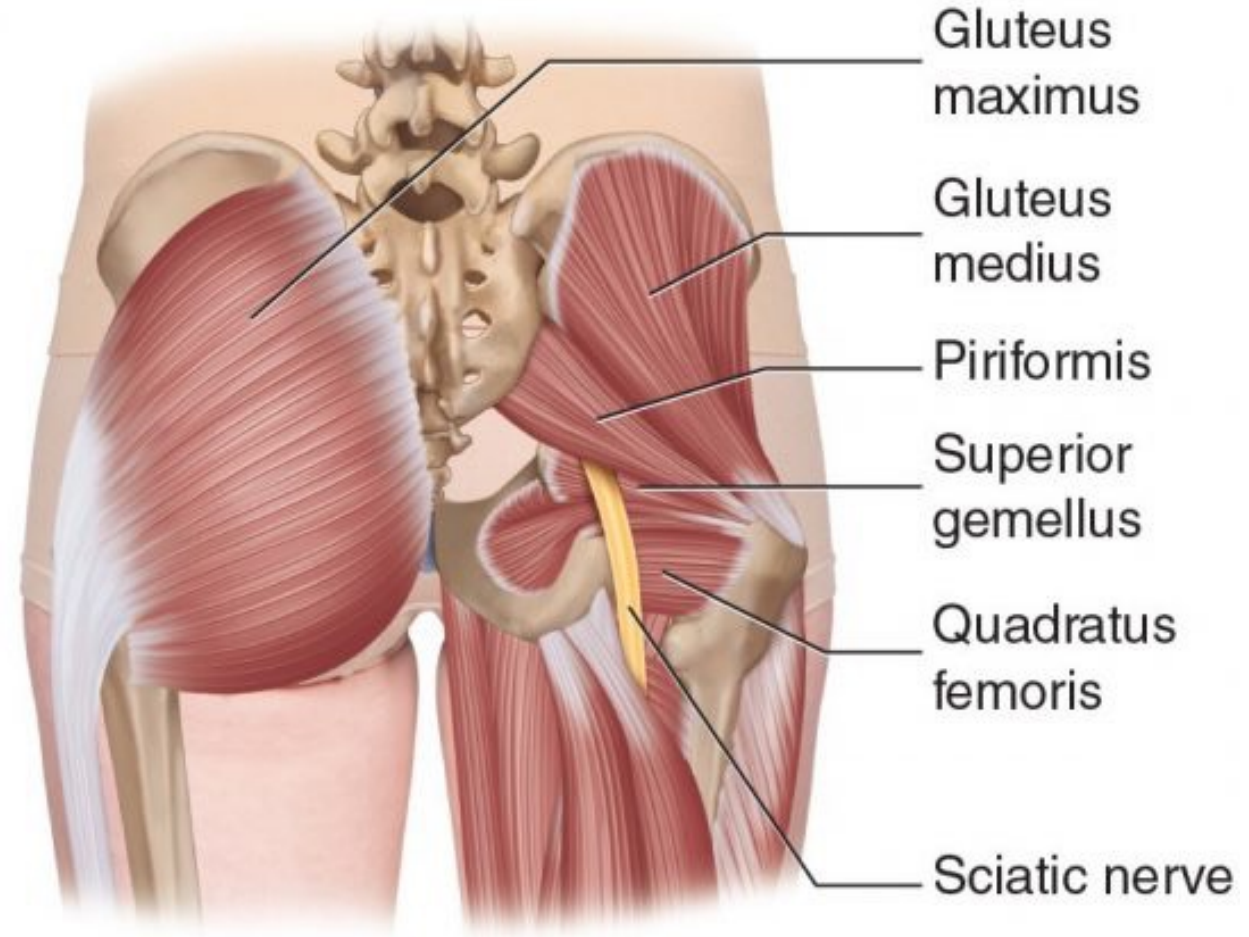
- ❖ Typically affects one leg
- ❖ Rarely, both legs may be affected

## SCIATICA



# Piriformis Syndrome

- ❖ Muscle that runs above the sciatic nerve
- ❖ When the muscle becomes tight: “sciatica” type pain down the leg
- ❖ Due to prolonged sitting, car accidents, falls



- ❖ Normal progression of aging
- ❖ Most people do **not** develop symptoms.
- ❖ Most people do **not** require surgery.
- ❖ Physical exam is often **normal**.
- ❖ Weakness and numbness are **not** typical.



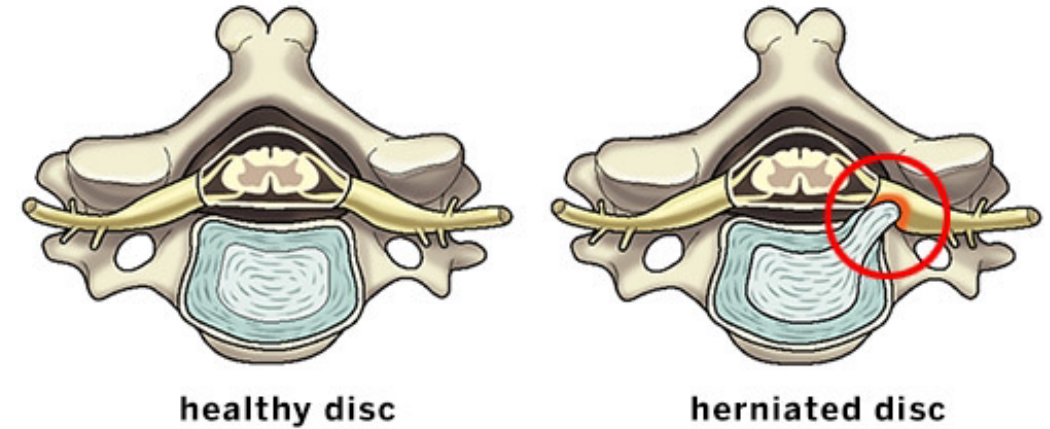


# Spinal Stenosis: Classic Presentation



# Disc Herniation

- ❖ Disc degenerates due to loss of elasticity and/or injury over time
- ❖ The disc can bulge/herniate into the spinal canal and compress the spinal nerve roots
- ❖ Severe compression may lead to permanent nerve damage

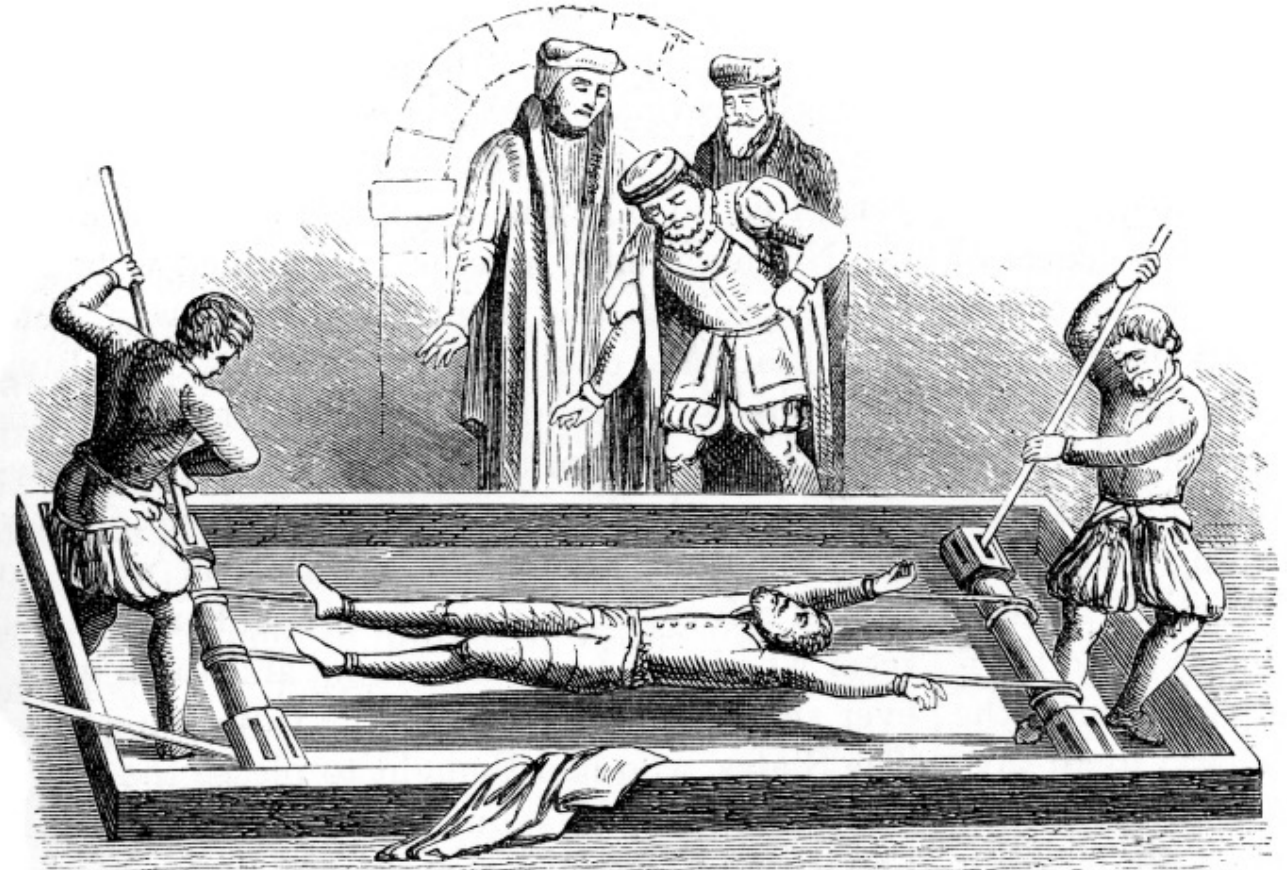


## ❖ Non-Operative Treatments

- ❖ Medications
- ❖ Physical therapy (PT)
- ❖ Injections

## ❖ Operative Treatments

- ❖ “Open” traditional surgery
- ❖ Minimally invasive surgery (MIS)

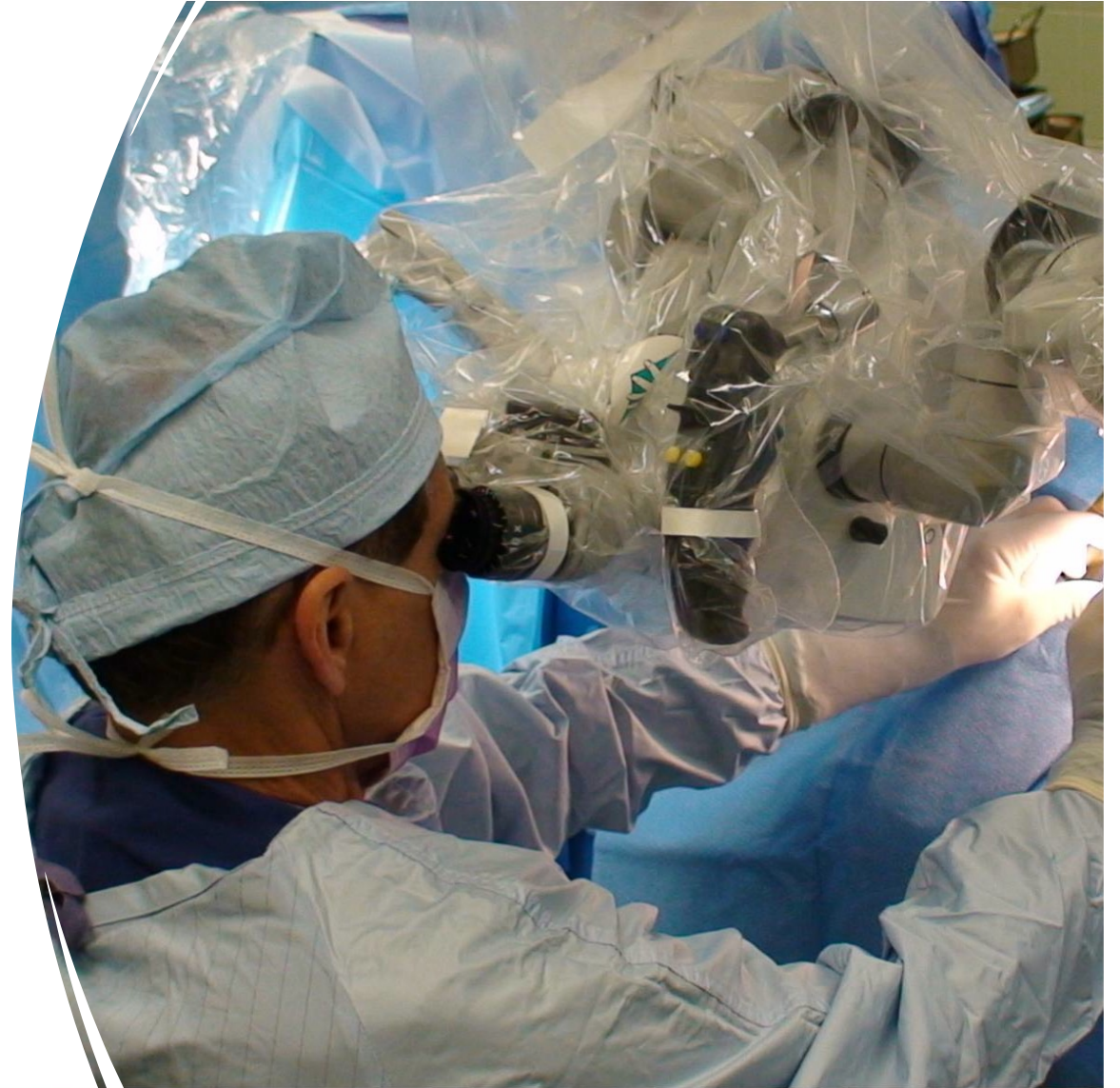


THE RACK.—Fox's Acts and Monuments.



# Why MI Spine Surgery?

- ❖ Smaller incisions
- ❖ Minimize scarring
- ❖ Less blood loss during surgery
- ❖ Shorter hospital stay
- ❖ Less postoperative pain
- ❖ Less need for narcotics
- ❖ Faster return to work and daily activities





# Remote Past: CUT and SEE







**Recent Past: SEE then CUT**



Present





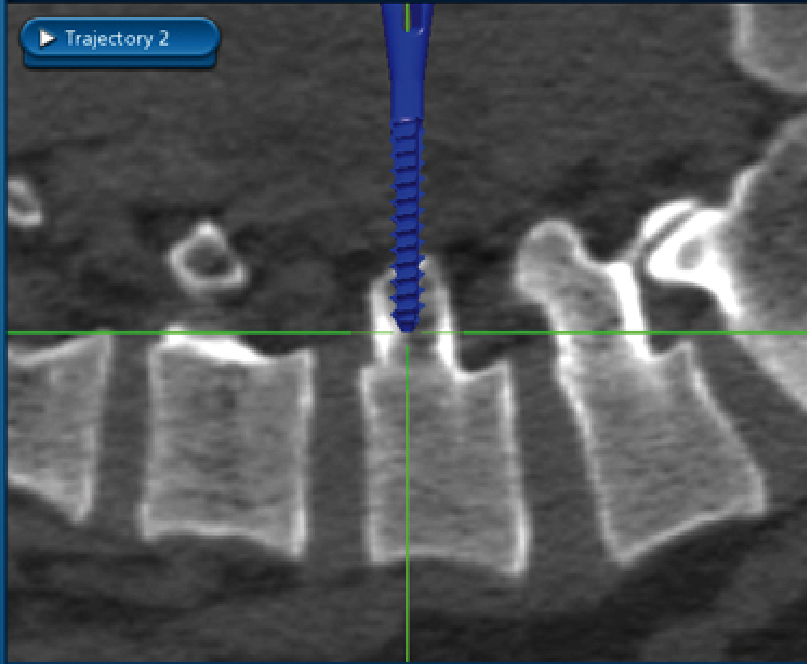
Register

Navigate

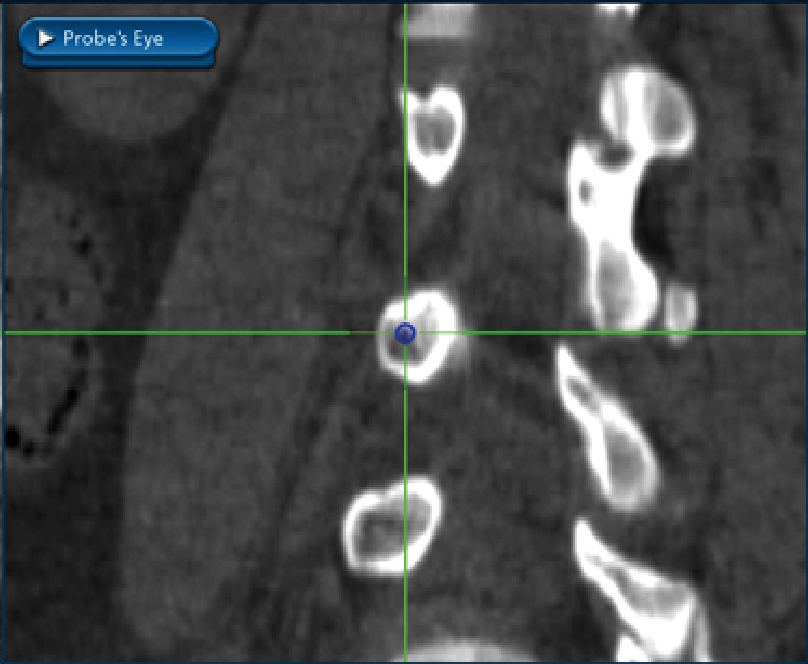
Archive



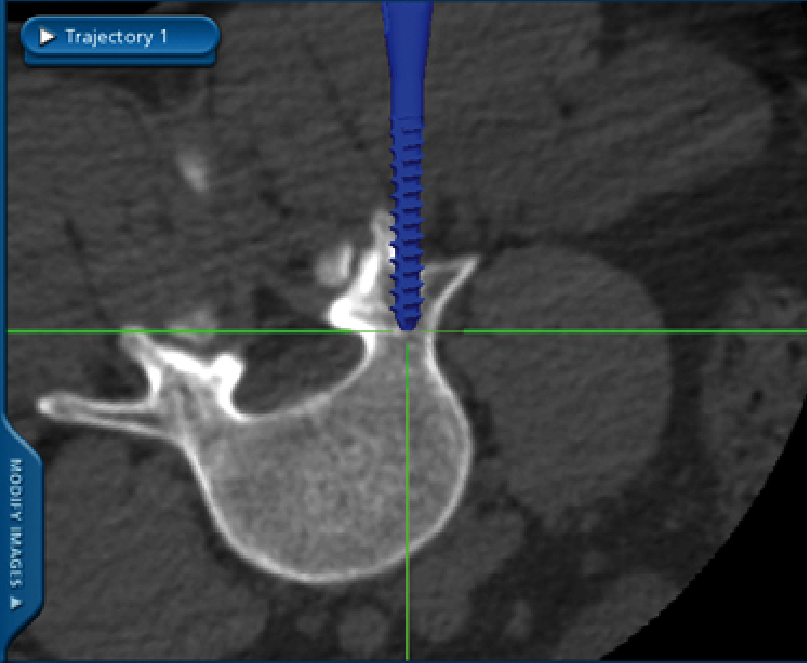
▶ Trajectory 2



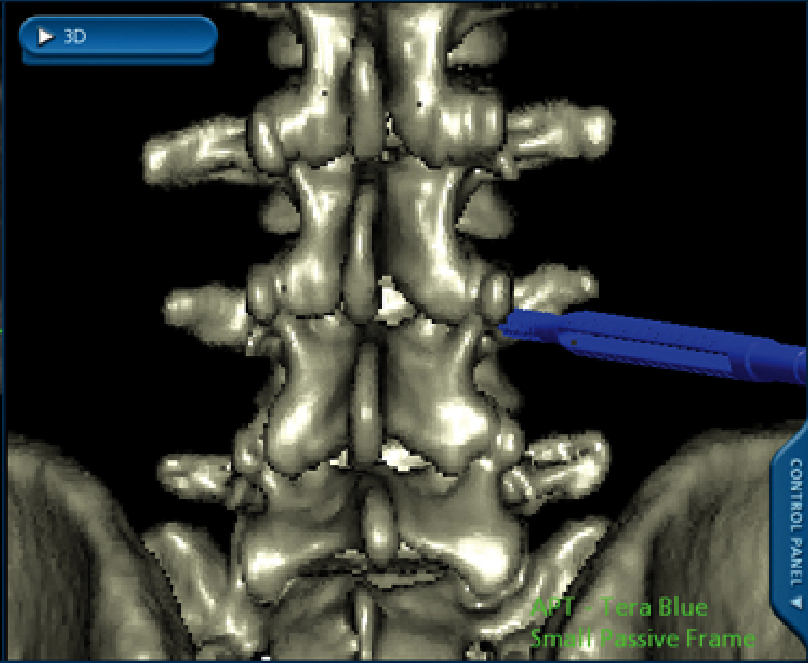
▶ Probe's Eye



▶ Trajectory 1



▶ 3D



SPT - Tera Blue  
Smart Passive Frame



Project Length



Select Tip



Cycle Views



Select Plan

Medtronic



Camera



Help



Admin

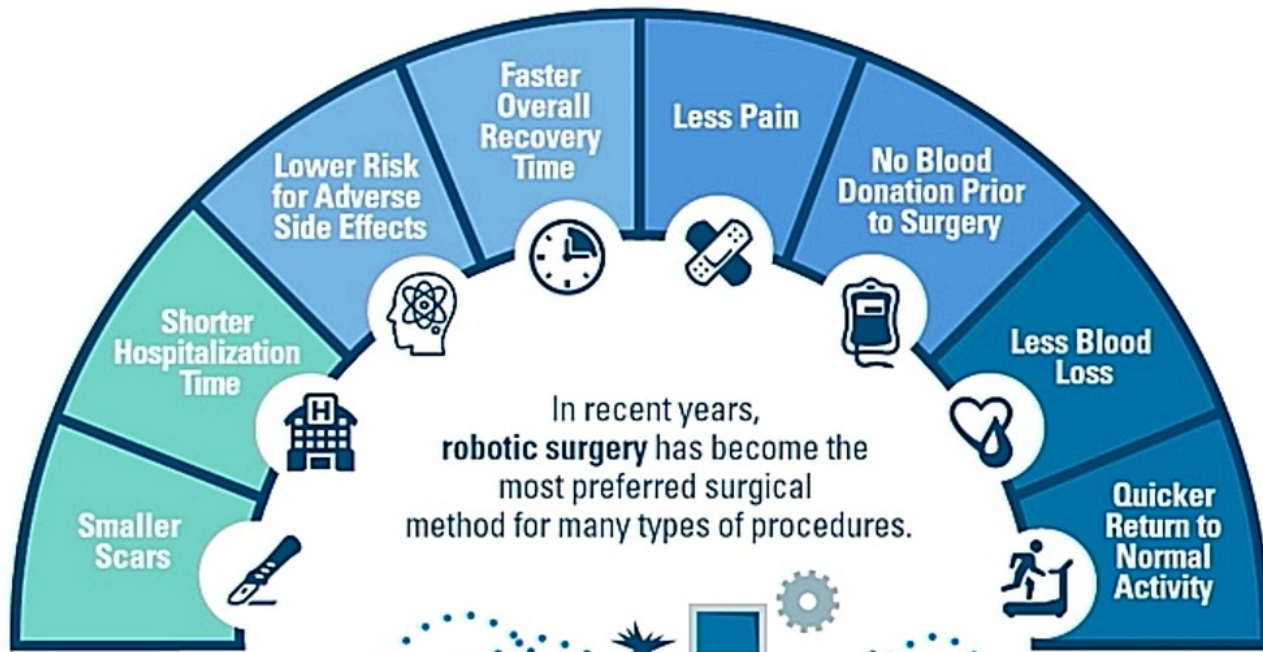


Exit

MODIFY IMAGES ▲

CONTROL PANEL ▼





Why Robotic Surgery?





# What Can Robots Do?



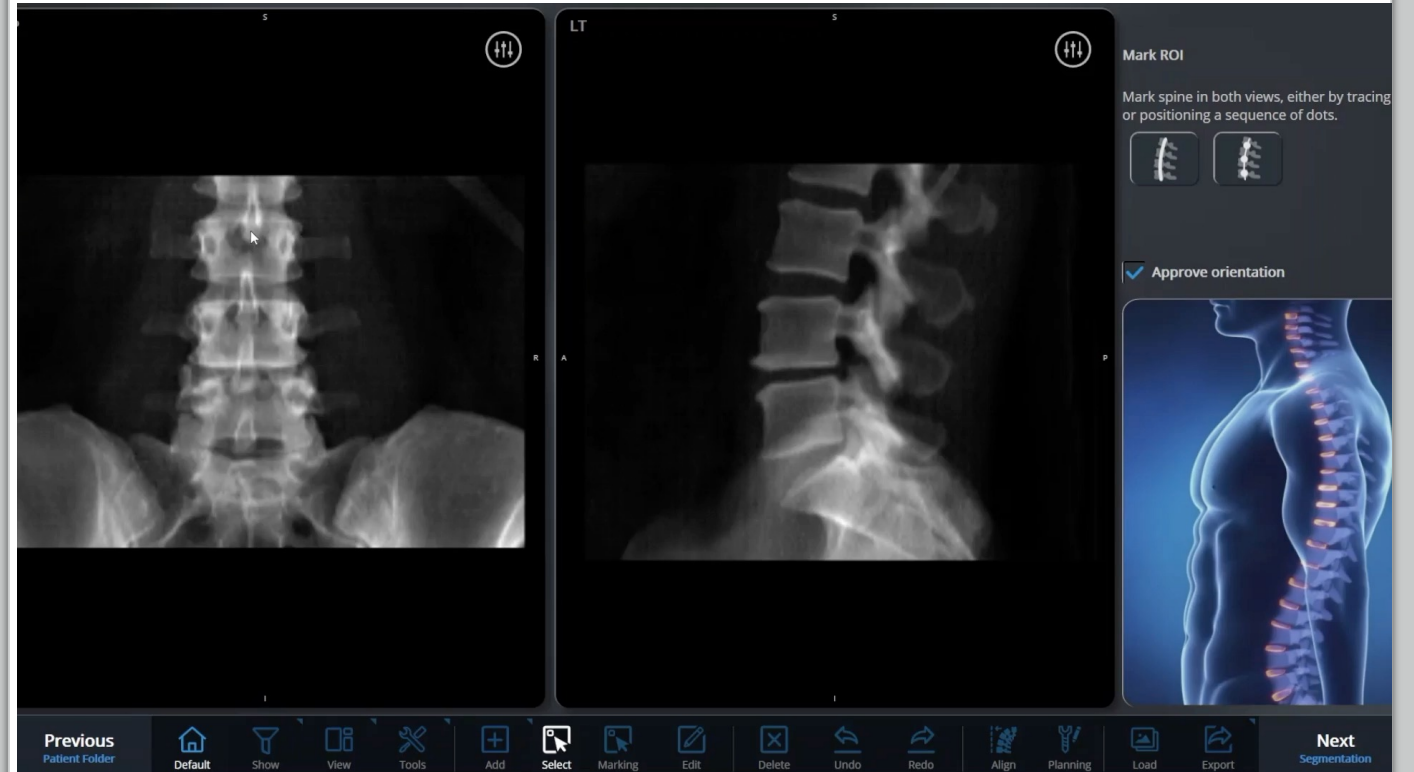
# Mazor X

- Medtronic, FDA clearance in 2018



# Robotic Spine Surgery

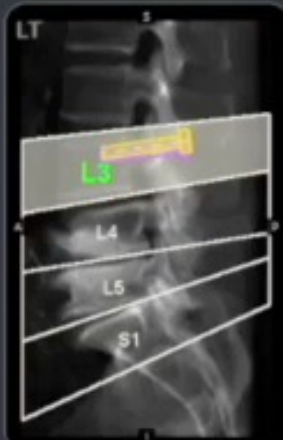
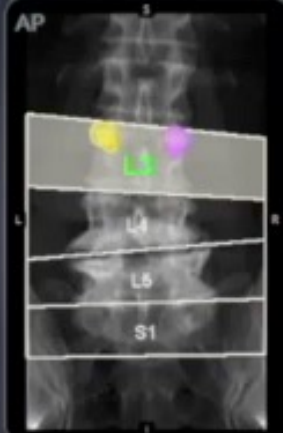
- ❖ Customized preoperative planning for each patient
- ❖ Reduces need for intraoperative x-rays – reduction in radiation exposure
- ❖ Safety: Eliminates the error of the human hand
- ❖ 10% misplaced screws
- ❖ 0.8-2% permanent nerve damage
- ❖ Operative time reduction
- ❖ Reduction in potential complications
- ❖ Facilitates MIS



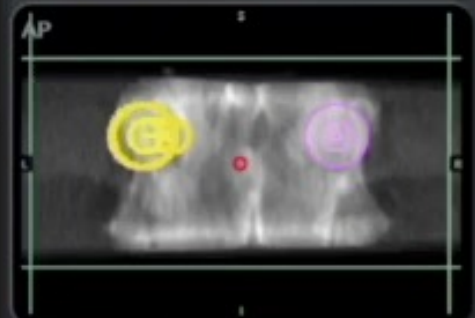
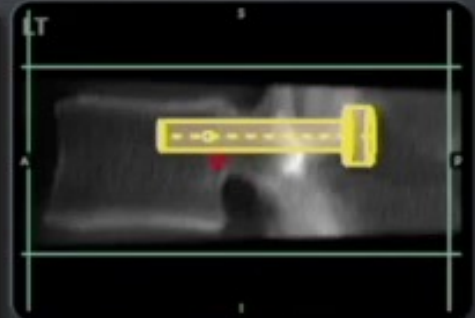
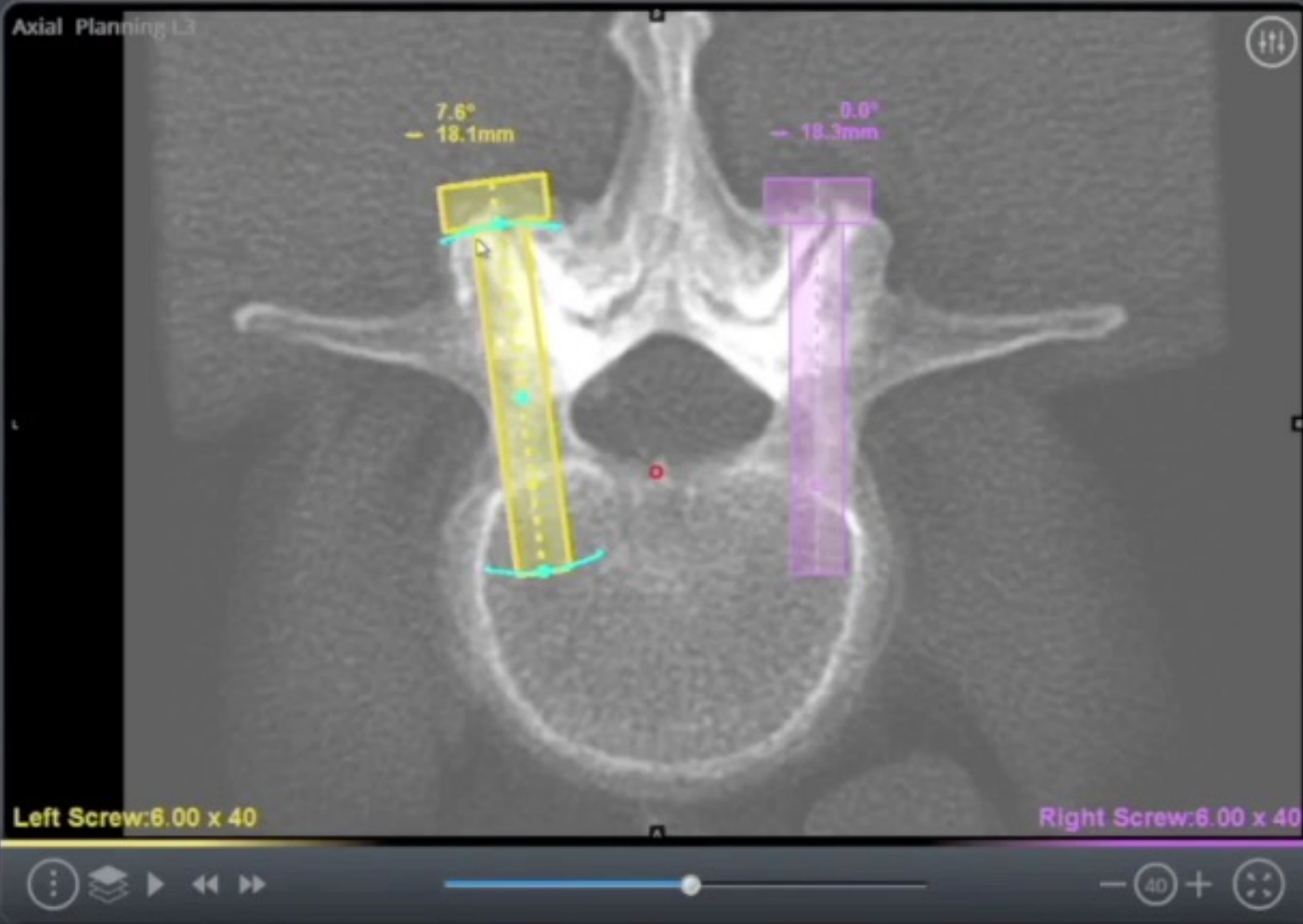


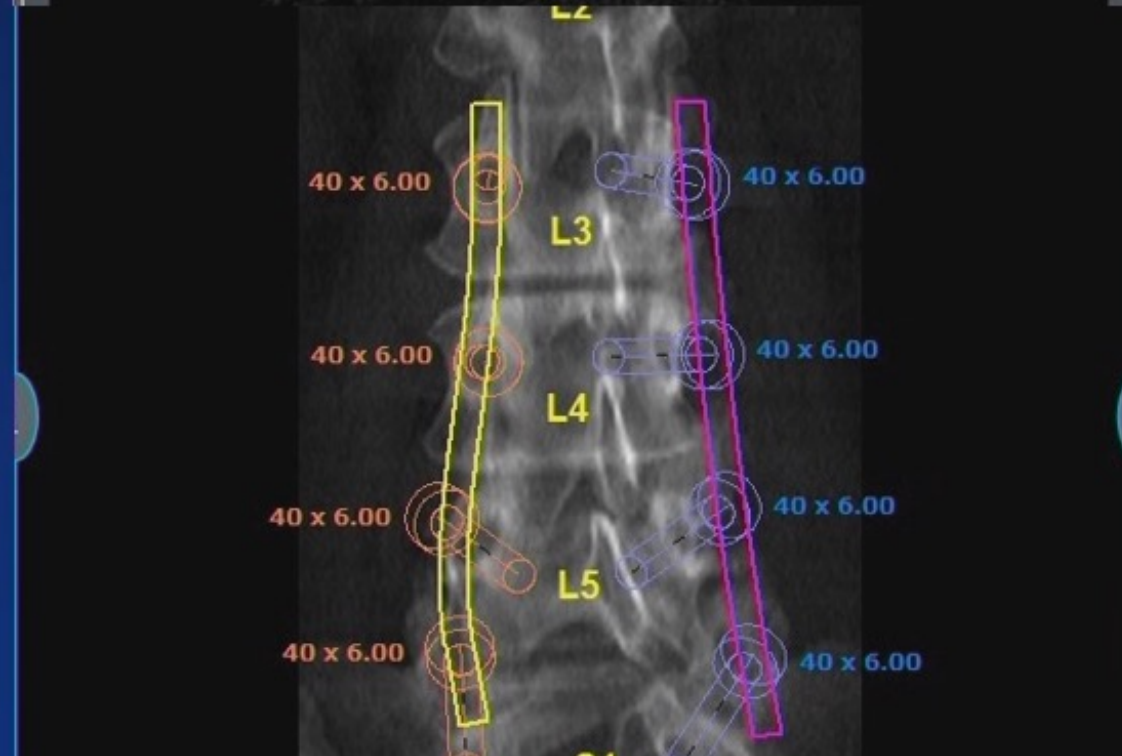
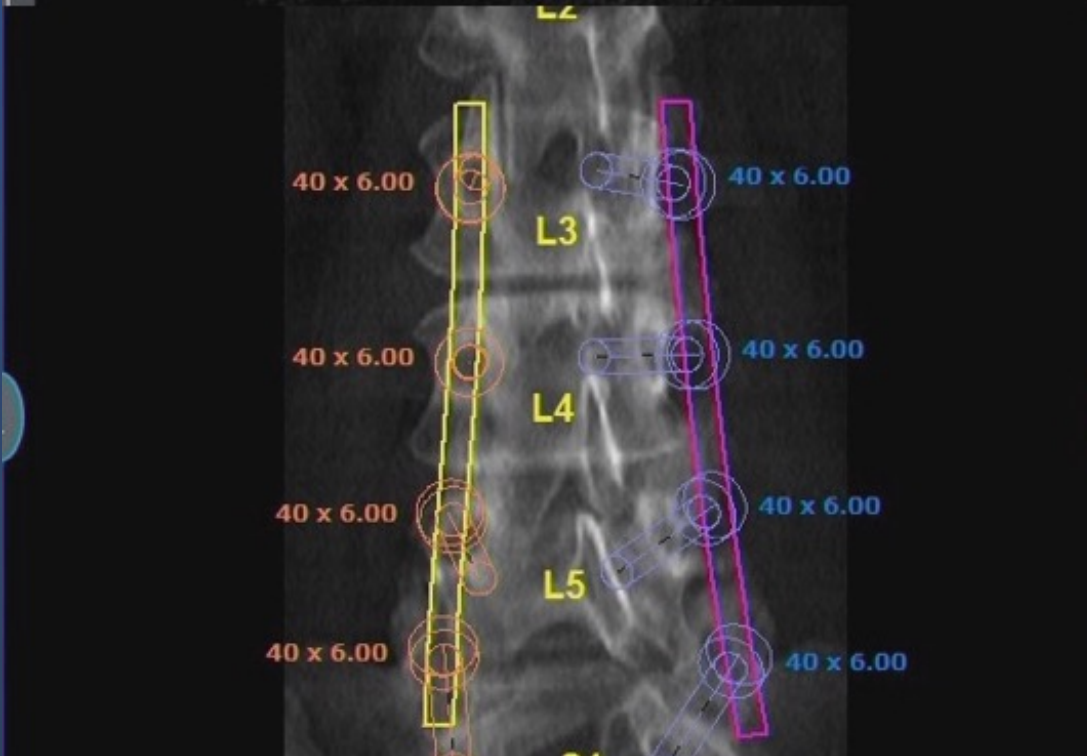
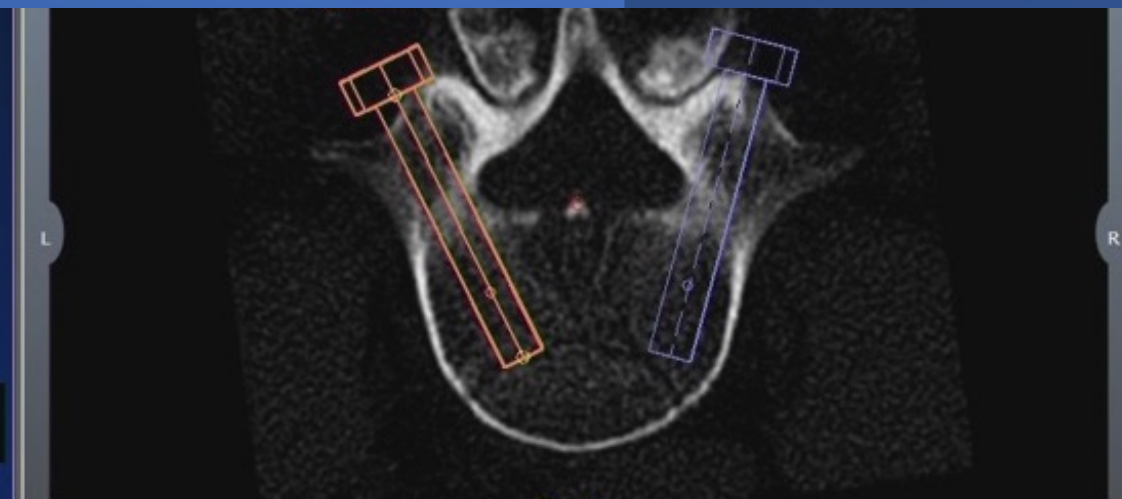
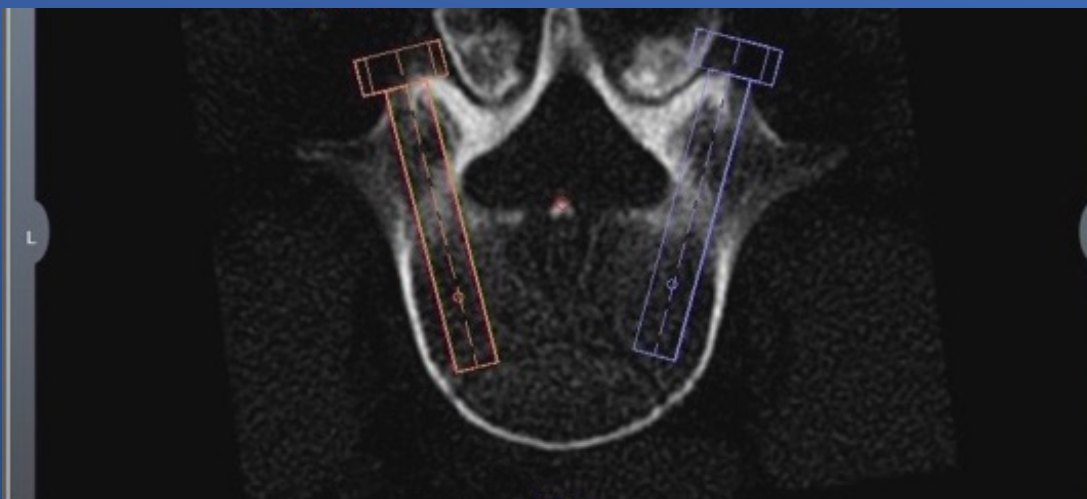
Planning L3

Select Vertebra

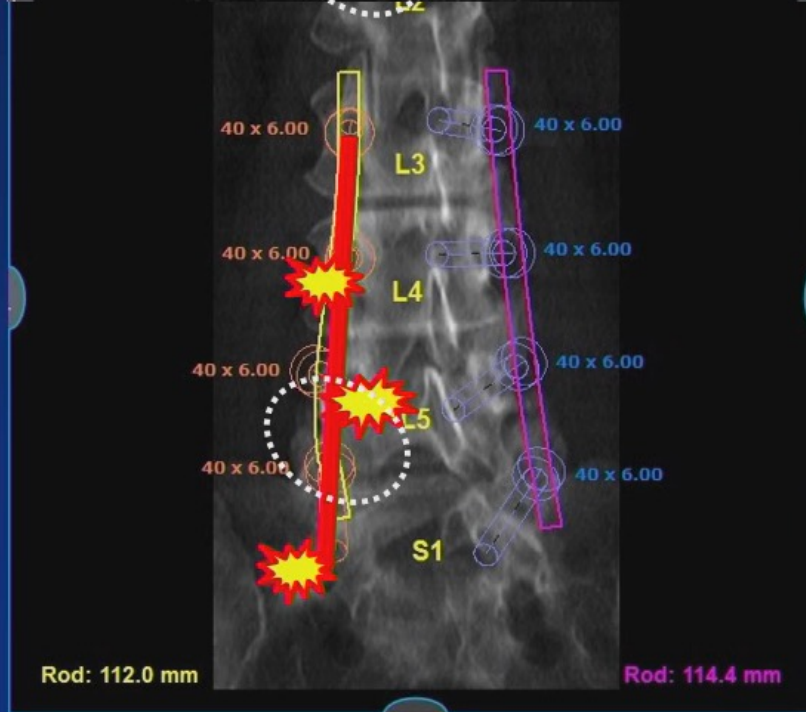
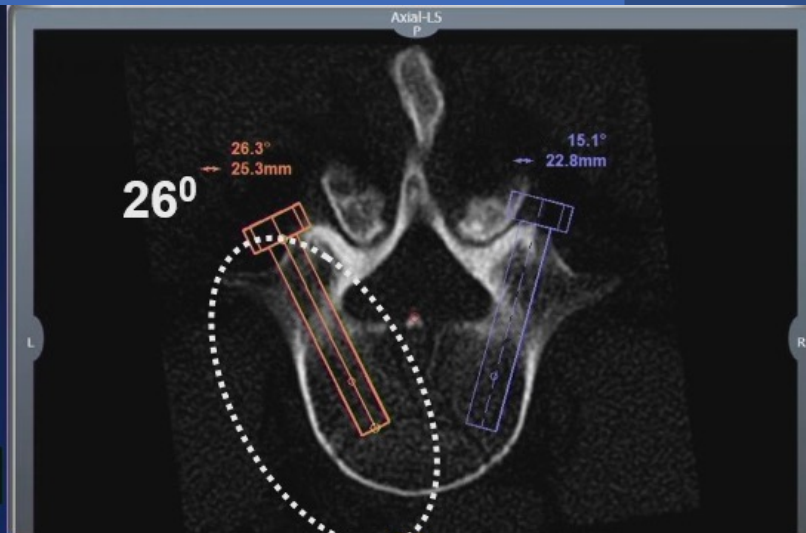
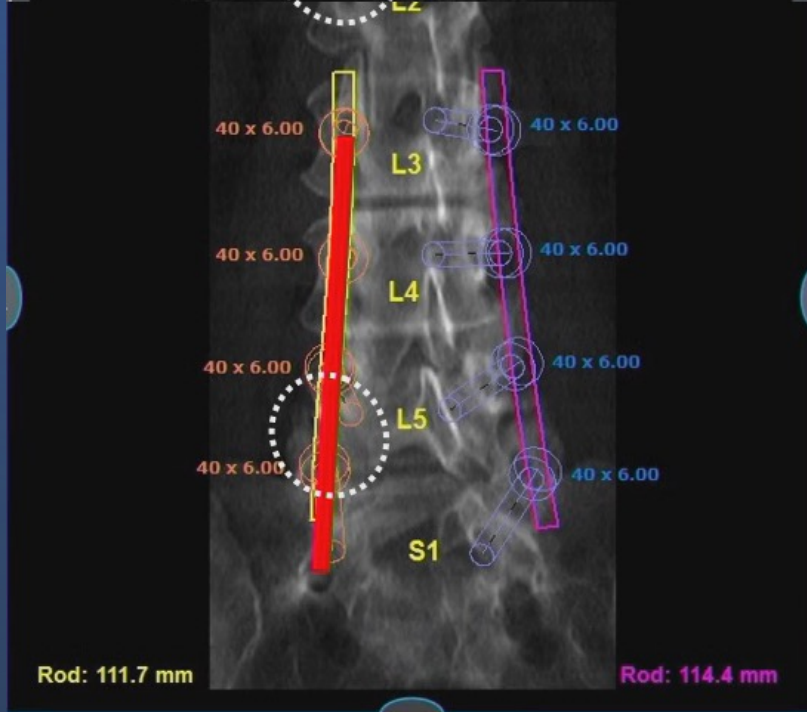
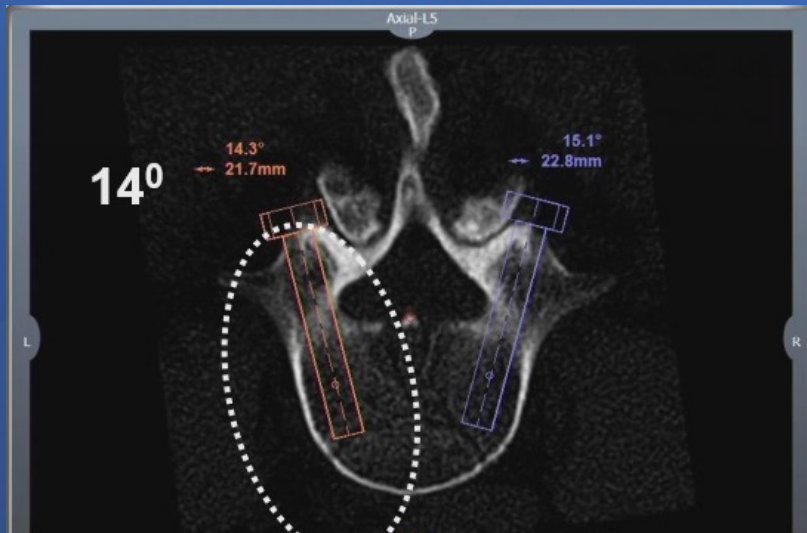


Axial Planning L3



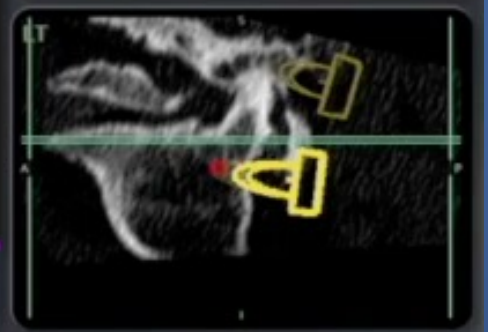
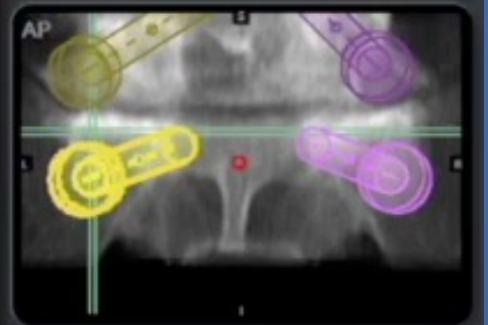
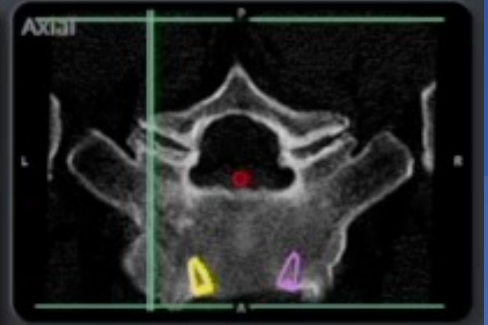
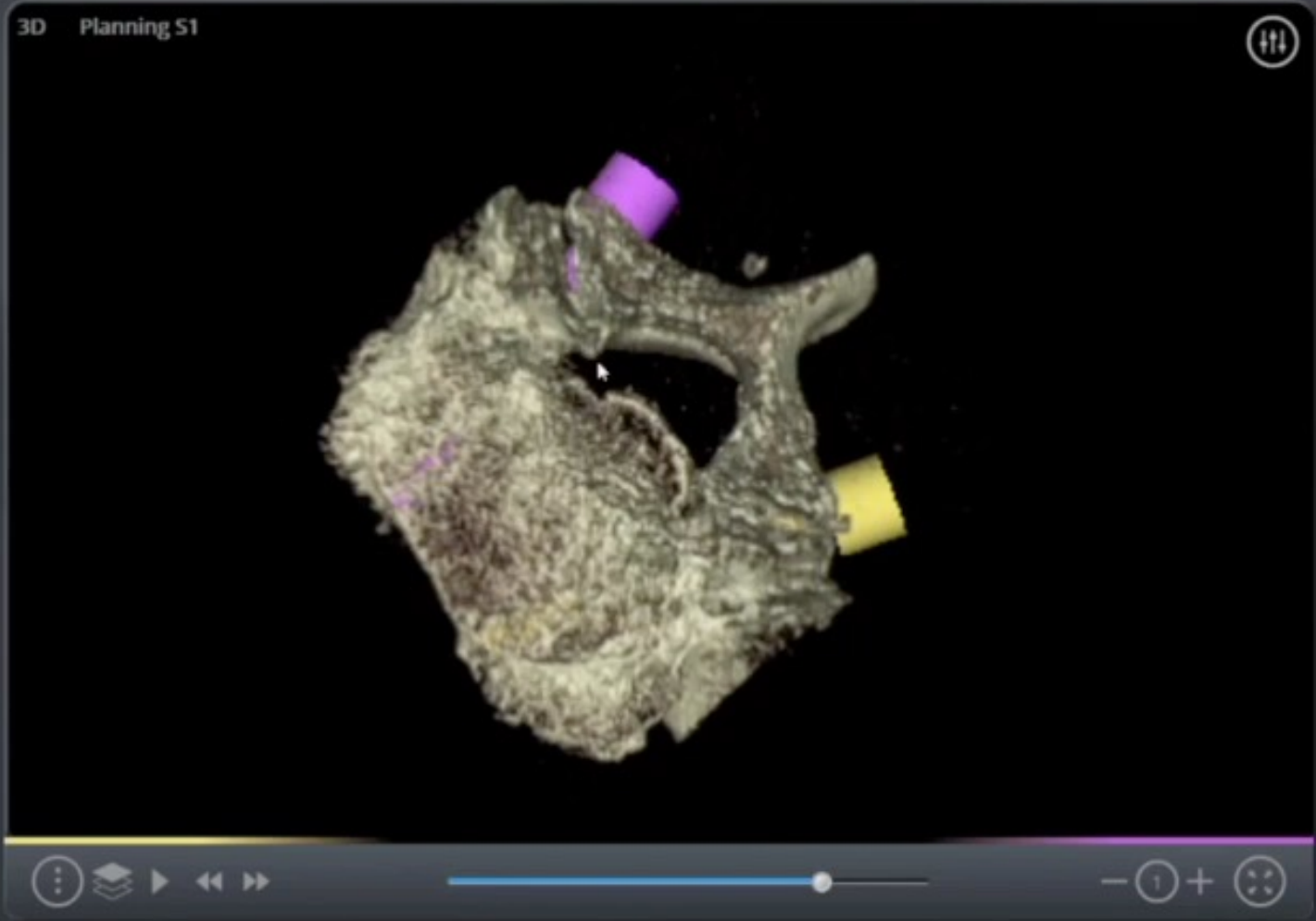
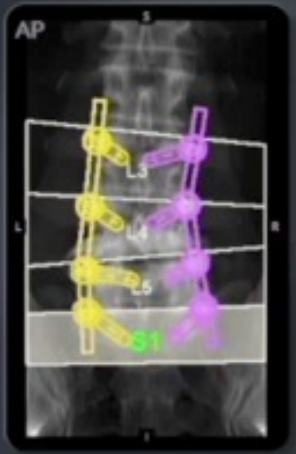






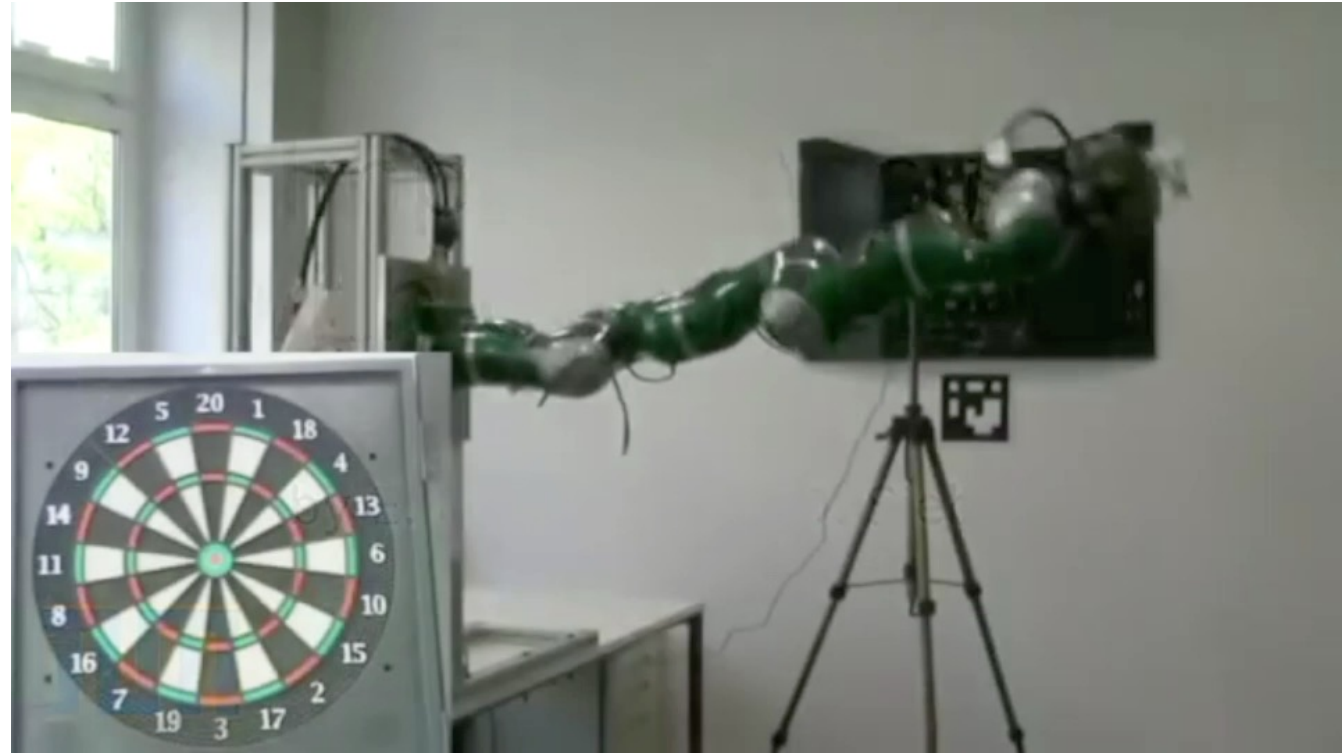
Planning S1

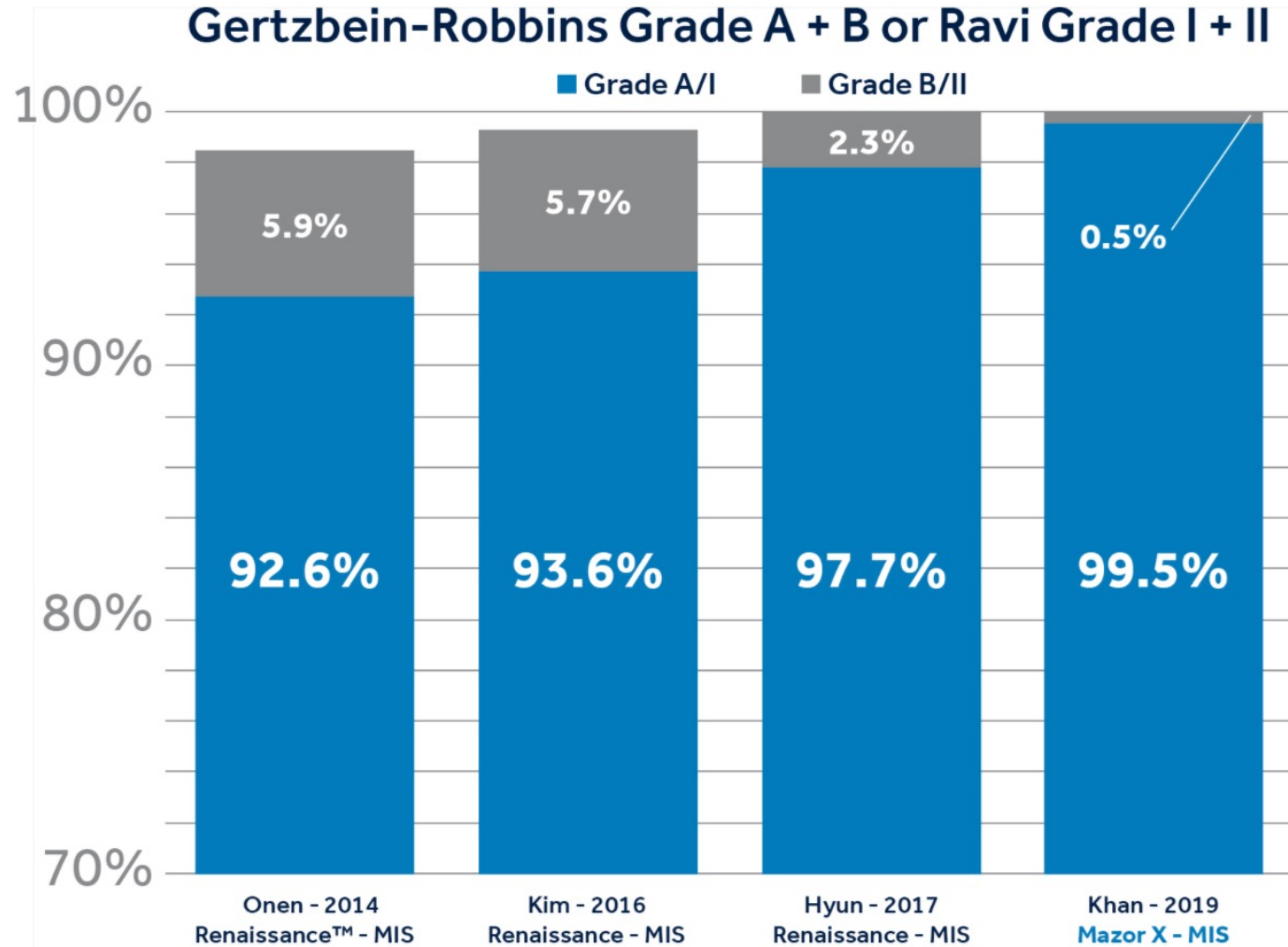
Select Vertebra





# Accuracy





Up to  
**100%**  
Screw  
Placement  
Accuracy<sup>1-4</sup>

[SEE CLINICAL EVIDENCE](#) 



# CAUTION



**Robotic Assistance  
will not make a  
Bad Surgeon good,,,**

**It will make a  
Good Surgeon Better!**