AI in Hip Replacement Surgery

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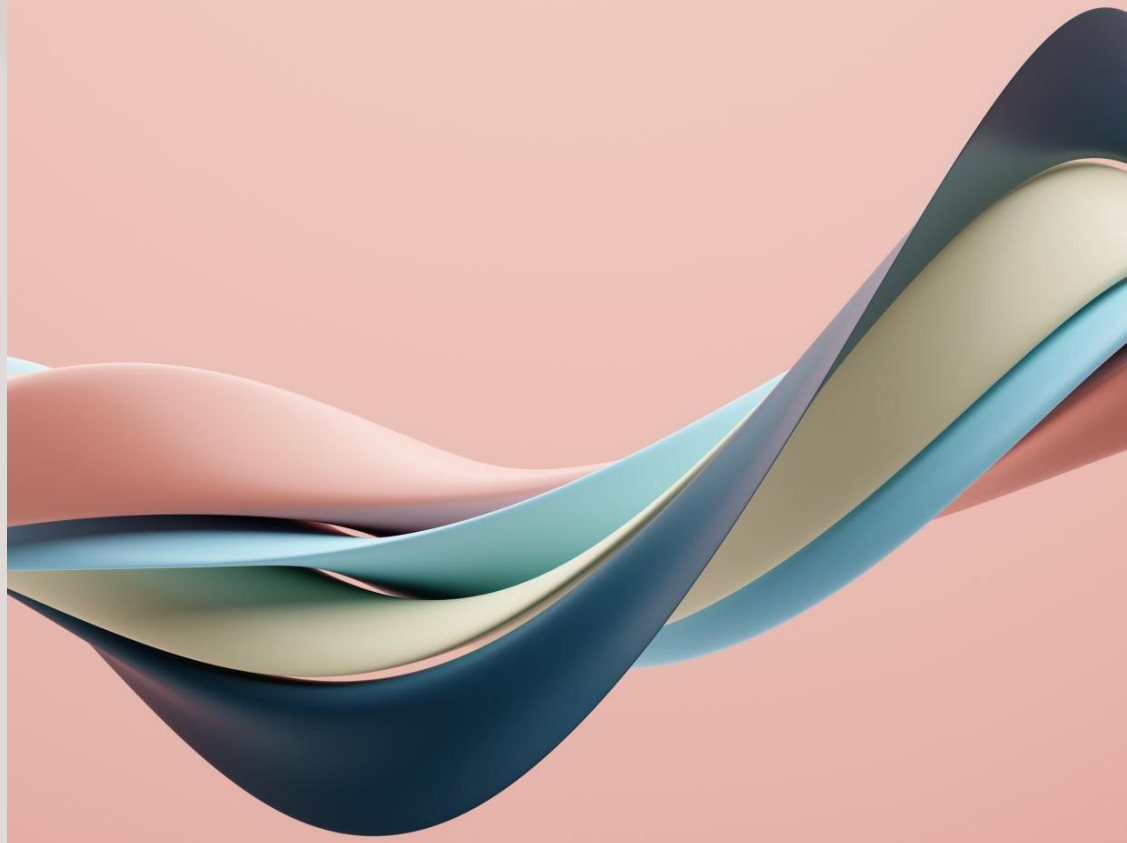
Chippewa Valley Orthopedics

Oakleaf Surgical Hospital

AI in Hip Replacement Surgery

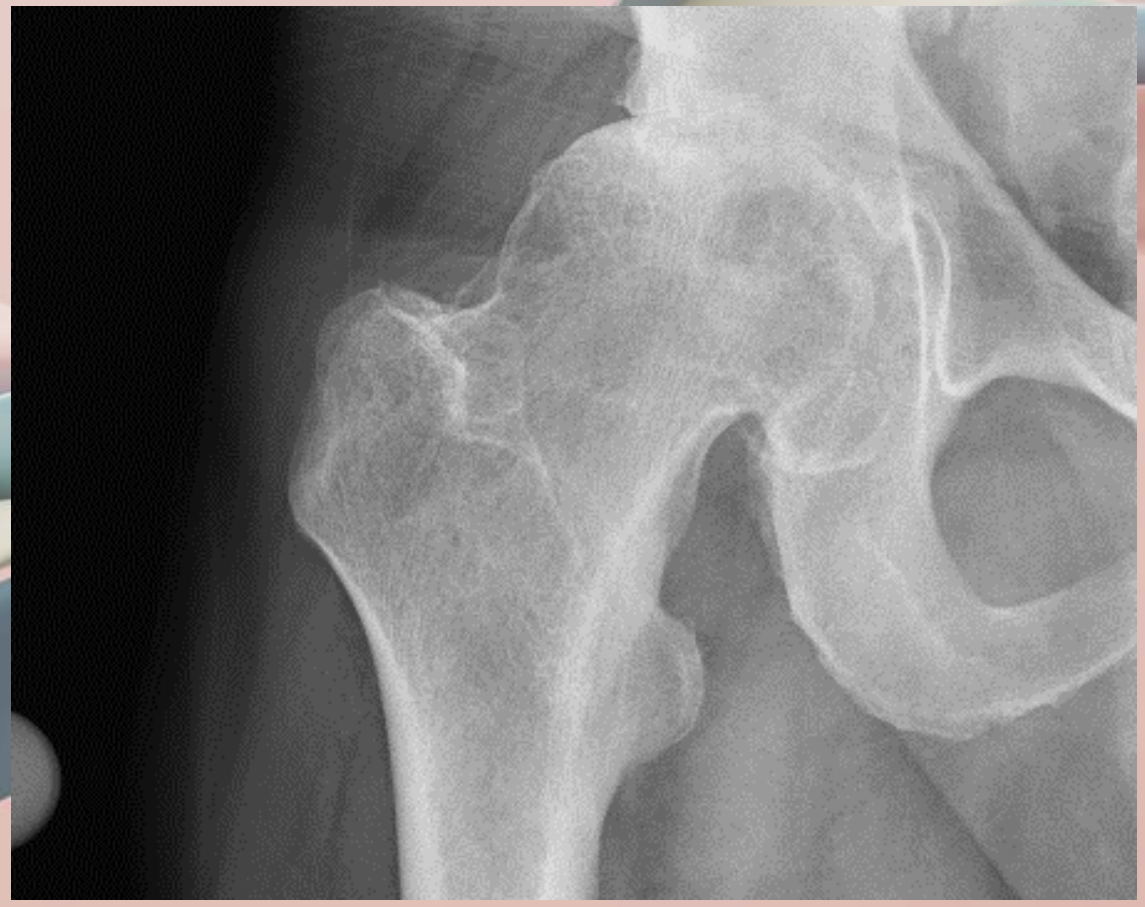
Goals of the presentation

- Describe Hip Replacement surgery in simple terms
- Define the important measures of implant placement
- Historic methods of implant placement
- Fluoroscopic Assistance
- Robotic Assistance
- Fluoroscopic Assistance with AI



AI in Hip Replacement Surgery

- Hip Replacement Surgery
  - What is a Total Hip?
  - Acetabular Component
  - Femoral Component
  - Bearing surfaces



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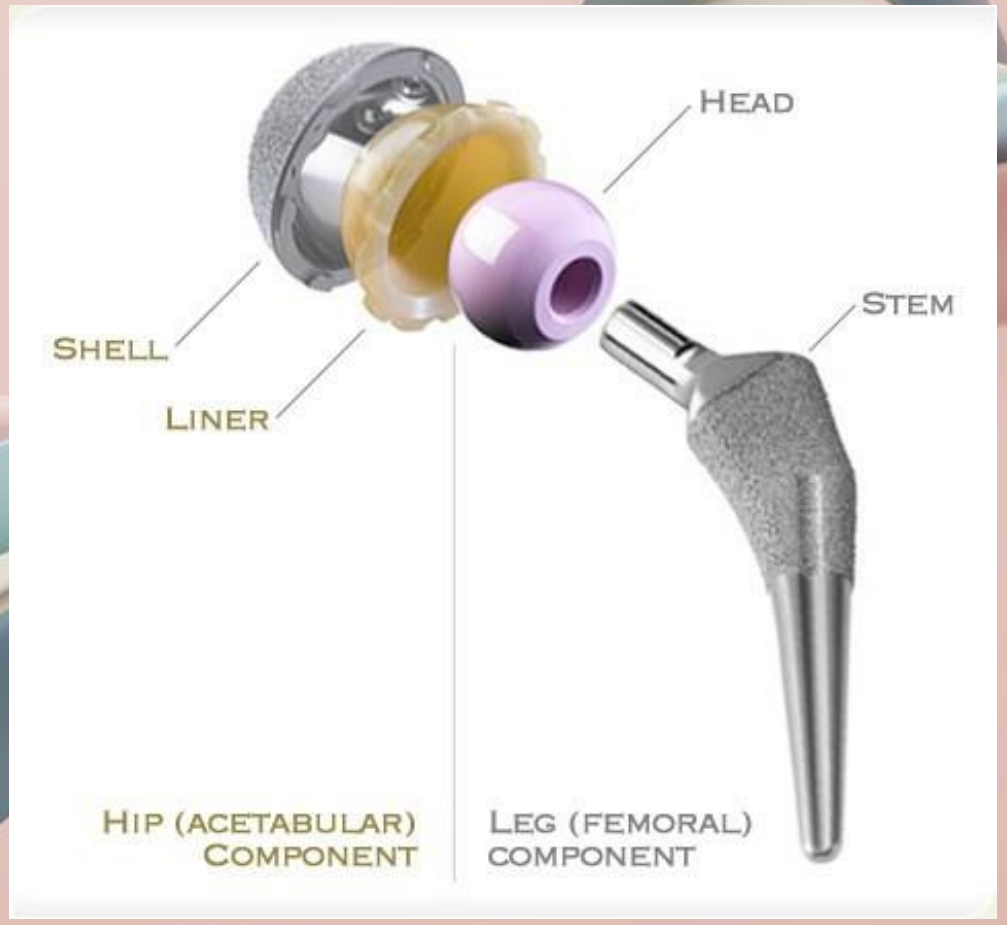

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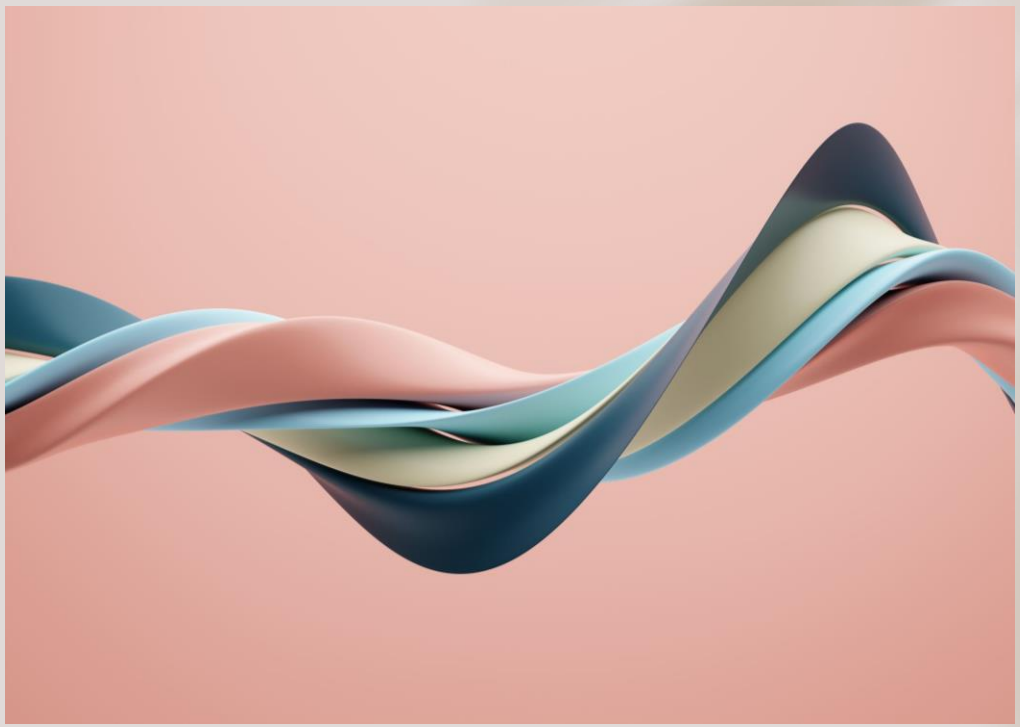
- Component Placement
  - Where exactly do the components go?
  - How do we describe the position of the components?
  - Why do we care about the position of the components?



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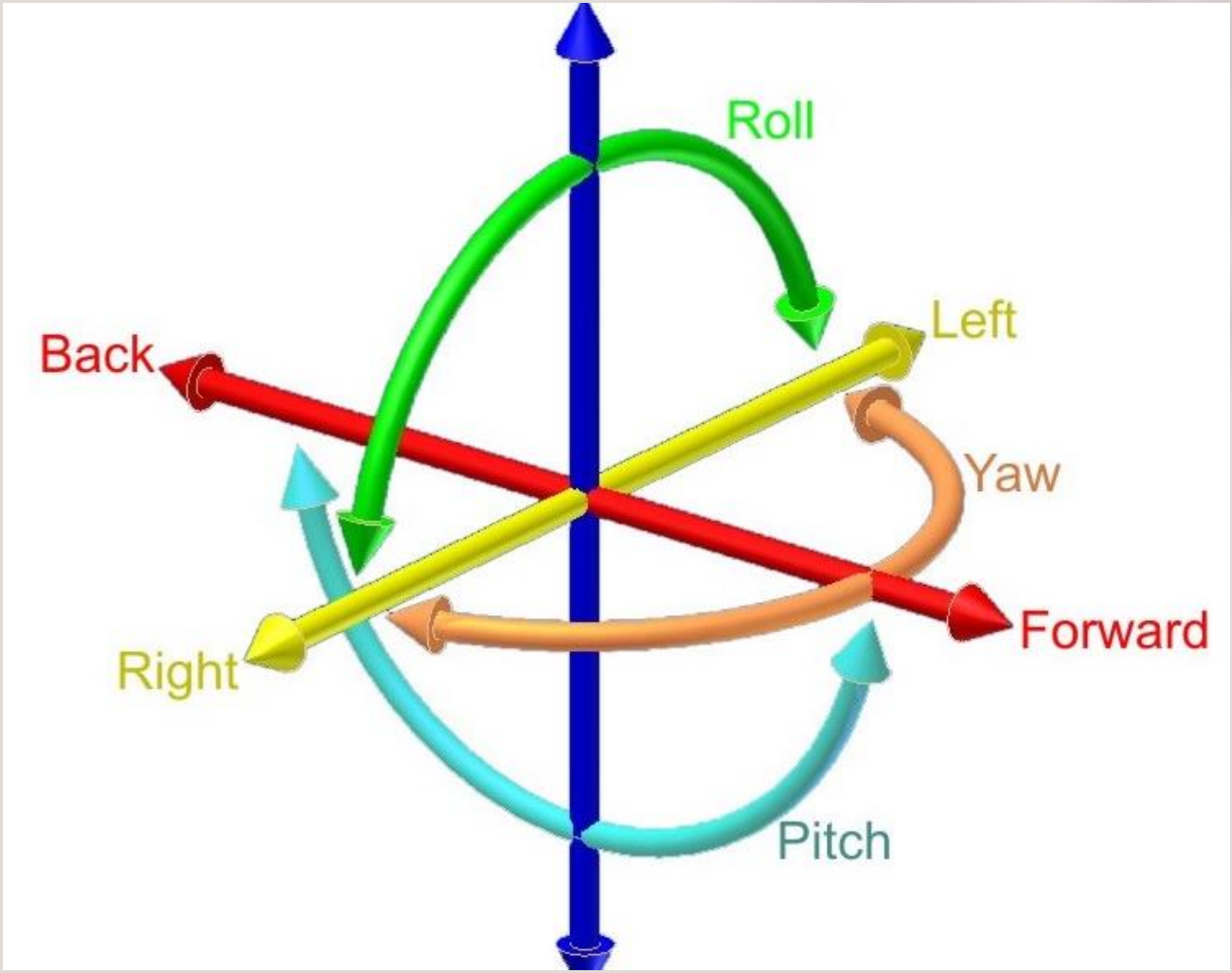
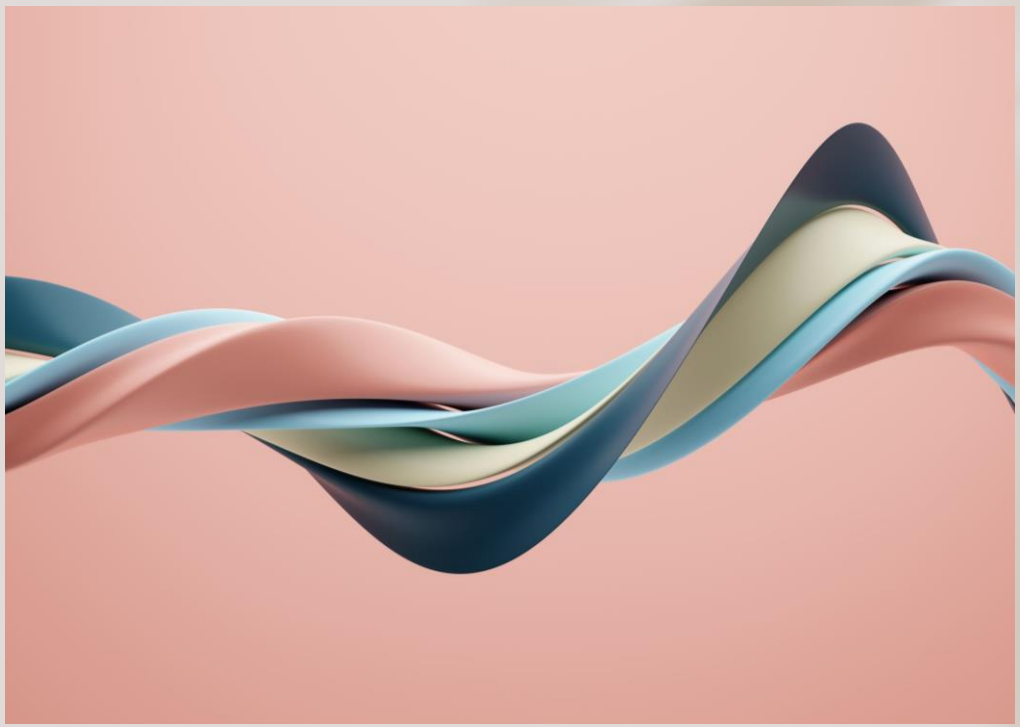
- Any object has six determinants of its position



AI in Hip Replacement Surgery

- Components must be firmly set with in the bone. They must be attached by pressing into place or cementing into place. With either technique, they need to be placed well with in the bone.
- This more or less sets four of the six component position determinants.
- Leaving two determinants per component that the surgeon can vary



AI in Hip Replacement Surgery

The Acetabular component

Inclination

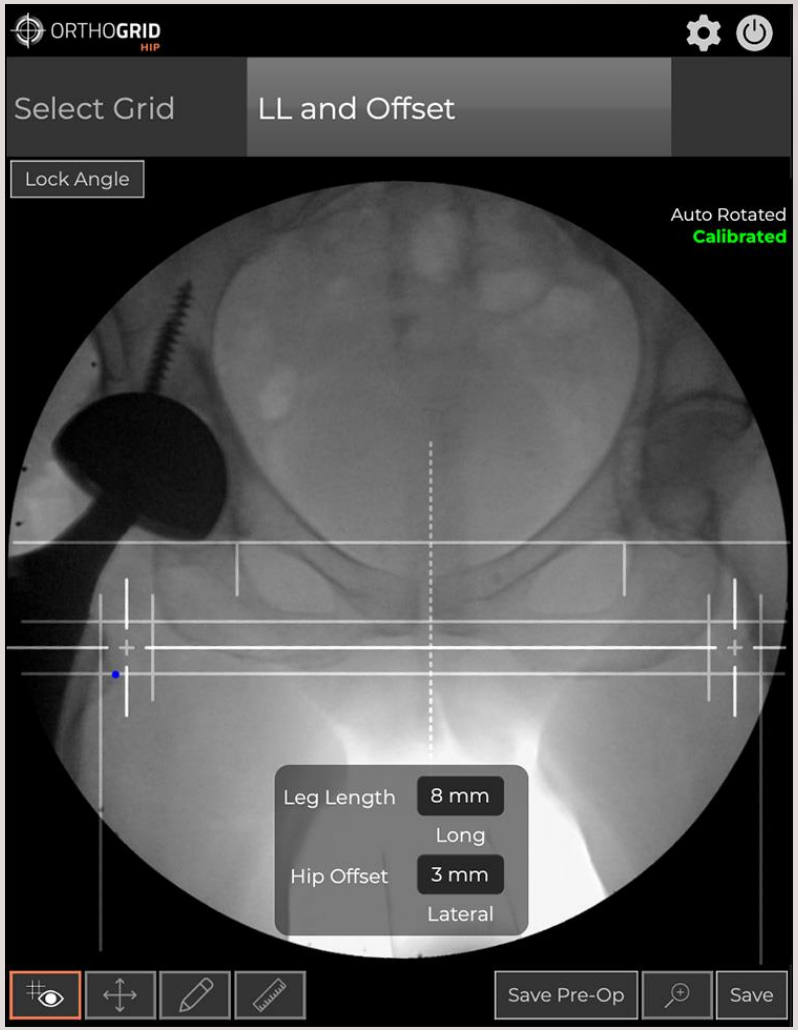
Anteversion

AI in Hip Replacement Surgery

- Femoral component

  Leg length

  Leg offset



AI in Hip Replacement Surgery

- Why does component position matter?
- Dislocation
- Wear
- Strength and balance

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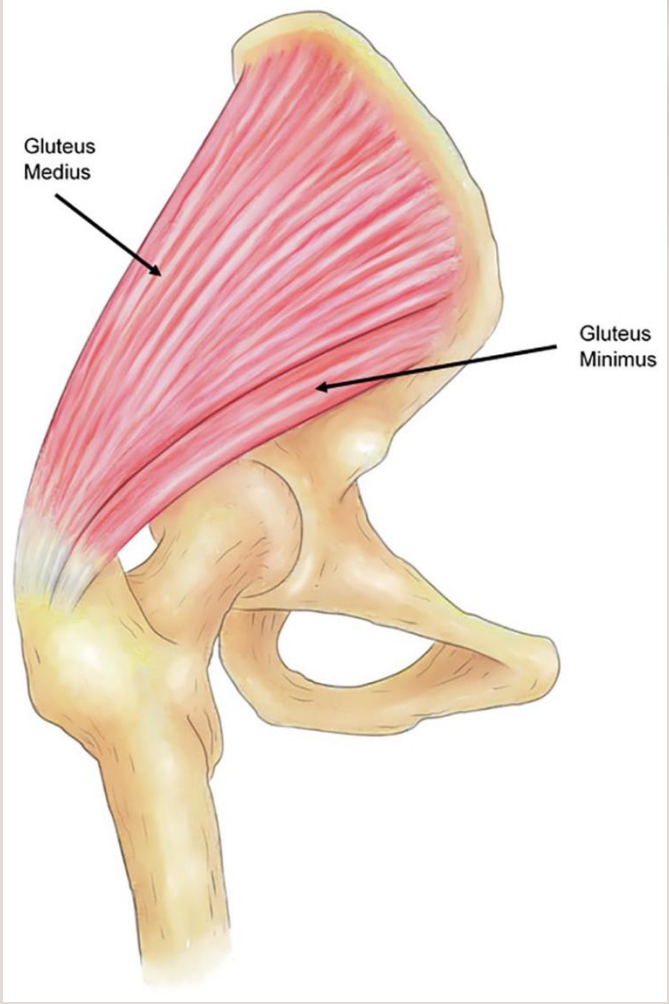

AI in Hip Replacement Surgery

- Traditional methods
- Acetabulum
  - Patient positioning
  - Instruments to reference the floor, long axis of the patient

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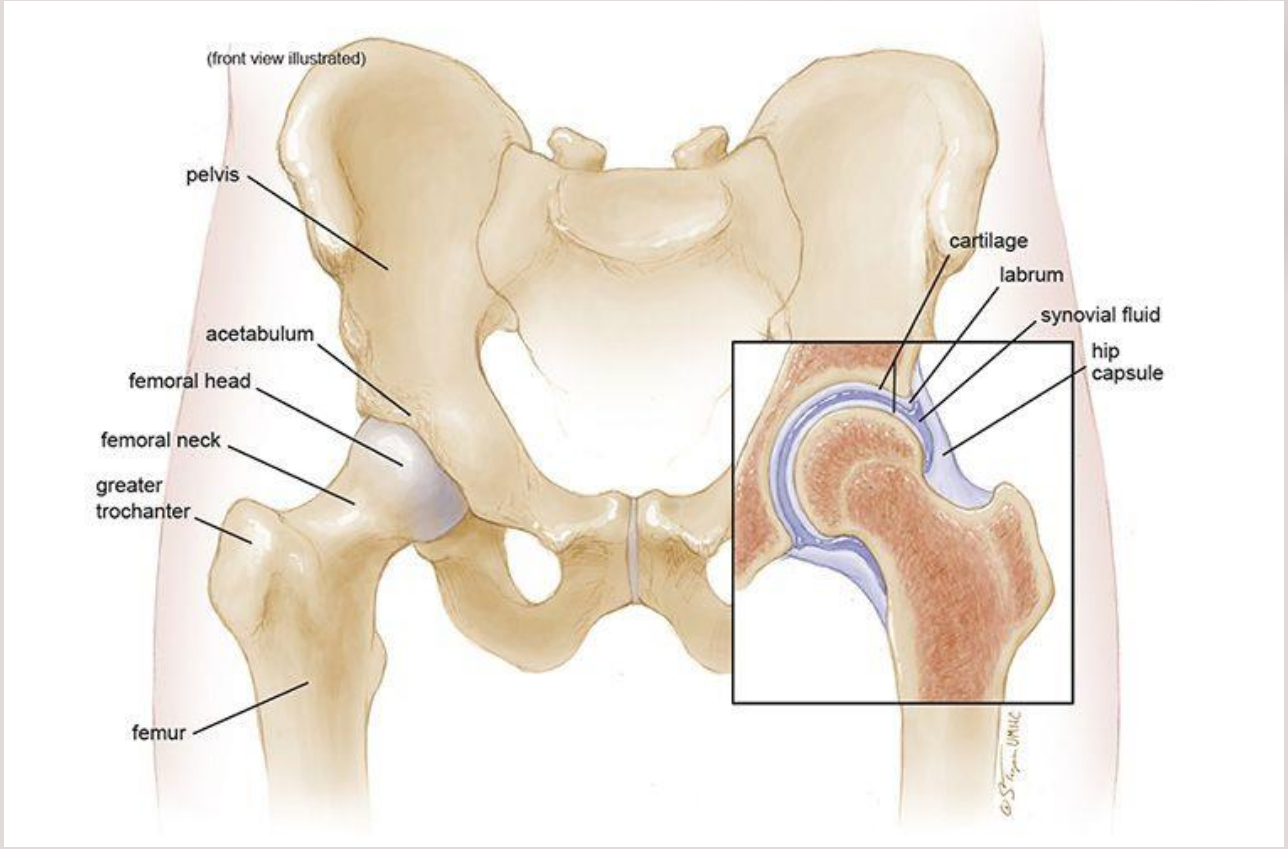
AI in Hip Replacement Surgery

- Traditional methods
- Acetabulum
  - Anatomic references
  - The intra-operative landmarks
  - Limitations with abnormal anatomy



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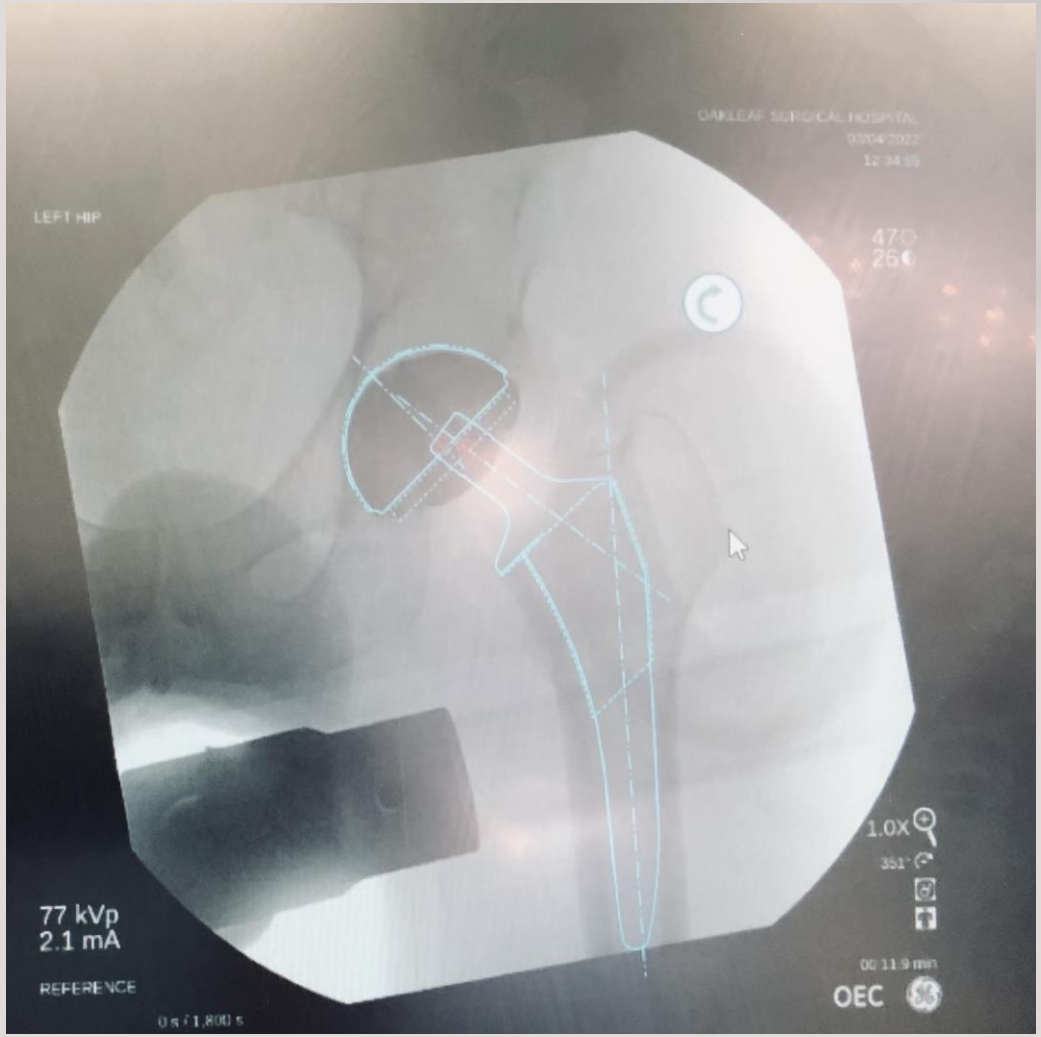
- Femoral Component positioning
  - Templating
  - Depth of insertion
  - Choice of implant shape
  - Choice of length of modular head



AI in Hip Replacement Surgery

- Femoral Component positioning
  - Templating
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  - Choice of implant shape (high or low offset)
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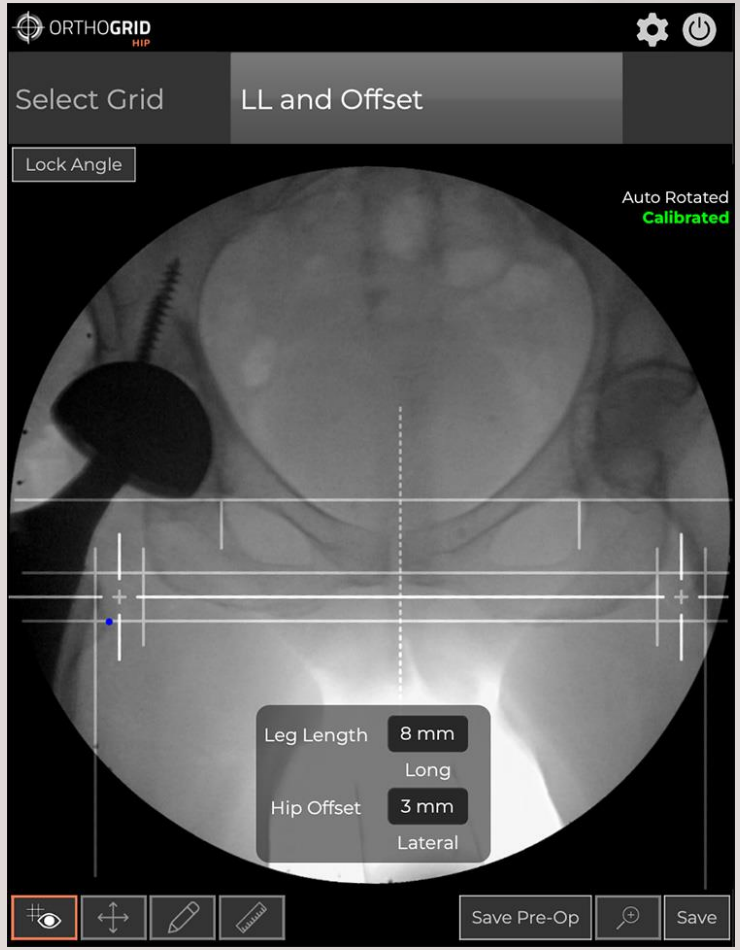

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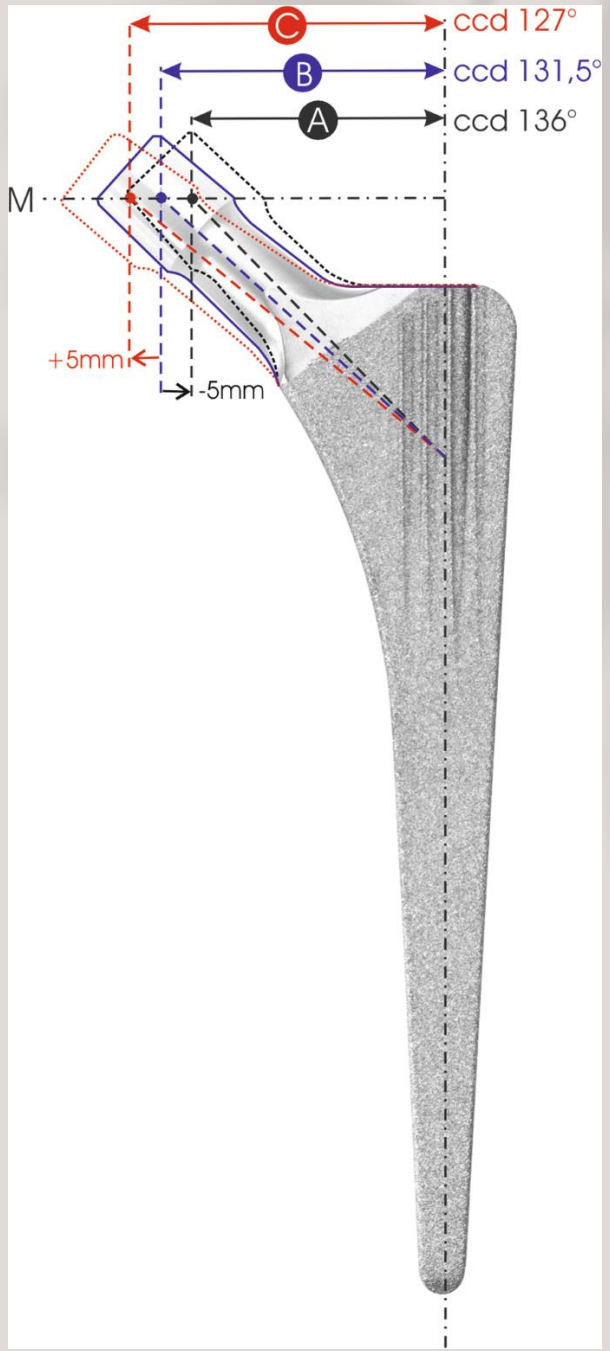

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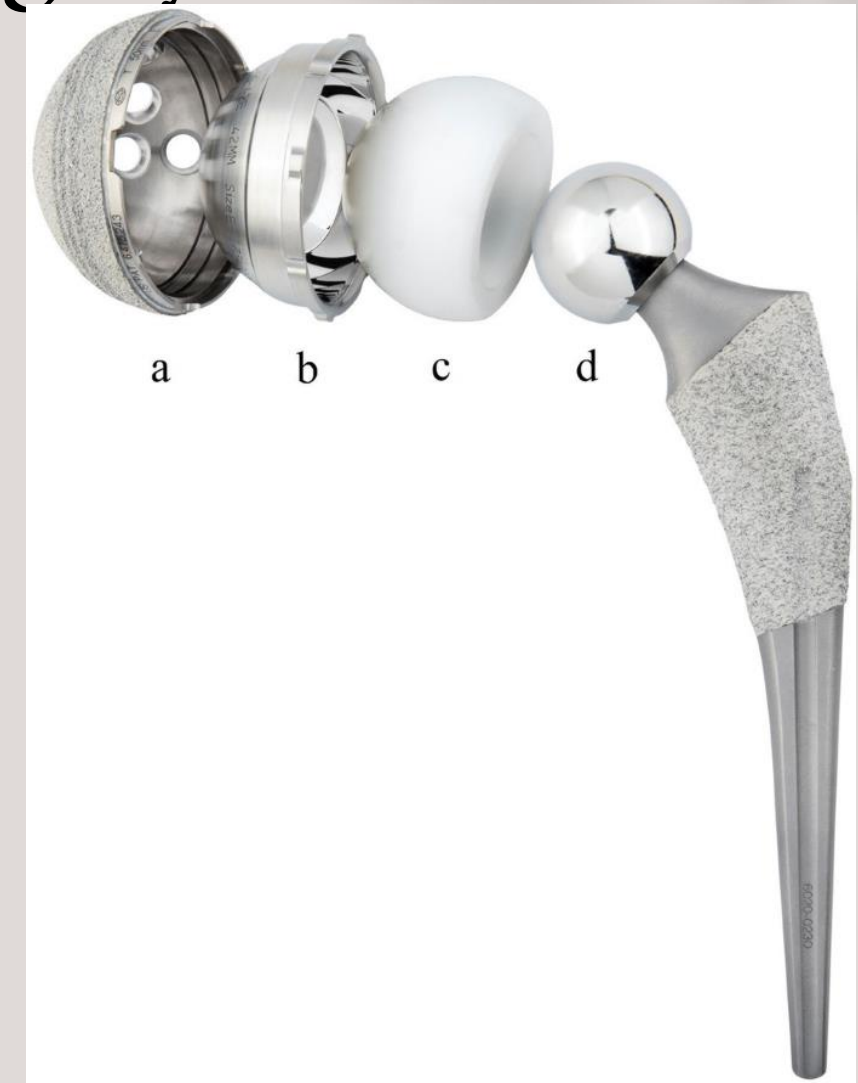

AI in Hip Replacement Surgery

- Femoral component assessment
  - Manual assessment, side to side
  - Manual assessment, shuck test
  - Capsule length
  - String method

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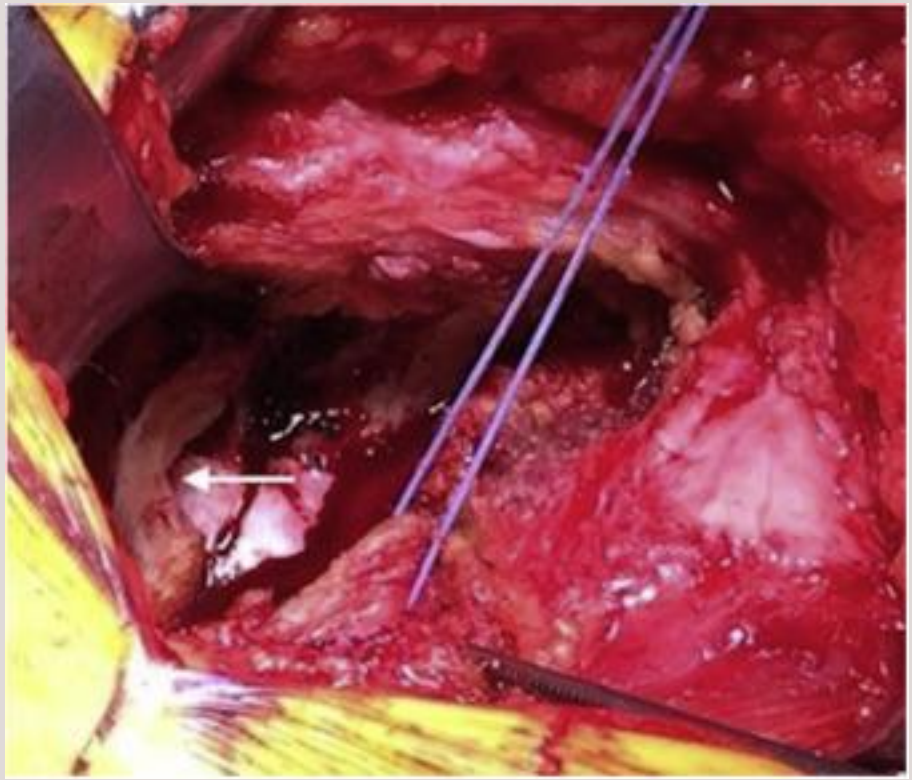

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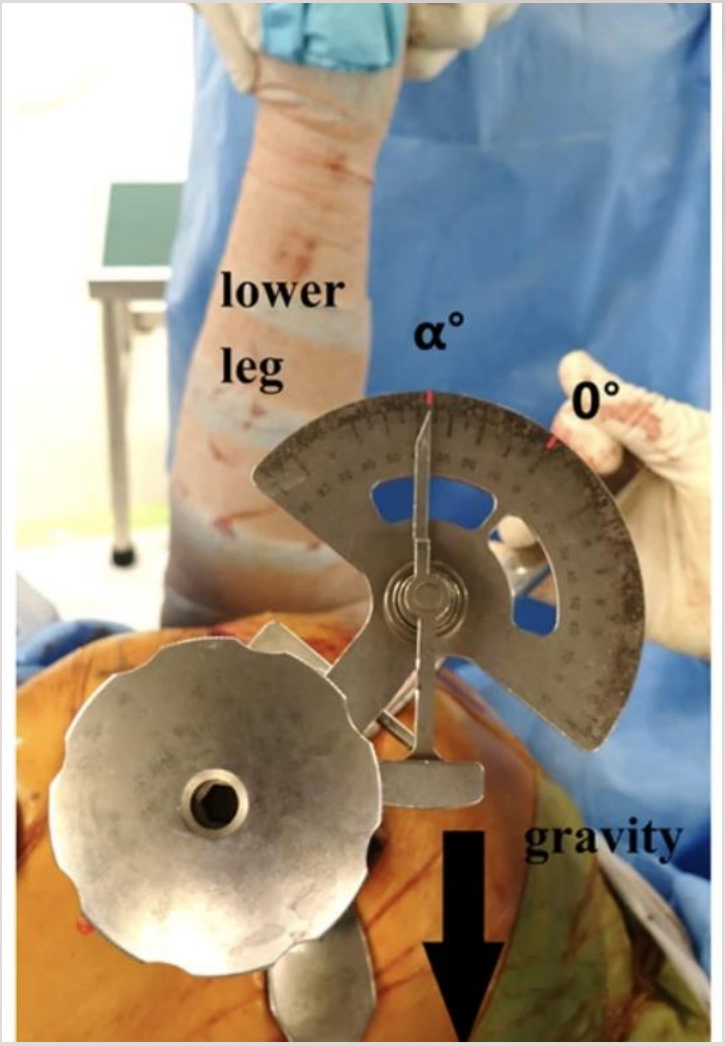
AI in Hip Replacement Surgery

- Combined assessment of component position
- 90 90 test
- Combined anteversion test



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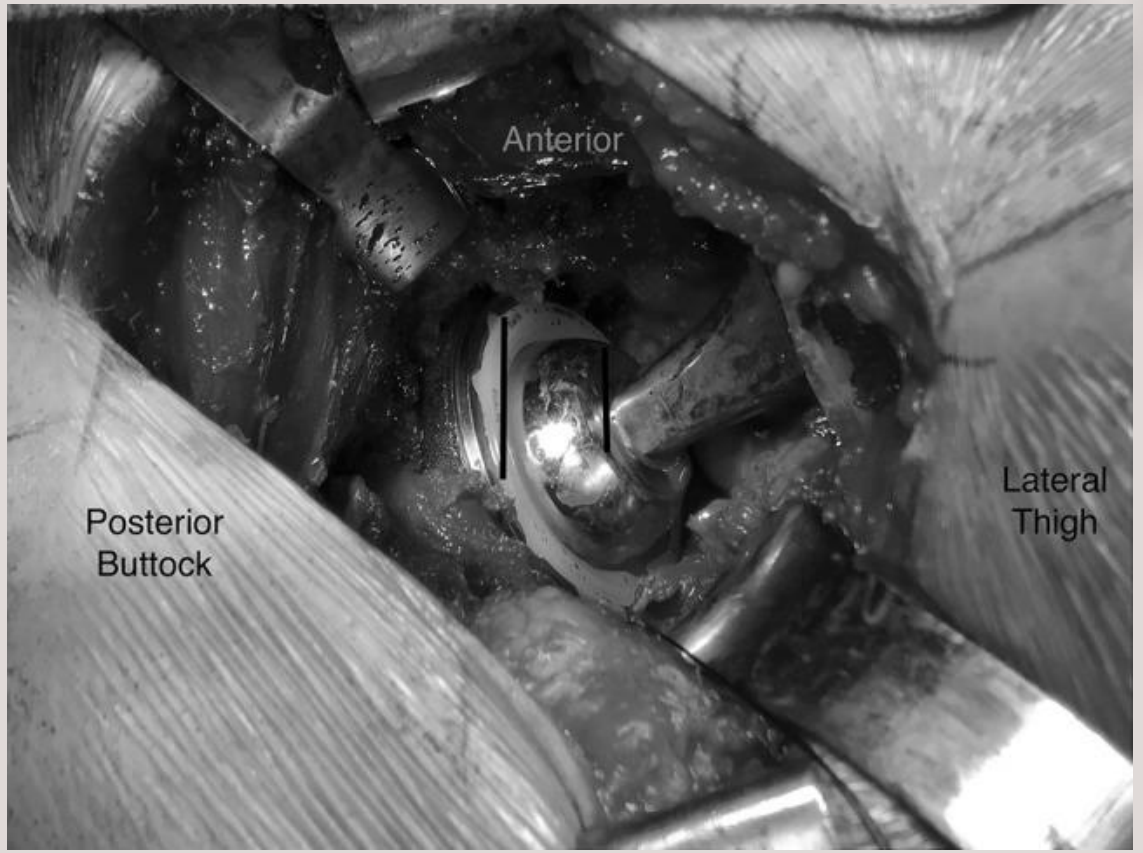
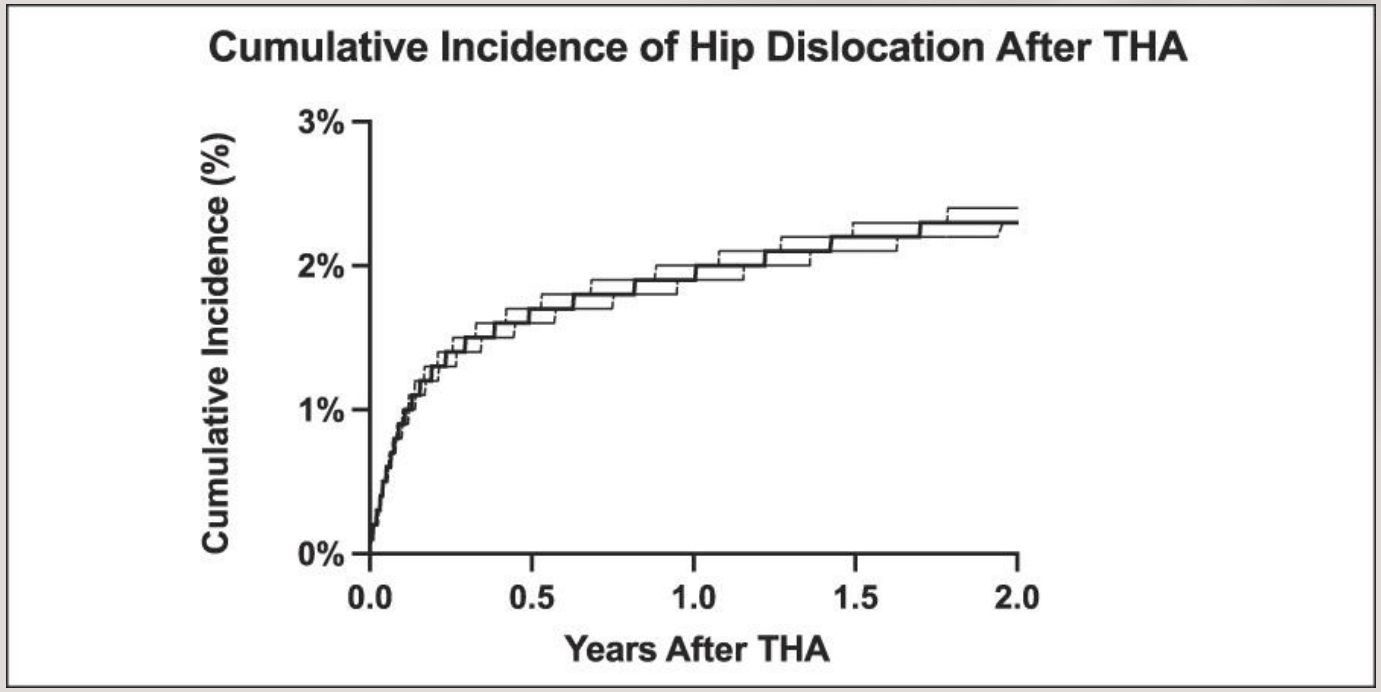


AI in Hip Replacement Surgery

- The argument for improved accuracy
  - Historical dislocation rate
  - Leg length as a cause of patient dissatisfaction
  - Physician accuracy with traditional methods was not really that good (scatter plot)
  - We all took x-rays in the recovery room, “like watching our golf shot”



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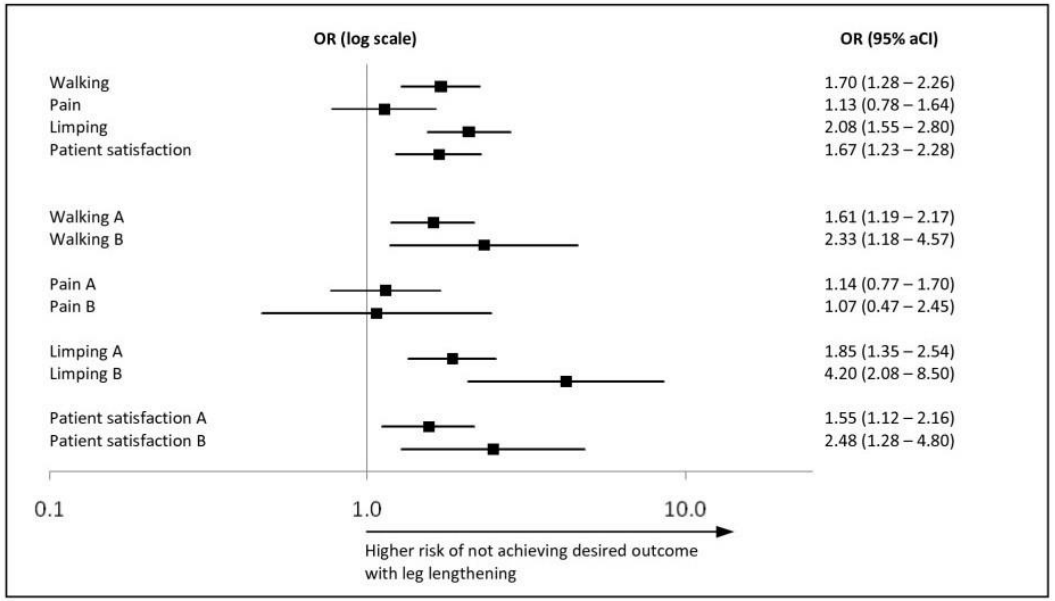

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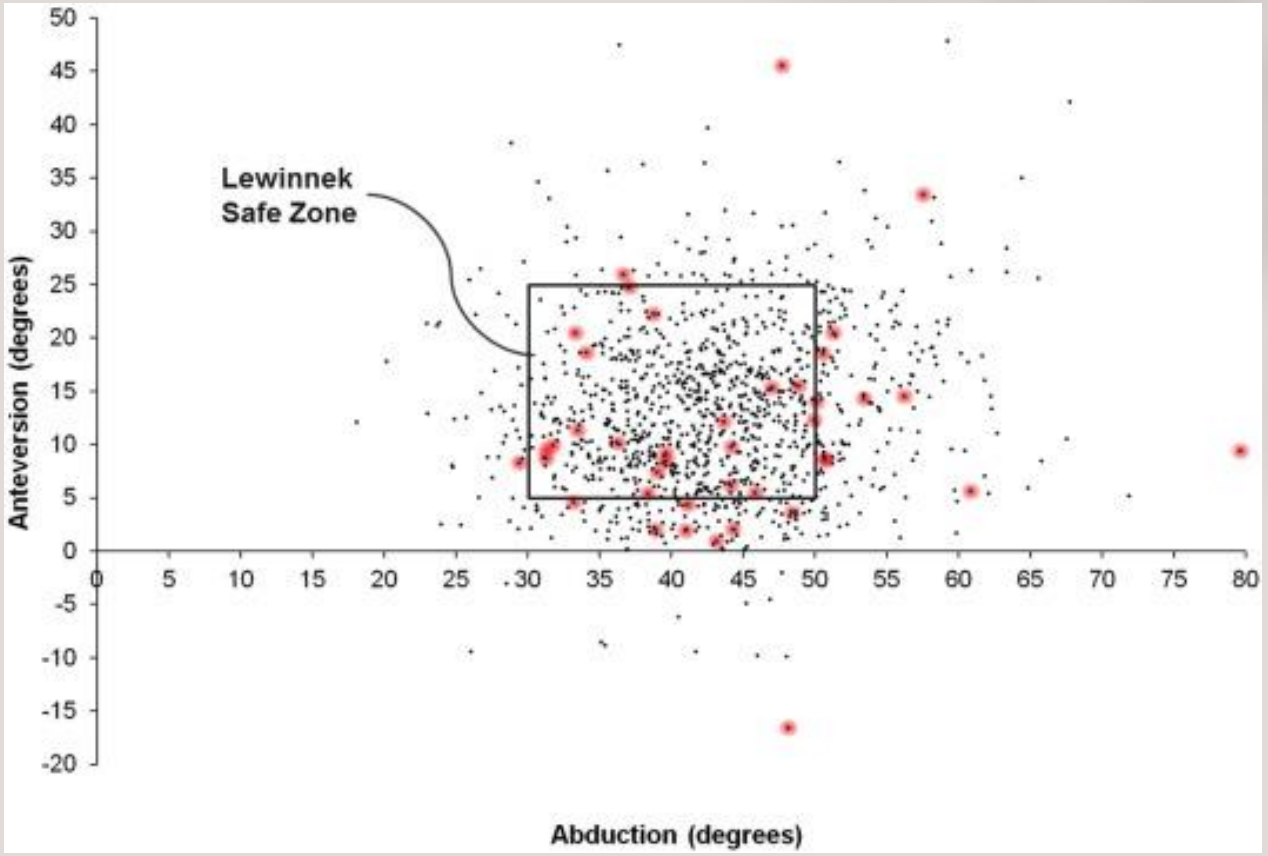

AI in Hip Replacement Surgery

- Fluoroscopic Intra operative component assessment was adopted to improve accuracy
- C arm, and its issues
  - Orientation
    - Lateral position (posterior approach)
    - Supine position (anterior approach)
  - Parallax
  - Distortion

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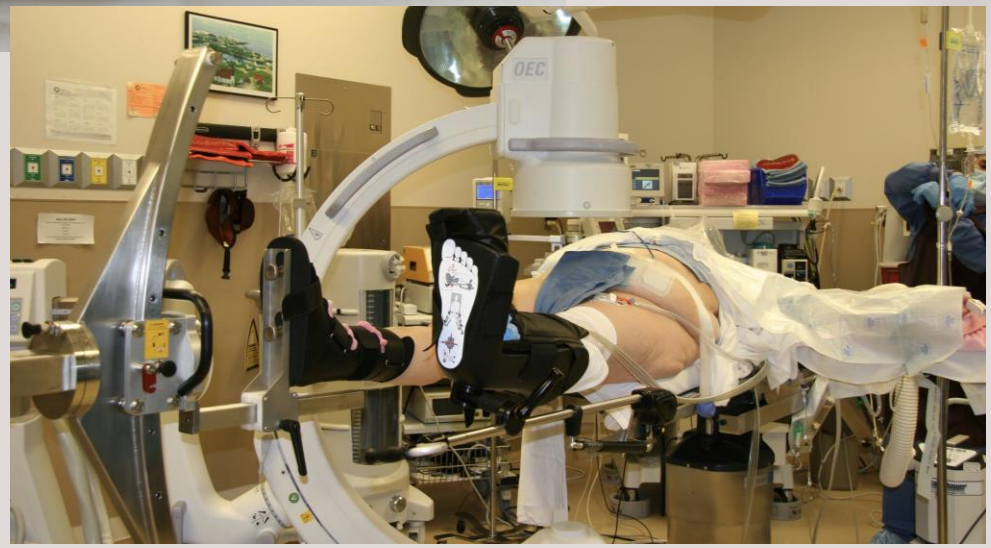

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AI in Hip Replacement Surgery

- Fluoroscopic Intra operative component assessment
- C arm, and its issues
  - Orientation
    - Lateral position (posterior approach)
    - Supine position (anterior approach)
  - Comparing results of fluoroscopic posterior and fluoroscopic anterior THA

Variables	Intraoperative fluoroscopy	Postoperative standing AP X-ray	*t* value	*P* value
DAA				
Inclination	42.32±1.91	42.98±1.81	1.354	1.181
Anteversion	22.30±1.41	22.88±1.38	−1.618	0.111
PA				
Inclination	36.80±3.72	39.29±4.58	2.174	0.022
Anteversion	25.60±3.64	21.31±4.04	4.389	<0.001

DAA direct anterior approach, *PA* posterior approach

AI in Hip Replacement Surgery

- Robotic (MAKO) THA represented a possibly more accurate way to place components
  - Pre-operative CT scan
  - Registering the patient to the CT
  - Robotic arm to place the Acetabular component
  - Measuring the femoral component

AI in Hip Replacement Surgery

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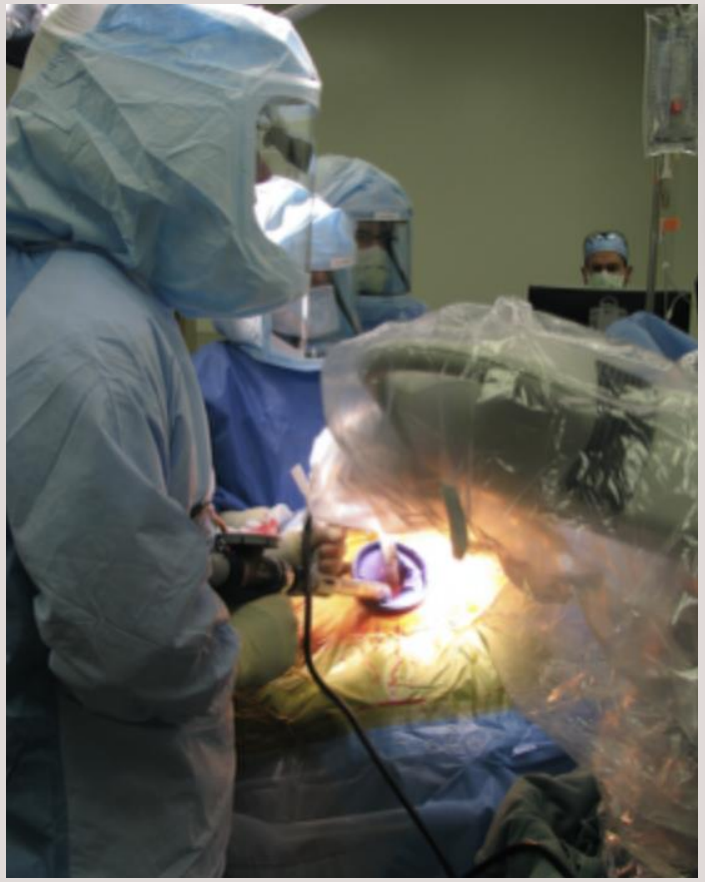

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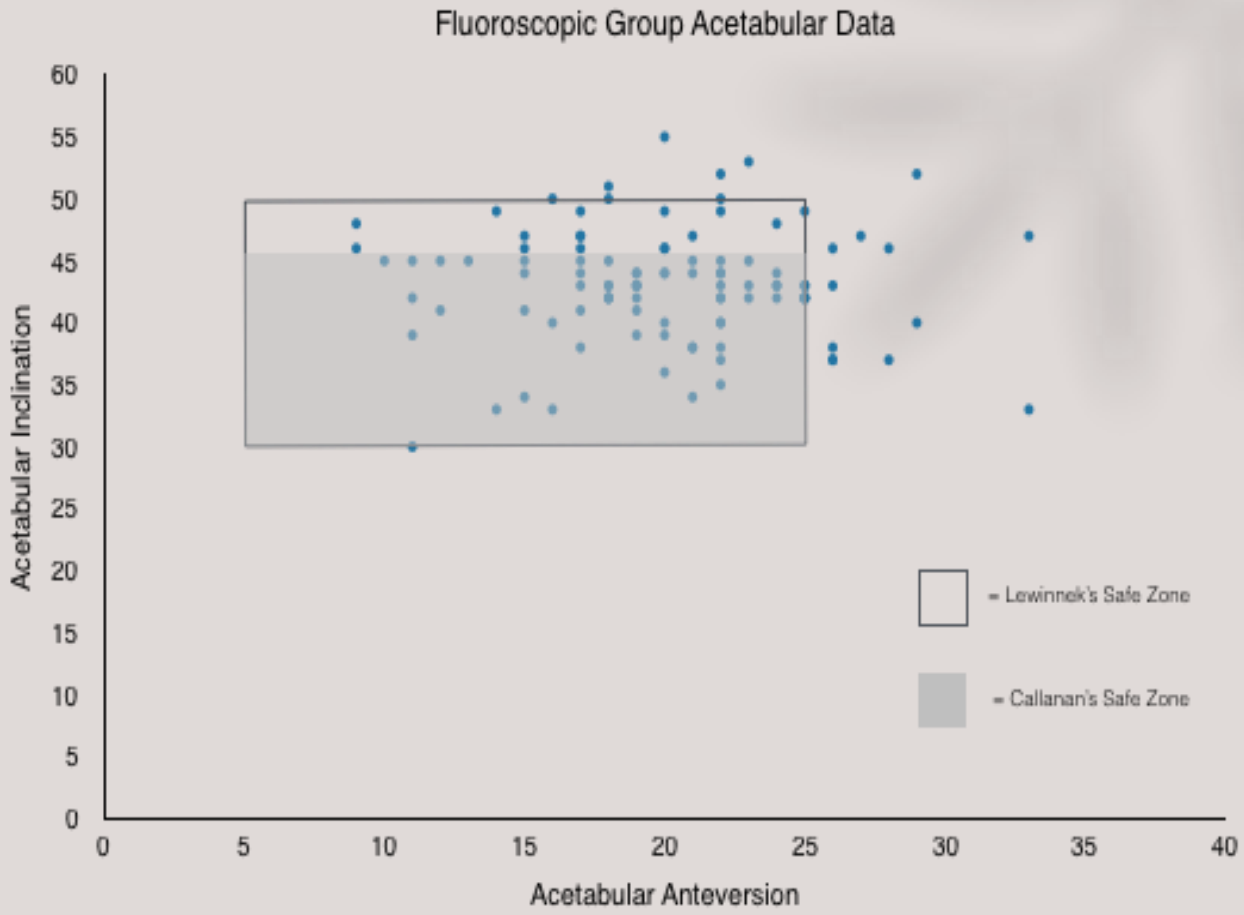
AI in Hip Replacement Surgery

- Robotic (MAKO) THA
  - Comparing Robotic THA with Fluoroscopic Anterior THA
  - Accuracy measures
  - Reliability measures



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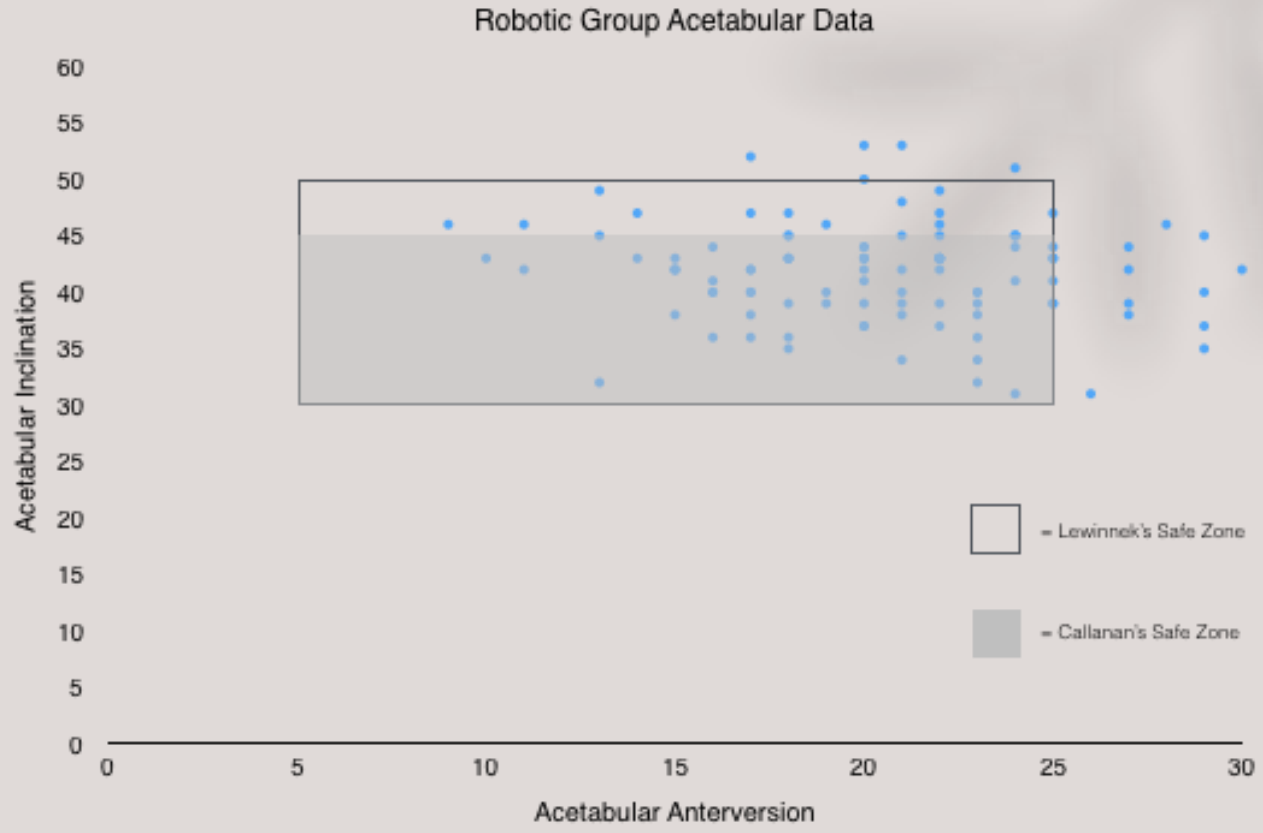

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Primary Hip

A Comparison of Component Positioning Between Fluoroscopy-Assisted and Robotic-Assisted Total Hip Arthroplasty

Nathaniel J. Stewart MD [a], James L. Stewart BS [a], Abra Brisbin PhD [b]

AI in Hip Replacement Surgery

- Computer Enhanced Fluoroscopic Anterior THA. (If MAKO was not superior to anterior hips with fluoroscopy, could we make fluoroscopy even better)
- Velys (Depuy)
  - Physician driven C arm orientation
  - Depuy representative defining anatomical points (with supervision)
- Orthogrid AI (open platform)
  - AI driven C arm orientation to a chosen standard
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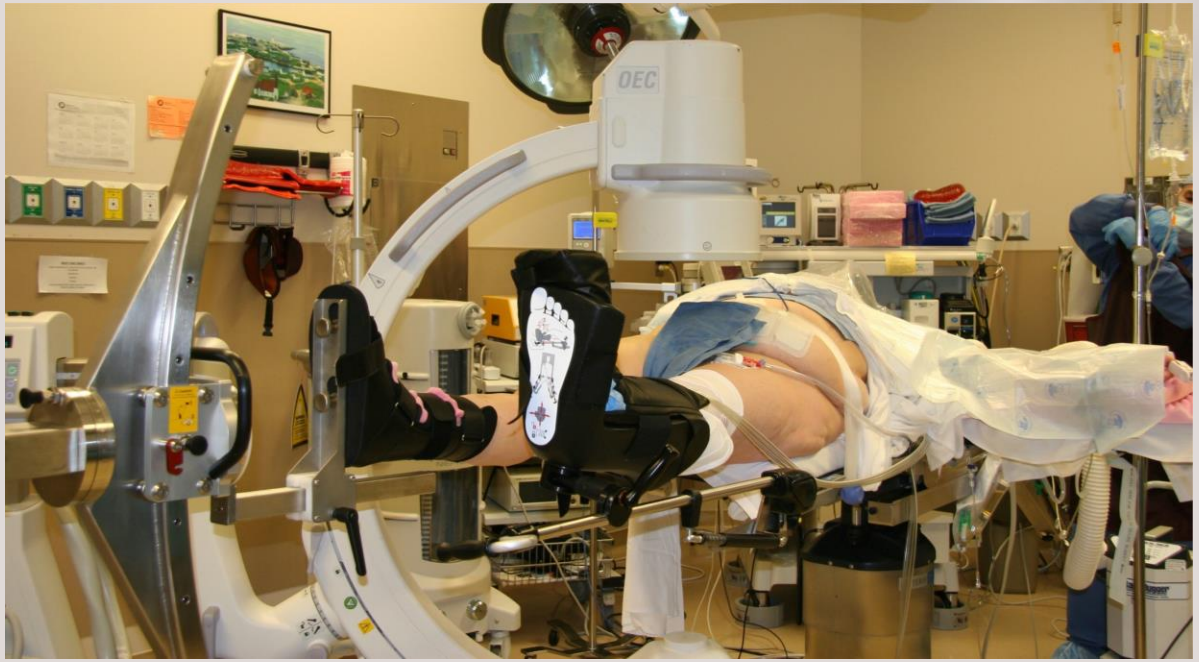

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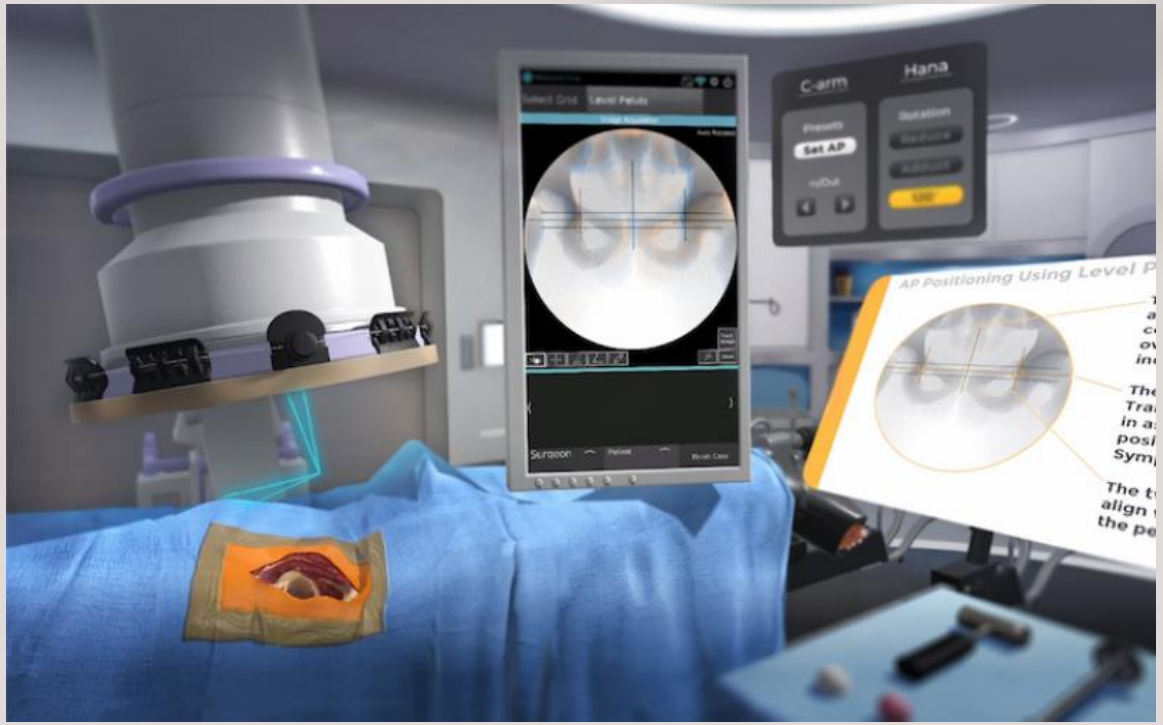

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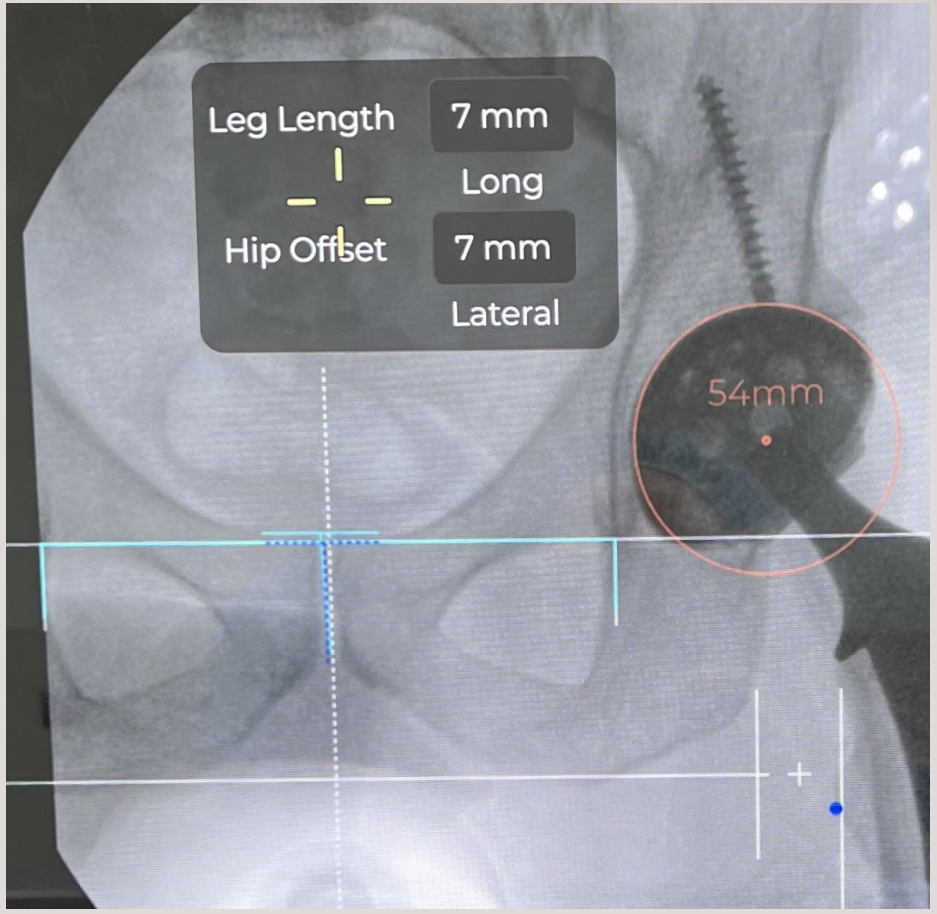

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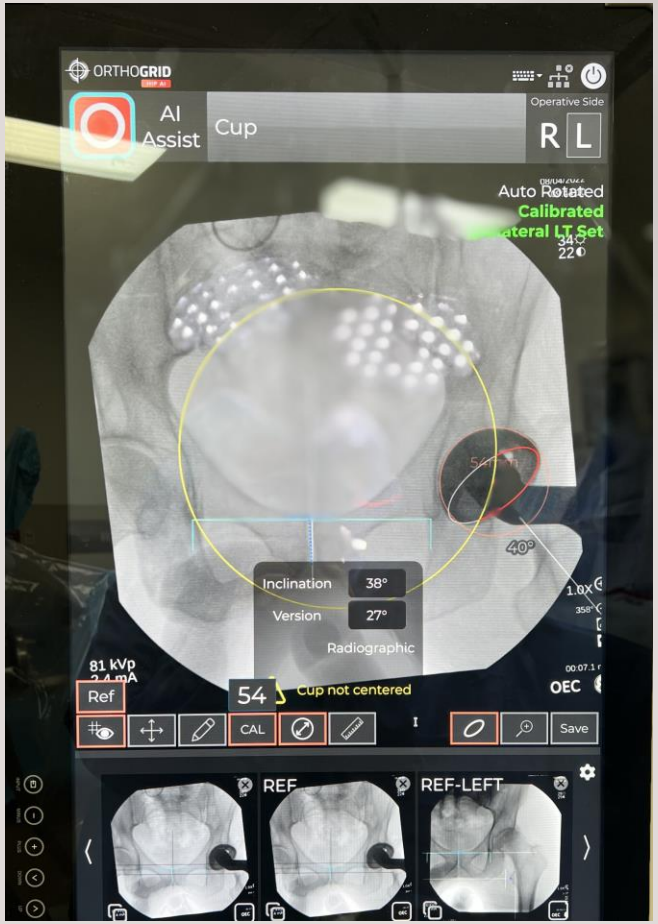

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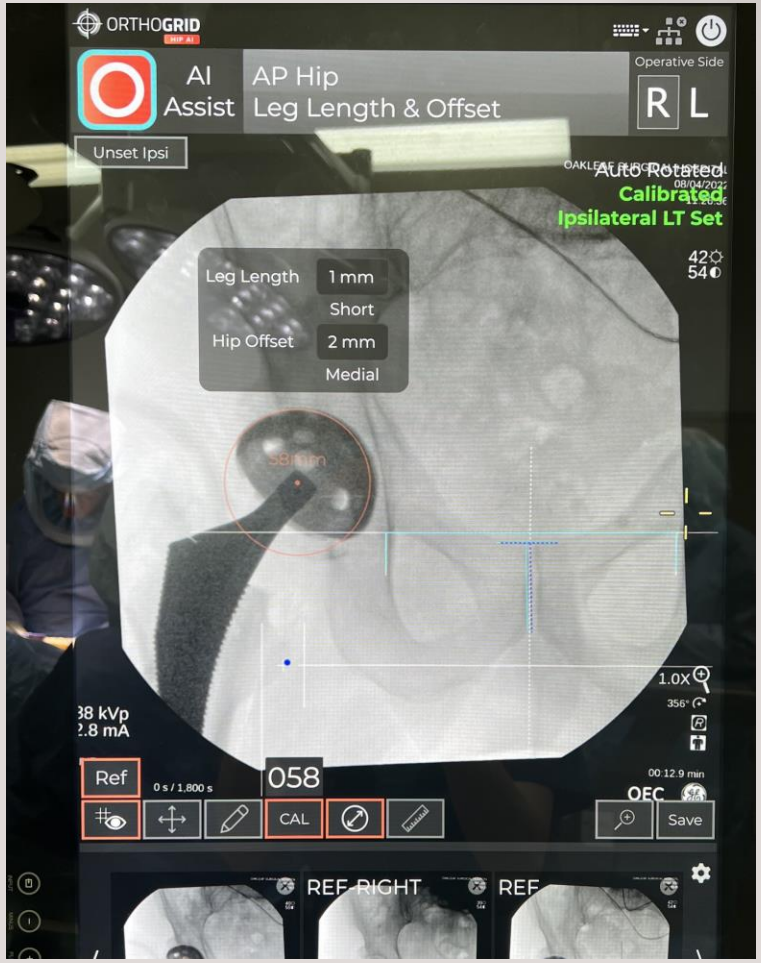

AI in Hip Replacement Surgery

- What is the state of the art today?
- Efficiency is certainly higher with AI
- Accuracy, at this point, seems at least to be comparable to un-aided fluoroscopy
- As the first center to use AI for total hips, we are in the process of documenting the accuracy as compared to MAKO and un-aided fluoroscopic guidance.

AI in Hip Replacement Surgery

I want to thank all the members of Oakleaf Hospital and the members of my team for making AI adoption smooth and seamless.

And thank all of you for your attention