Innovative Treatments for Hip and Knee Pain

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100 YEARS 1922 - 2022 Boulder Community Health

BoulderCentre for Orthopedics

My Training

- Undergrad - Carroll College - Helena, MT
- Medical School - University of Washington
- Residency - University of New Mexico
- Fellowship in Joint Replacement - Coon Joint Replacement Institute, St. Helena, CA
- First Surgeon with Fellowship training specifically in Robotic Joint Replacement

Medical License: CO and MT
Disclosures: Consultant for Stryker Robotics

Boulder County Fair circa 1990

Times-Call photo by DOUG CONARROE

Hay ride

Brian Blackwood, 11, rides on the back of a wagon full of hay he was helping collect at 21st Avenue and Meadow Street on Friday.


HELLO
MY NAME IS:
Bennett
HELLO
MY NAME IS:
Ty

About my practice…

- Focus on minimally invasive surgical techniques combined with advanced technology
- 99% of cases done under spinal anesthesia
- Avg LOS: TKA 1 days, THA 1 days
- 91% of patients discharged to home with outpatient PT
- Now doing Outpatient Surgery Center

Lowest Complication Rate in Boulder

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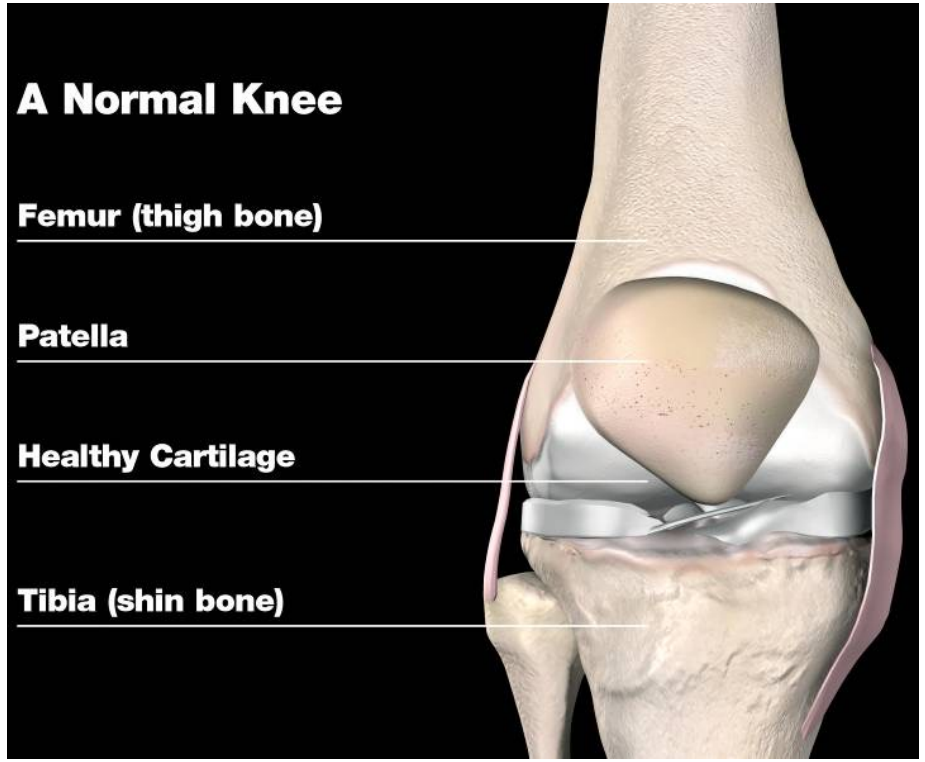
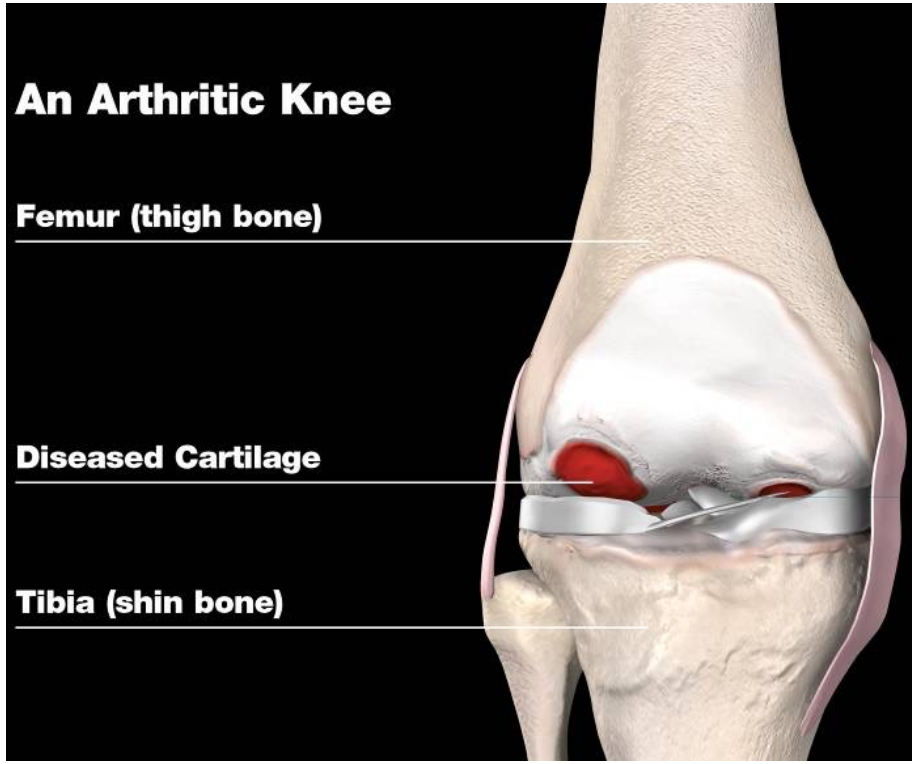
Boulder Centre
for Orthopedics

What is Arthritis?


A Normal Knee
Femur (thigh bone)
Patella
Healthy Cartilage
Tibia (shin bone)


An Arthritic Knee
Femur (thigh bone)
Diseased Cartilage
Tibia (shin bone)

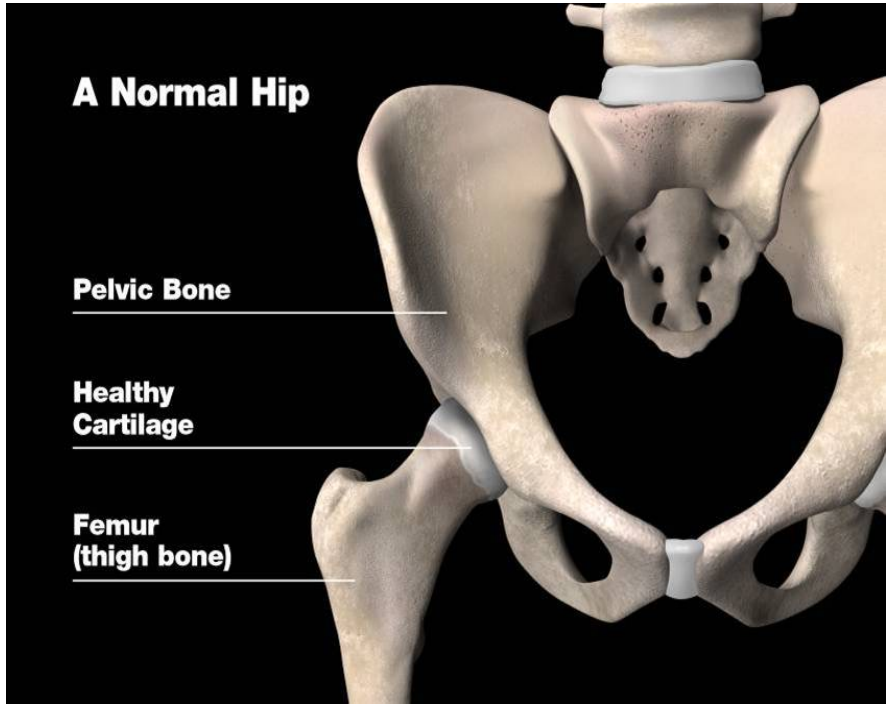
Osteoarthritis - Worn out articular cartilage

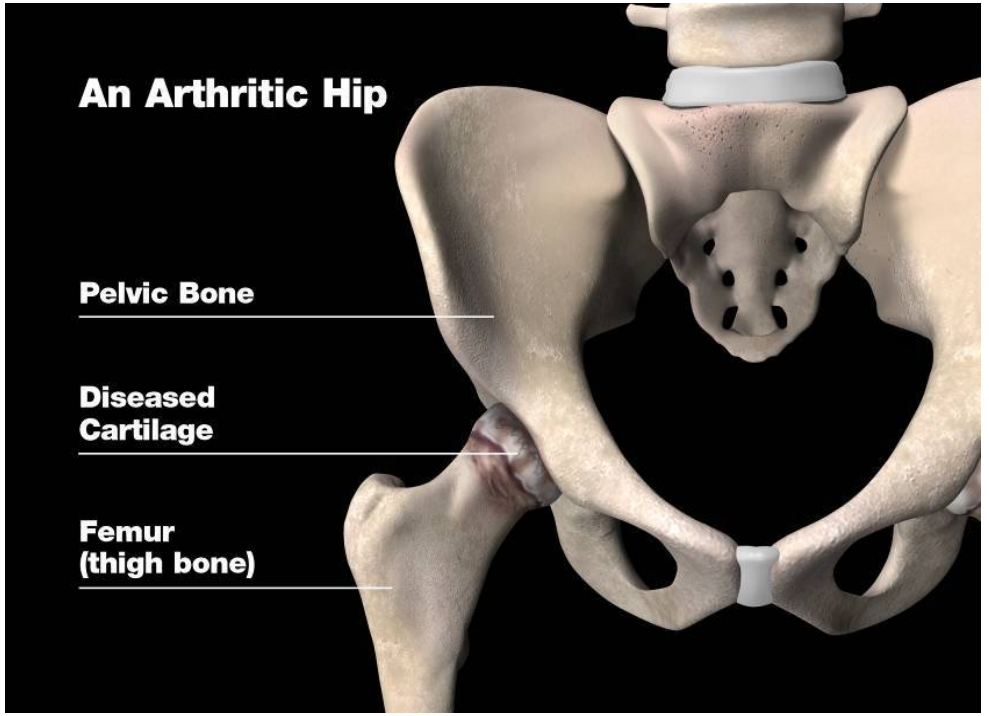
Inflammatory Arthritis - Systemic process
ex: Rheumatoid, Psoriatic, etc.


FLEXION
WT BEARING


L
HC
WT BEARING

Hip Stages


A Normal Hip
Pelvic Bone
Healthy Cartilage
Femur (thigh bone)

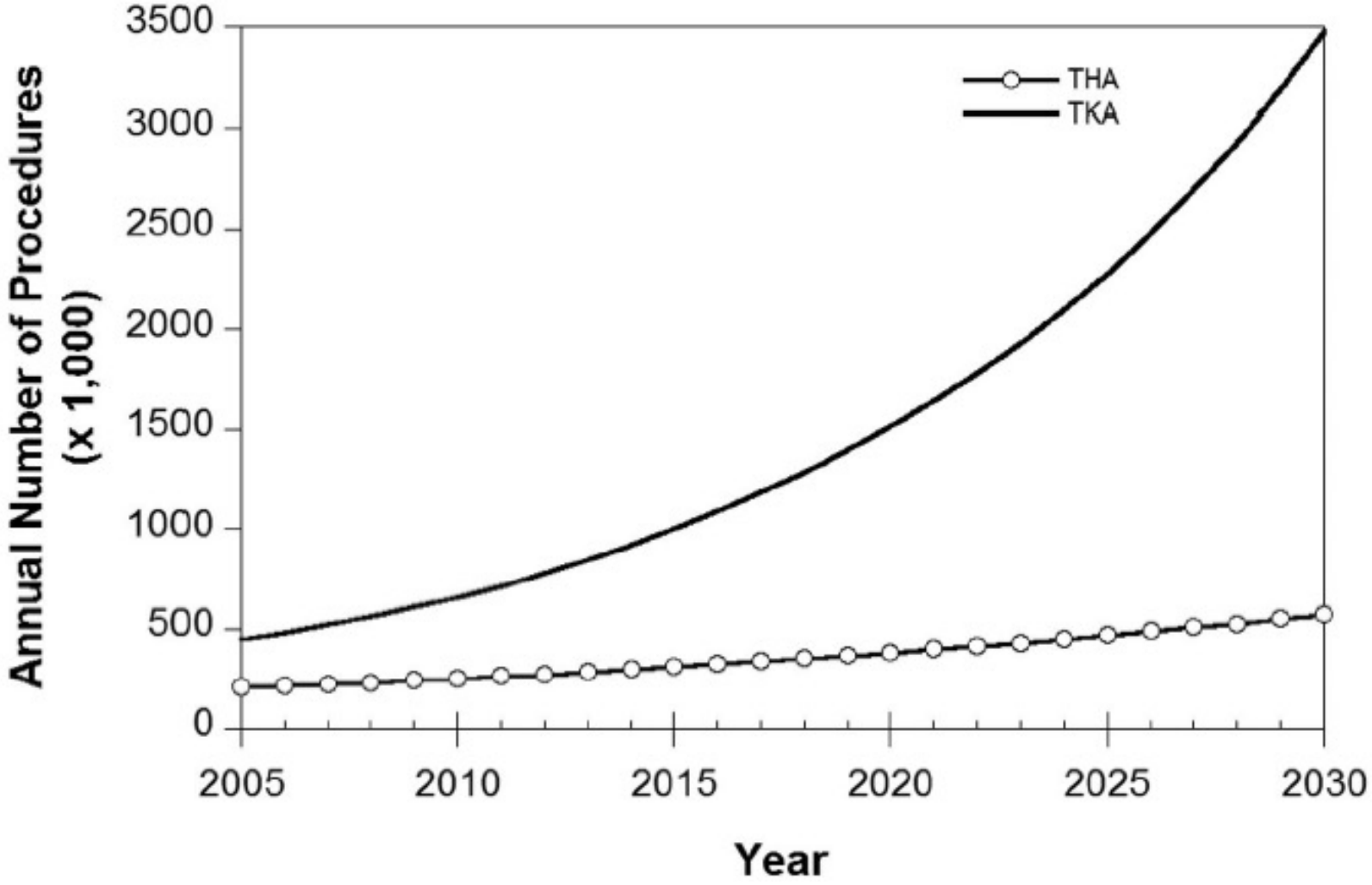

An Arthritic Hip
Pelvic Bone
Diseased Cartilage
Femur (thigh bone)

X-ray Showing Arthritis

Other Causes of "Hip Pain"

- Bursitis: Lateral/Side pain. Worse when you lay on that side
- Back pain: Can radiate down to hip and cause hip pain symptoms
- Hernia: Abdominal opening causing pain in the groin

Primary Hip and Knee Replacement
Projection 2005-2030



Kurtz, S, Projections of Primary and Revision Hip and Knee Arthroplasty in the US 2005-2030, JBJS, 2007;89:780-785.

New Generation of Patients

Patients are getting both younger and older. They have different expectations.

- Want to maintain their quality of life and active lifestyles

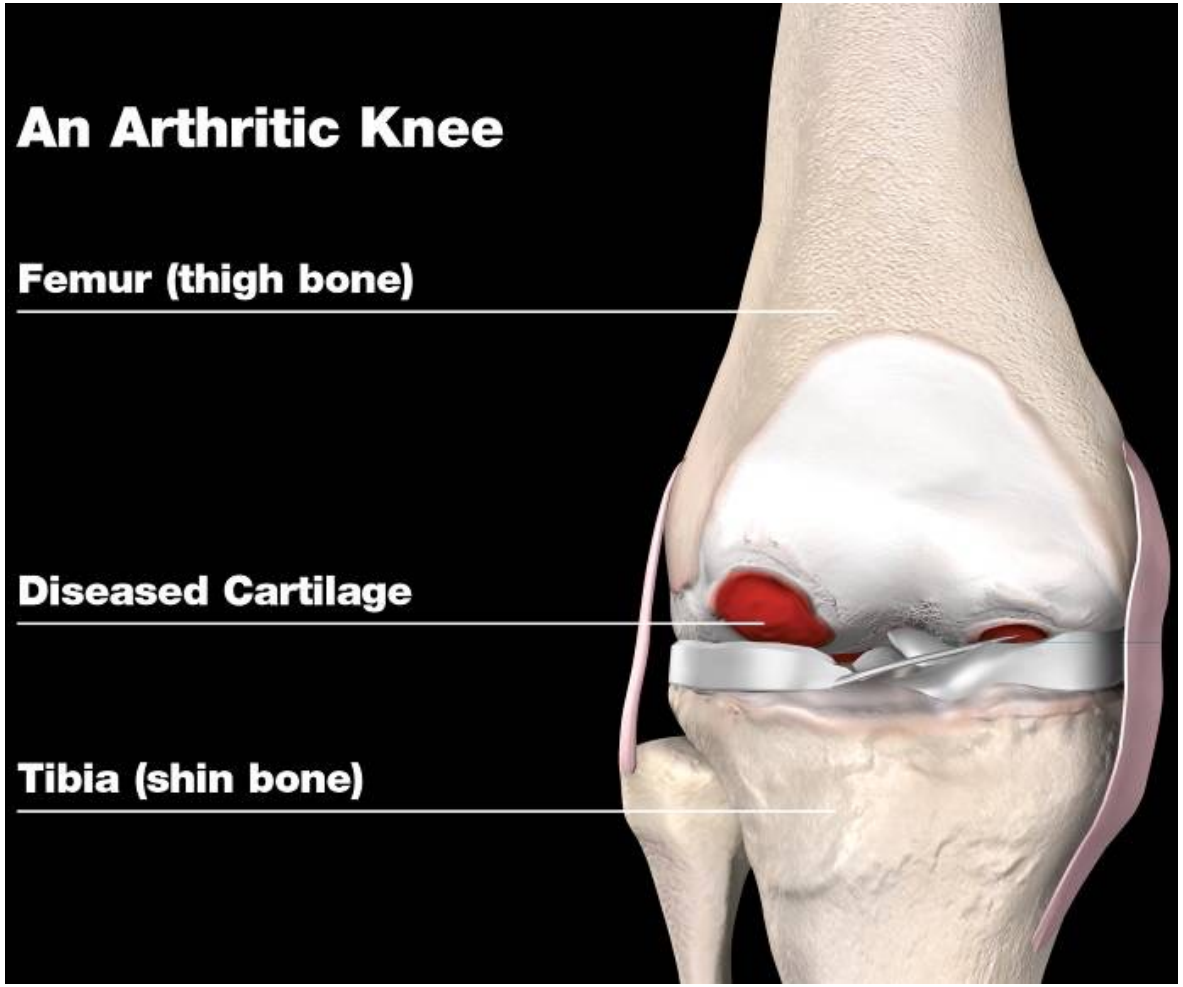
Patients are often better informed today.

- Internet allows access to more information
- BUT BEWARE THE INTERNET (and Stem Cells)

How Can I Avoid/Delay a Joint Replacement?

Treatment Options for Knee and Hip Pain

- Rest, ice, and heat applications
- Medications for inflammation and pain
- Lifestyle modification
- Physical therapy
- Joint fluid supplements
- Knee arthroscopy
- Total joint replacement



AAOS Guidelines

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Table. Nonsurgical Recommendations for Management of Knee OA

Intervention	AAOS (Rating)[a]	VA/DoD (Grade)[b]
Weight loss	Recommended for patients with a BMI ≥25 kg/m^2 (Moderate)	Recommended for patients with a BMI ≥25 kg/m^2 with a goal of losing ≥5% body weight (C)
Exercise/physical therapy	Self-management programs, strengthening, low-impact aerobic exercises, and neuromuscular education; engage in physical activity consistent with national guidelines (Strong)	Manual therapy (B) Aquatic therapy (C) Walking aids (EO)
Oral medications	Nonsteroidal anti-inflammatory drugs (NSAIDs) or tramadol (Strong) Unable to recommend for or against the use of acetaminophen, opioids, or pain patches (Inconclusive)	Acetaminophen (≤4 g daily) or oral NSAIDs are first-line therapy (B) Topical capsaicin may be considered as first-line or adjunctive therapy (C) Duloxetine or tramadol may be offered as an alternative/adjunct to oral NSAIDs (B) Non-tramadol opioids may be considered for patients with contraindications, inadequate response, or intolerable side effects with non-opioid therapies or tramadol (C)
Intra-articular injections	Unable to recommend for or against the use of intra-articular corticosteroids, growth factor injections, and/or platelet rich plasma (Inconclusive) Cannot recommend using hyaluronic acid (Strong)	Corticosteroid injection may be considered (C) Insufficient evidence to recommend for or against the use of intra-articular hyaluronate/hylan injection; however, it may be considered for patients with inadequate response to nonpharmacologic measures and an inadequate response, intolerable adverse events, or contraindications to other pharmacologic therapies (I)

[a] AAOS rating: Strong, the work group recommends; Moderate, the work group suggests; Inconclusive, the work group is unable to recommend for or against.
[b] VA/DoD grade: B, USPSTF recommends service. High certainty that net benefit is moderate or moderate certainty that net benefit is moderate to substantial; C, recommends selectively offering or providing service to individual patients based on professional judgment and patient preferences. At least moderate certainty that the net benefit is small; I, current evidence is insufficient to assess the balance of benefits and harms of the service; EO, expert opinion.
Source: Data extracted from National Guideline Clearinghouse.

RICE and NSAIDs

Rest, Ice, Compression, Elevation

Ibuprofen, Aleve, Tylenol, Celebrex

Topical compounds

Glucosamine

Activity Modification and Weight Loss

Avoiding high impact activities, i.e., running, jumping

Weight loss: Goal BMI<40

Joint Injections

Cortisone

Visco-supplementation

Platelet rich plasma (PRP)

Stem Cells

Visco-supplementation

"Chicken Shots"- Hyaluronic acid injections

**Covered by most insurance in knees but not hips*

PRP: Platelet Rich Plasma

Injections of concentrated blood products to enhance healing

**Not covered by insurance, expensive*

The Promise of Stem Cells

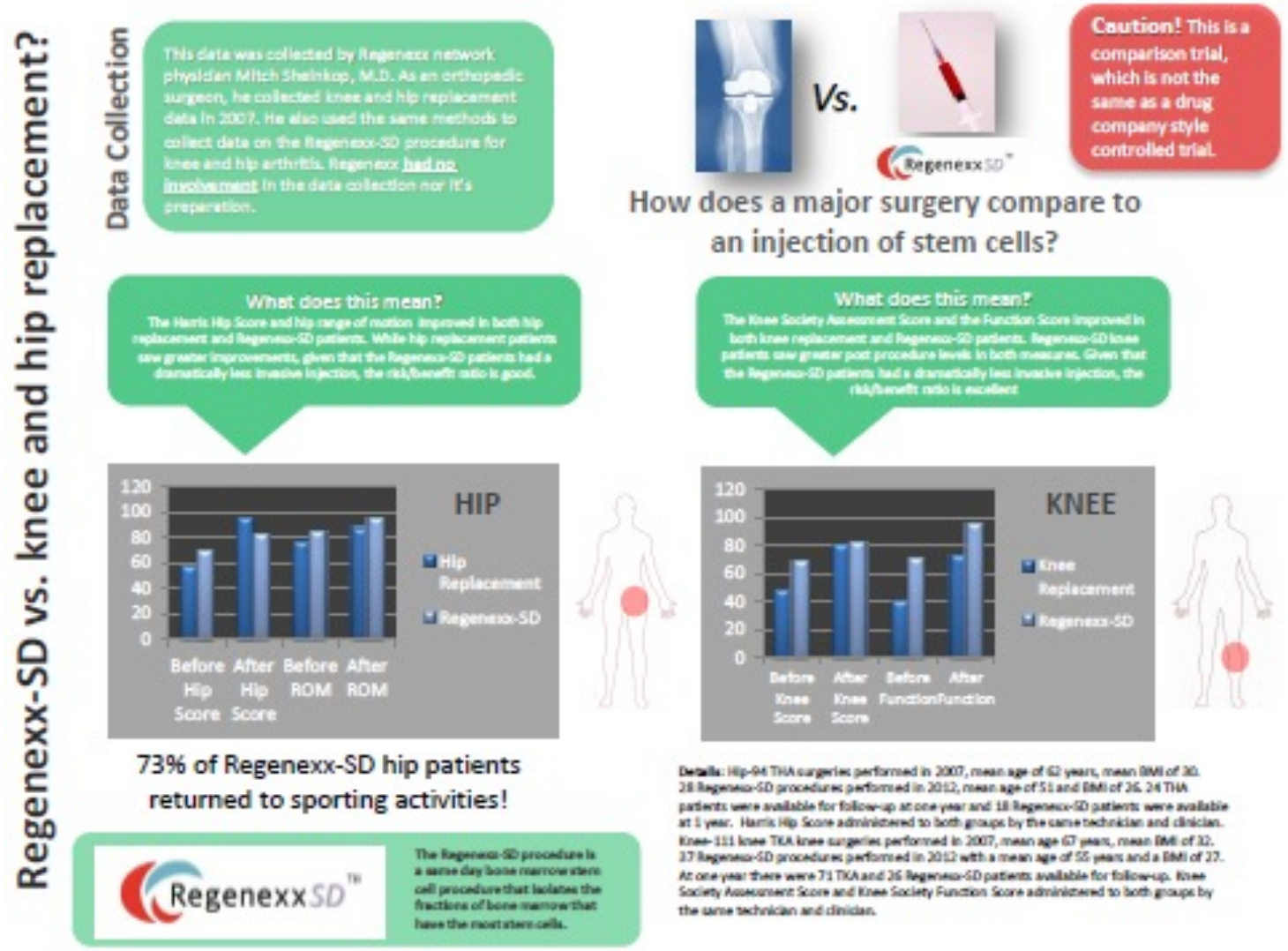
Obtain stem cells, concentrate them and inject them into the joint to decrease inflammation and promote healing.

**Not covered by insurance, very expensive*

My Future?

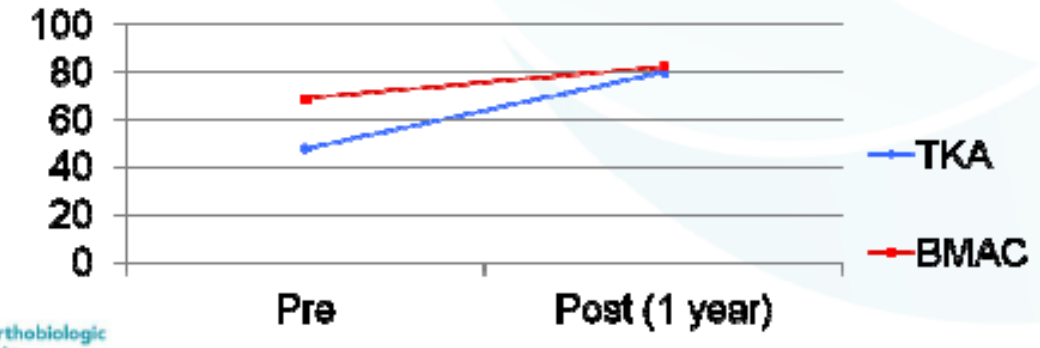
The Dustbin of History

Stem Cell Results:



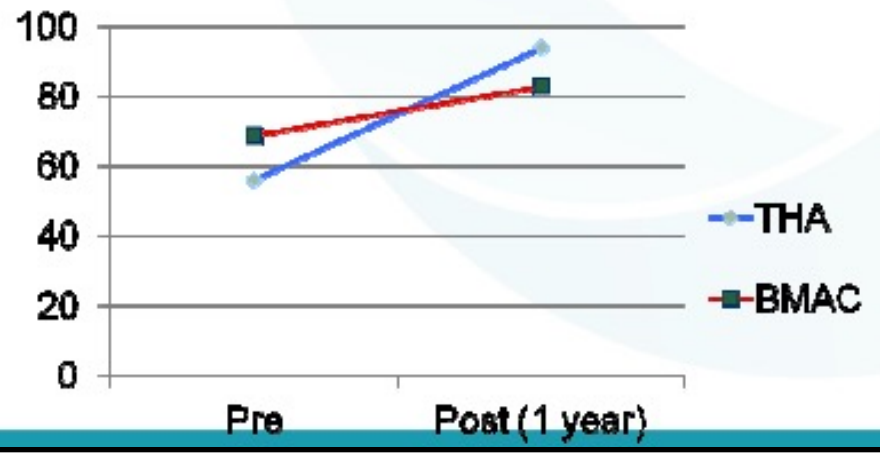
Knee Society Assessment Score

- TKA
  - Pre op 48
  - Post op 80
- BMAC
  - Pre op 69.08
  - Post op 82.44



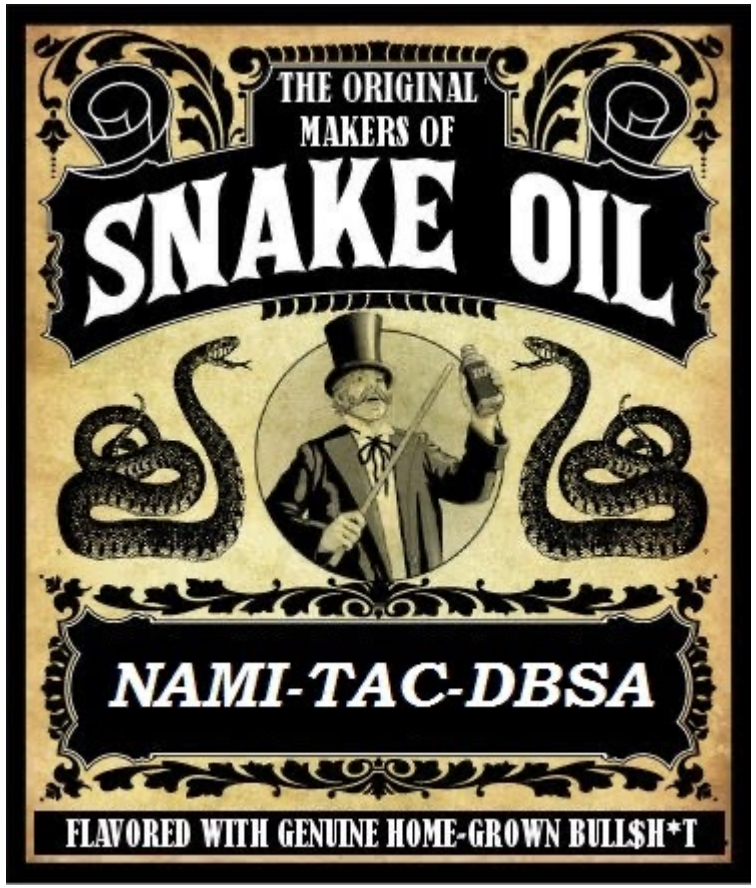
Mean Harris Hip Score

- THA Preop (101) 56
- THA Post(24) 94
- BMAC Preop (28) 68.75
- Post BMAC (18) 82.89



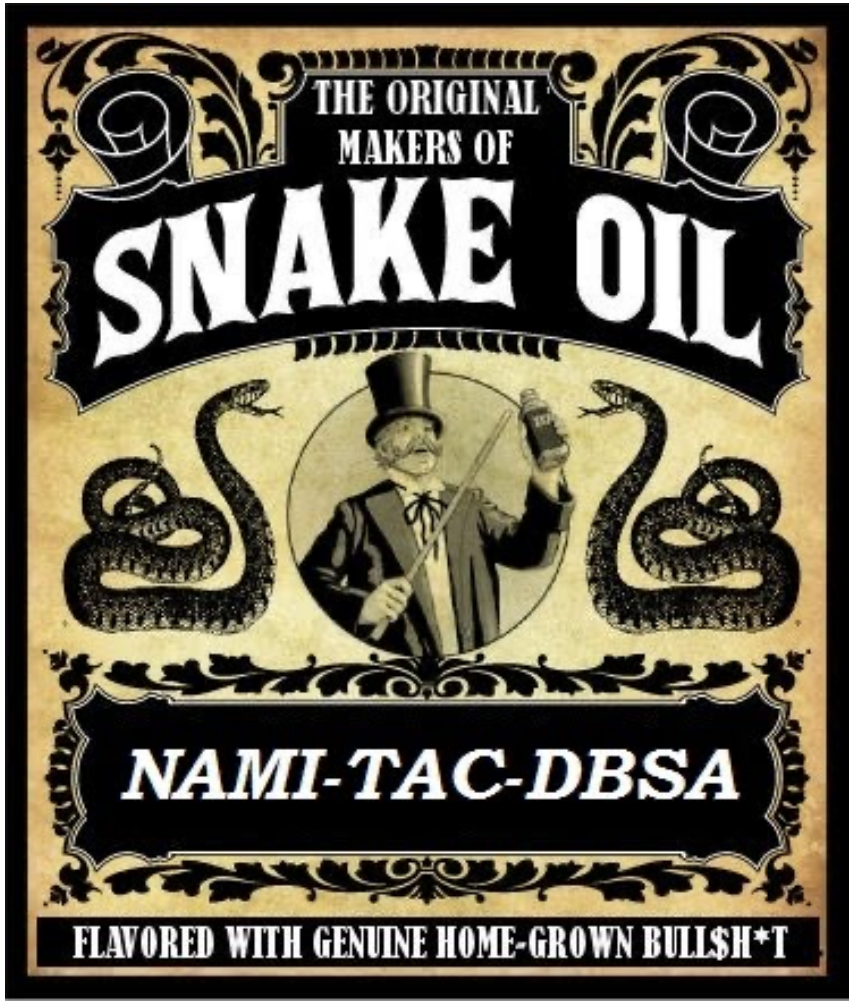
TOBI The Orthobiologic Institute

Stem Cells = Snake Oil?



STEM CELLS?


The Dustbin of History


THE ORIGINAL
MAKERS OF
SNAKE OIL
NAMI-TAC-DBSA
FLAVORED WITH GENUINE HOME-GROWN BULL$H*T

Consequences of Delaying Surgery

- Surgery is a difficult decision
  - Duke Study: 88% pts decline Joint Replacement
- OA is a degenerative disease
- Better outcomes are reported in patients who had a total joint operation earlier in the disease process[1]
- At 2 years post-operation, patients who chose surgery earlier in disease process vs. those who waited[1]
  - Had improved function
  - Had reduced pain

1. Fortin PR, et al. *Arthritis Rheum*. 2002;46:3327-3330.

New Opportunities in Arthroplasty

- Improvements in hip and knee replacement materials
  - Success rates >90% [1]
- Partial vs. total knee replacements
- Minimally invasive procedure techniques
- New designs

1. American Academy of Orthopaedic Surgeons. http://orthoinfo.aaos.org/topic.cfm?topic=A00389, accessed Dec. 15, 2010, and http://www.niams.nih.gov/Health_Info/Hip_Replacement/default.asp#8.

What is Mako?

Computer Navigated, Robotic Arm Assisted

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Early Arthritis

- Damage and pain isolated to one compartment of the knee, usually medial or lateral.

Early Arthritis

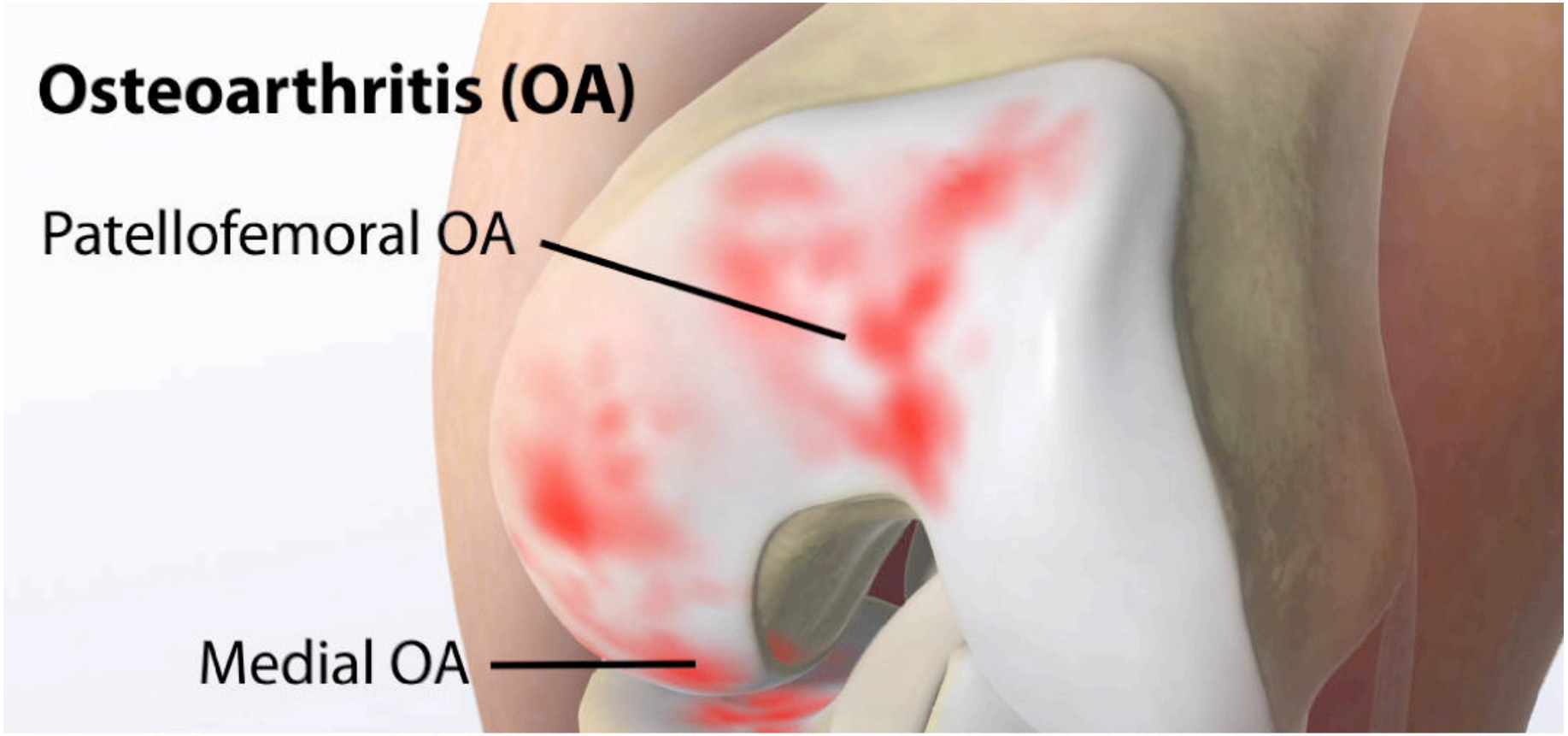
- Damage and pain isolated to one compartment of the knee, usually medial or lateral.

Early Arthritis

- Can also be isolated to the patella femoral joint.

Mid-stage Arthritis

- Occurs in 2 of the 3 compartments of the knee, most commonly the medial and patella femoral.

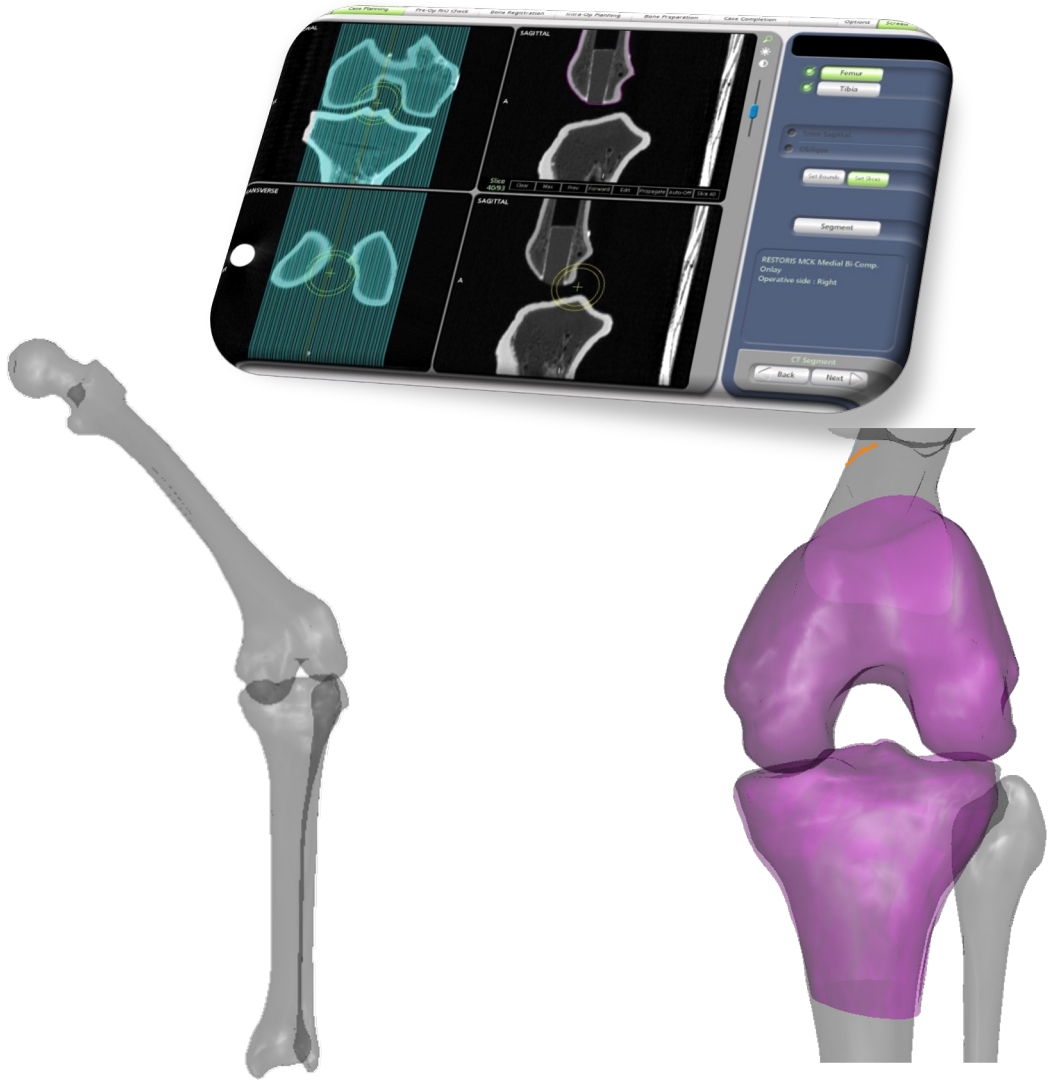


Mid-stage Arthritis

- Occurs in 2 of the 3 compartments of the knee, most commonly the medial and patella femoral.

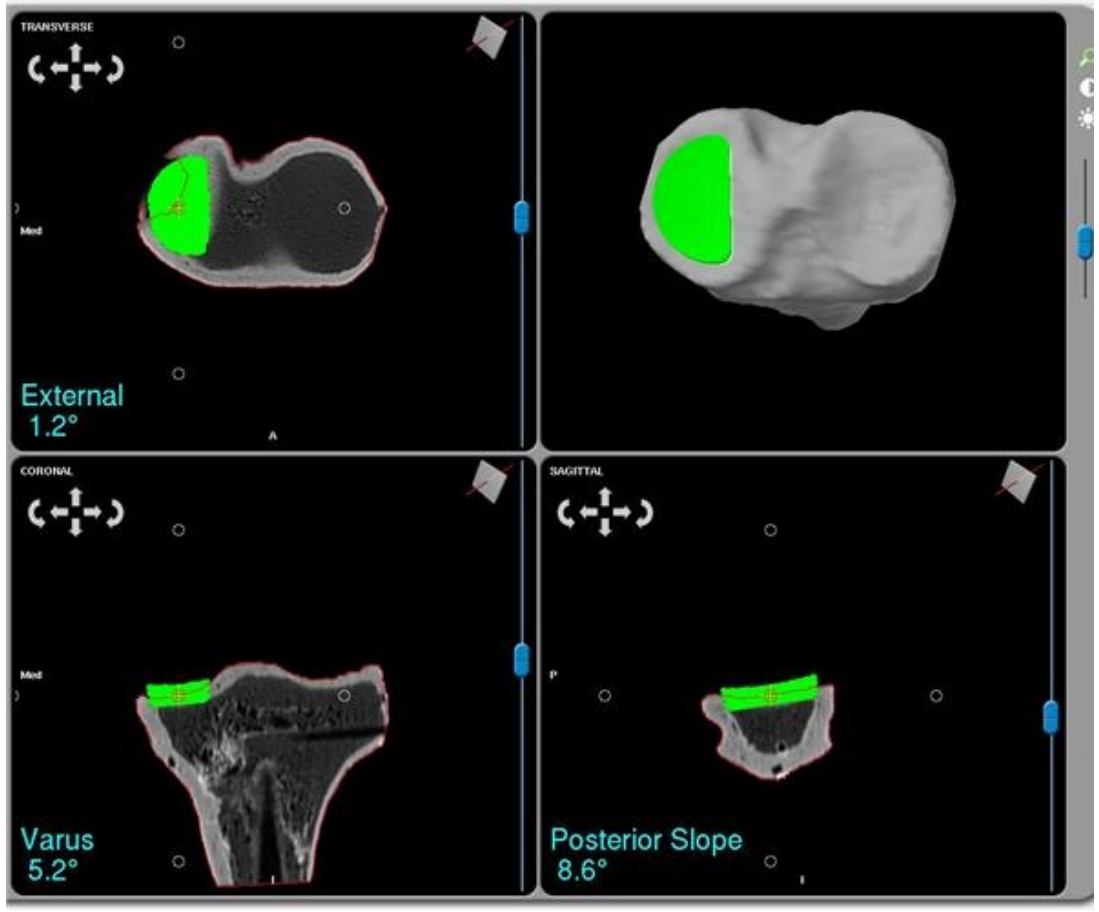
Makoplasty Procedure

- The patient must have the correct indications for the procedure.
- A CT scan is then performed to make a 3D model of the patients knee.

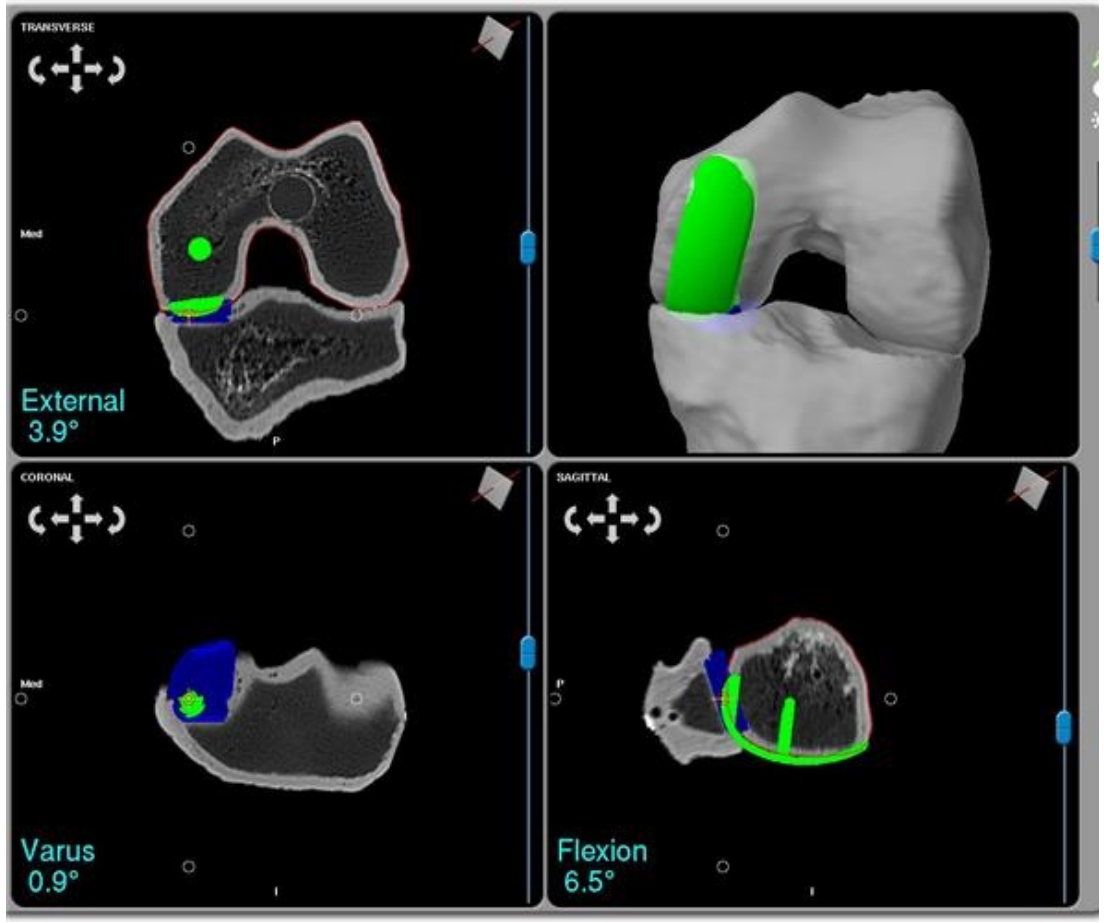


Makoplasty Procedure

The model is then used to plan for the placement of the components.



We are able to plan to 0.1 degrees and 0.1 mm.

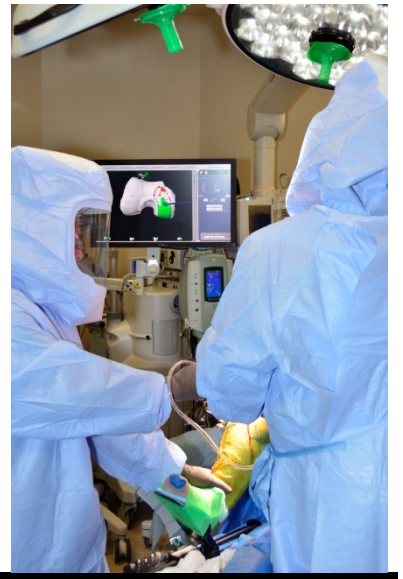


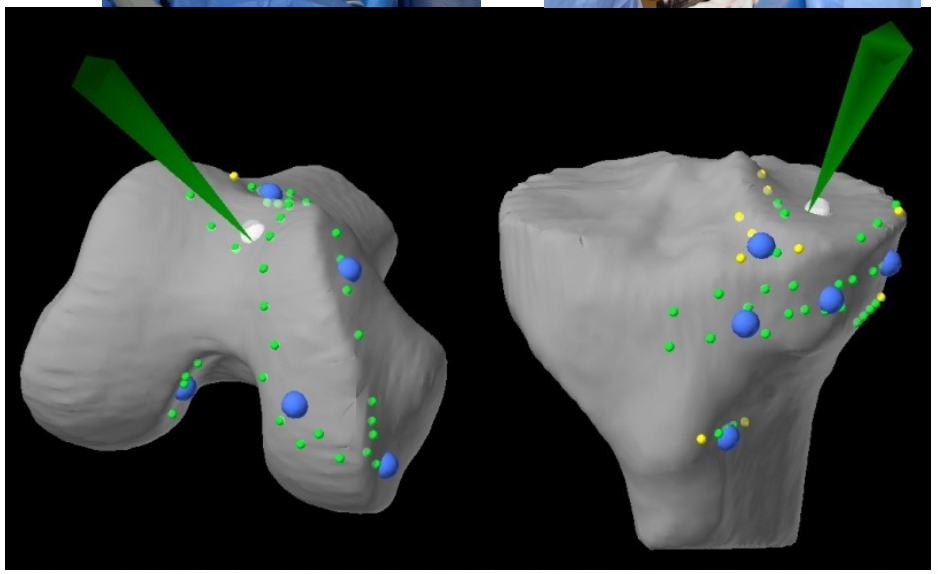
Robotic process (cont.)

- Then a pin is placed into the distal femur and proximal tibia for placement of tracking device.
- Center of hip is then found.

Surgical Technique

- Anatomic landmarks on the femur and tibia are used to calculate the position of the knee in space.
- This information is then combined with CT and pre-op plan.





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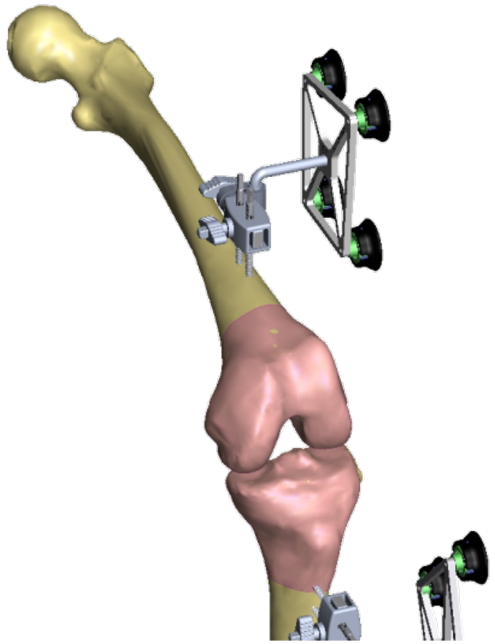
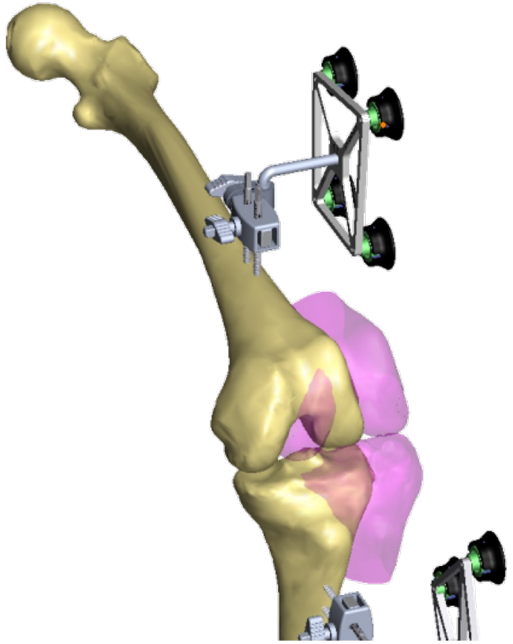
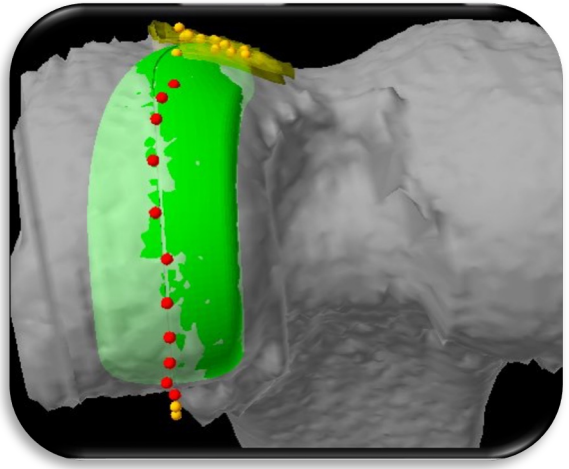


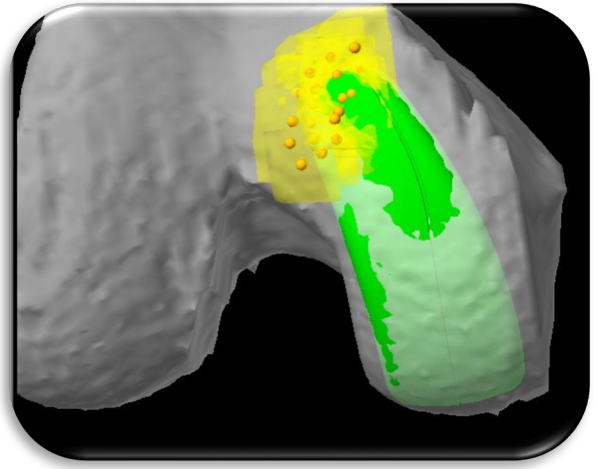


Surgical Technique (cont.)

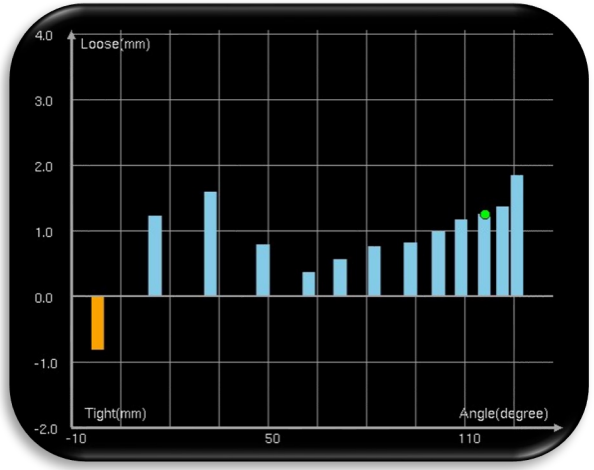
- After obtaining anatomic landmarks, evaluation of coronal and sagittal alignment, flexion and extension laxity and ROM can be measured.
- Infinitely personalized process.



Implant Tracking



Cartilage Mapping



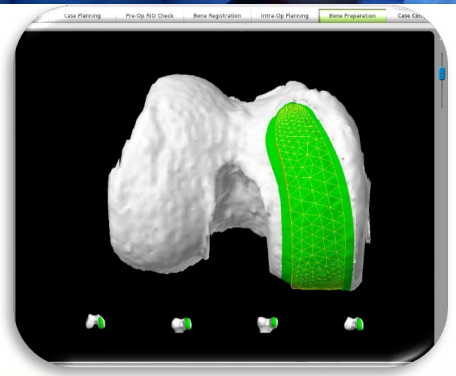
Joint Balancing

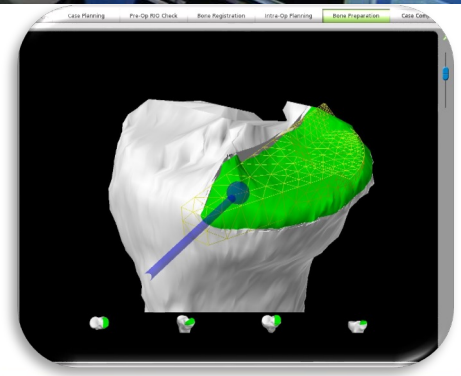
Bone Preparation

- Done through a minimal incision to allow for less tissue damage.

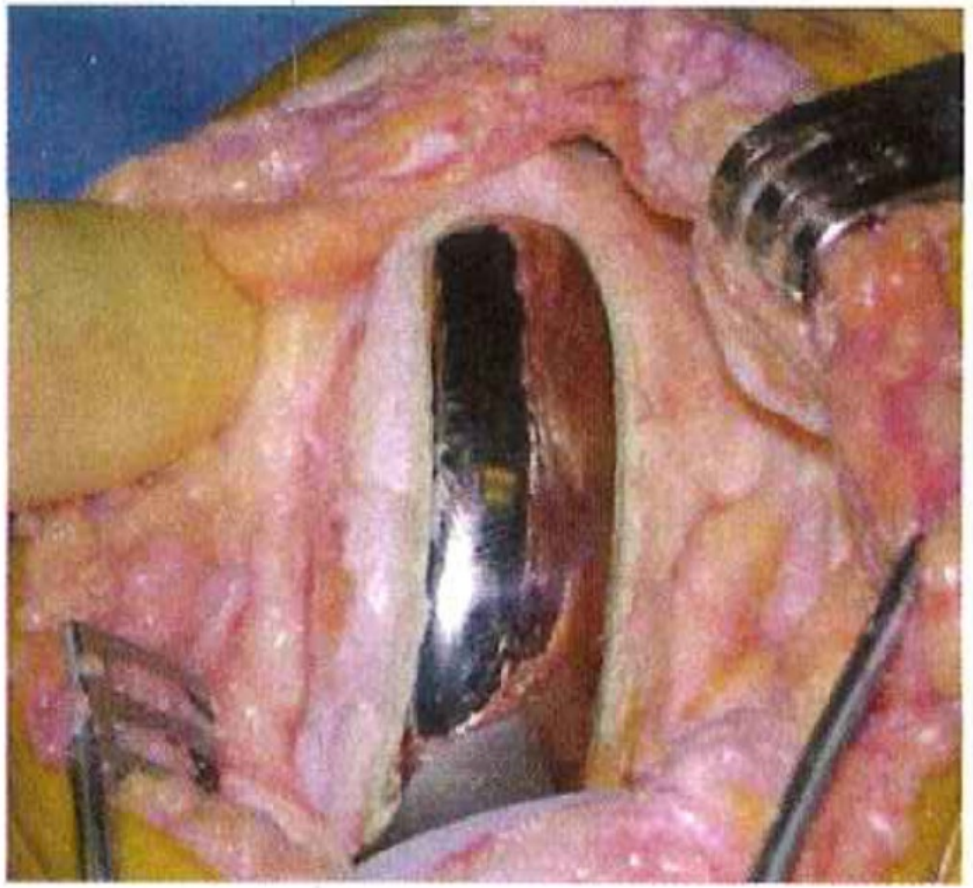
Surgical Technique (cont.)

- After finalizing operative plan a high speed burr is used to make the femoral and tibial cuts.
- The haptic feedback increases and will not allow you to go outside of the planned resection.





Surgical Technique (cont.)



Clinical benefits

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Pre-op

Post-op

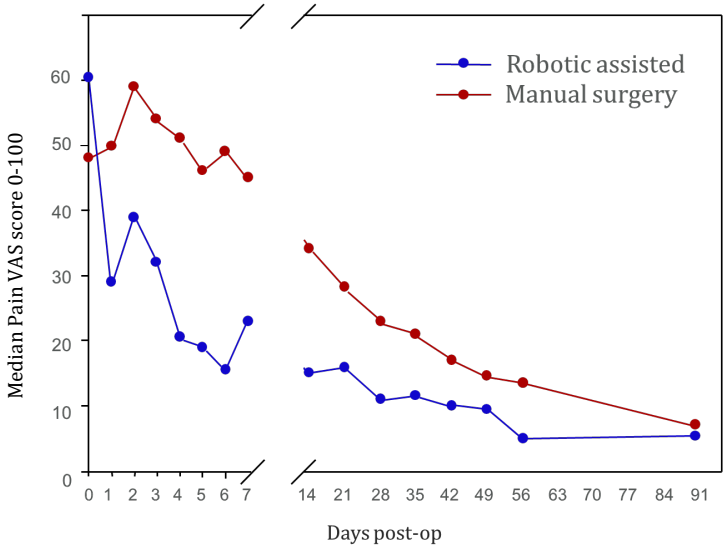
Makoplasty

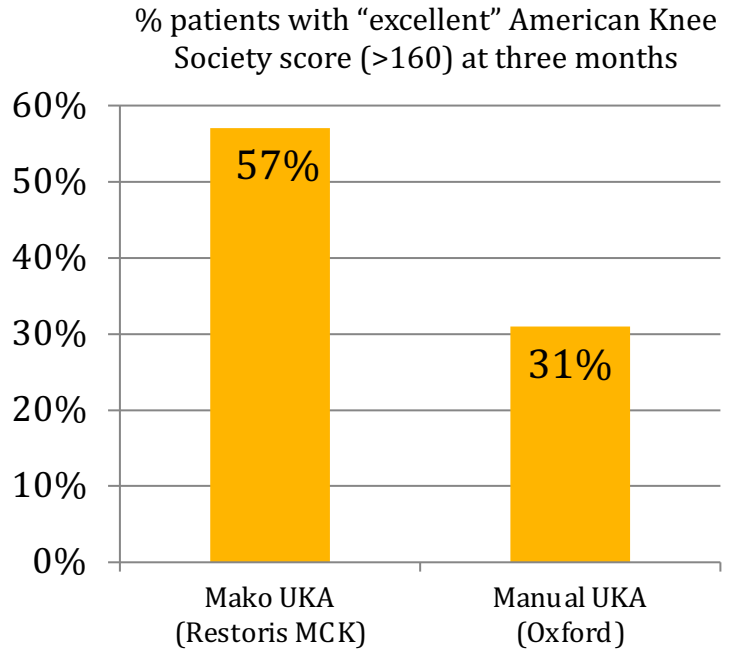
- Less invasive
- Accurate
- Reproducible
- Bone conserving

Patient satisfaction: Mako Partial Knee[6]

This prospective, single-center, level I, blinded, randomized controlled trial compared Mako Partial Knee and Biomet Oxford.

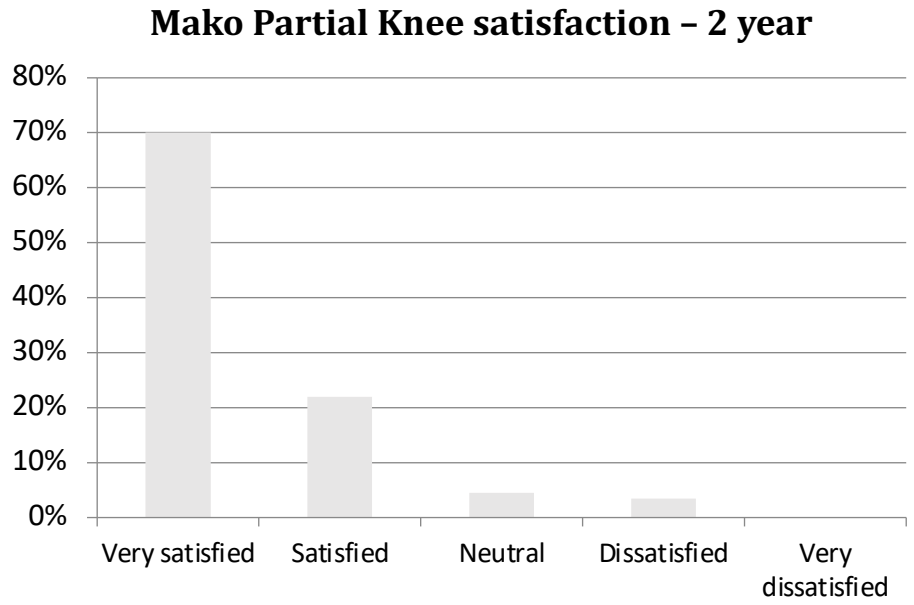
Early results showed higher functional outcomes scores and less early post-operative pain for Mako Partial Knee vs. manual procedures with Biomet Oxford.

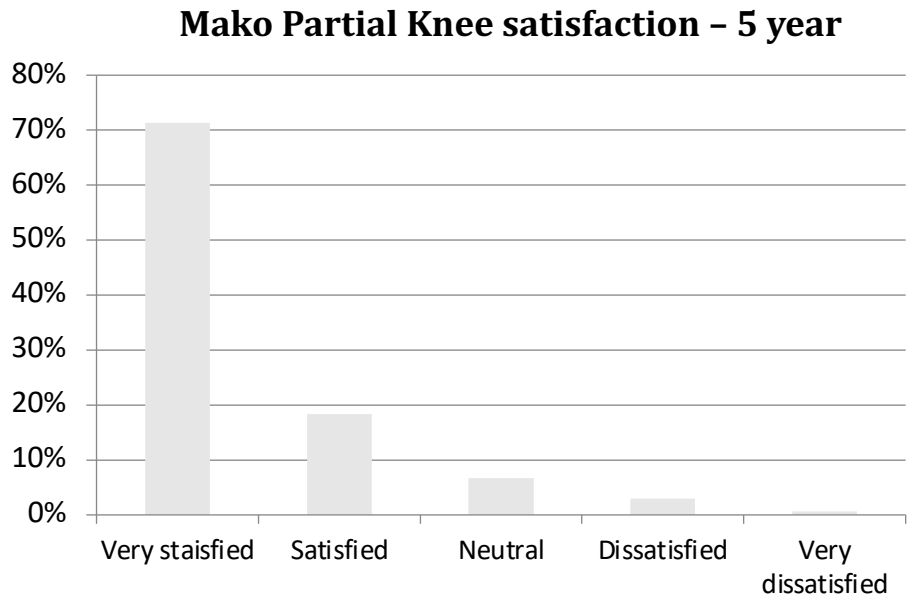




Patient Satisfaction: Mako Partial Knee[7-9]

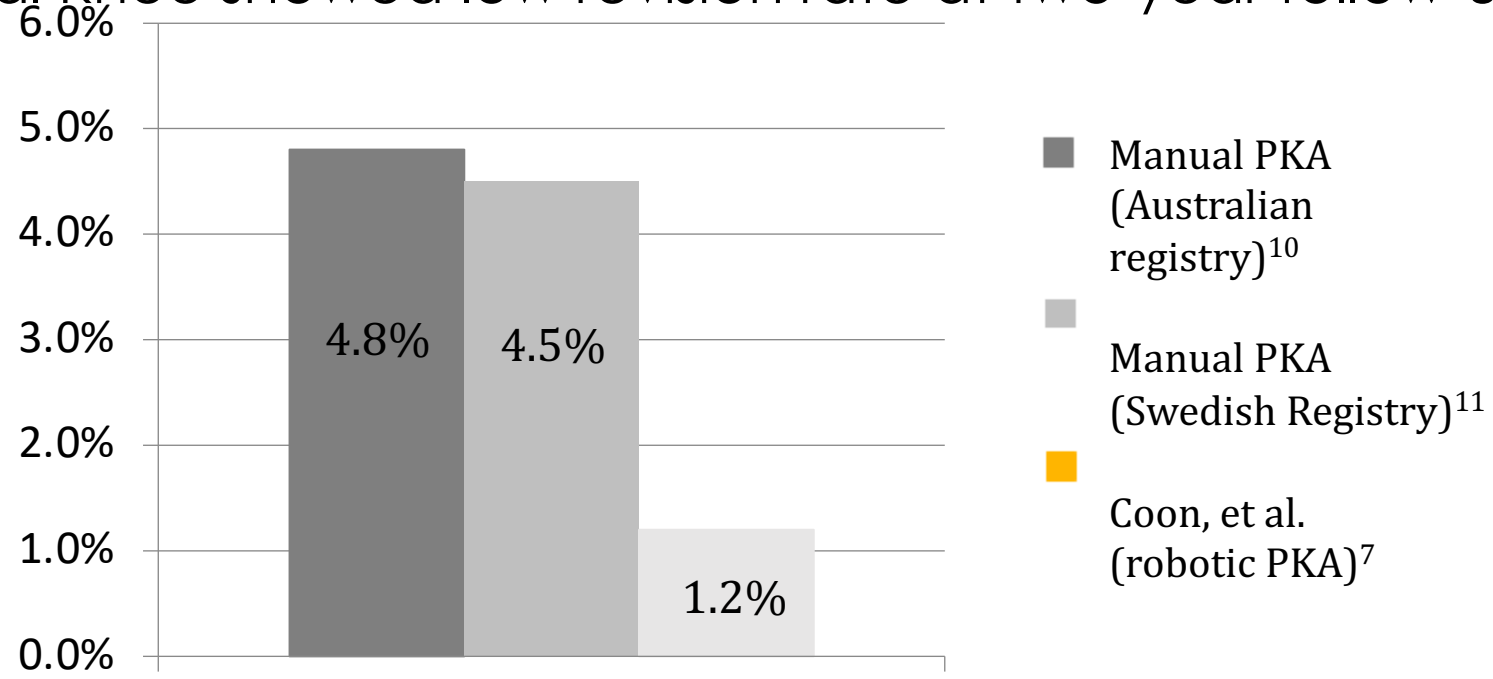
- Mako Partial Knee showed high patient satisfaction at two-year and five-year follow-up.





Survivorship: Mako Partial Knee

- Mako Partial Knee showed low revision rate at two-year follow-up.

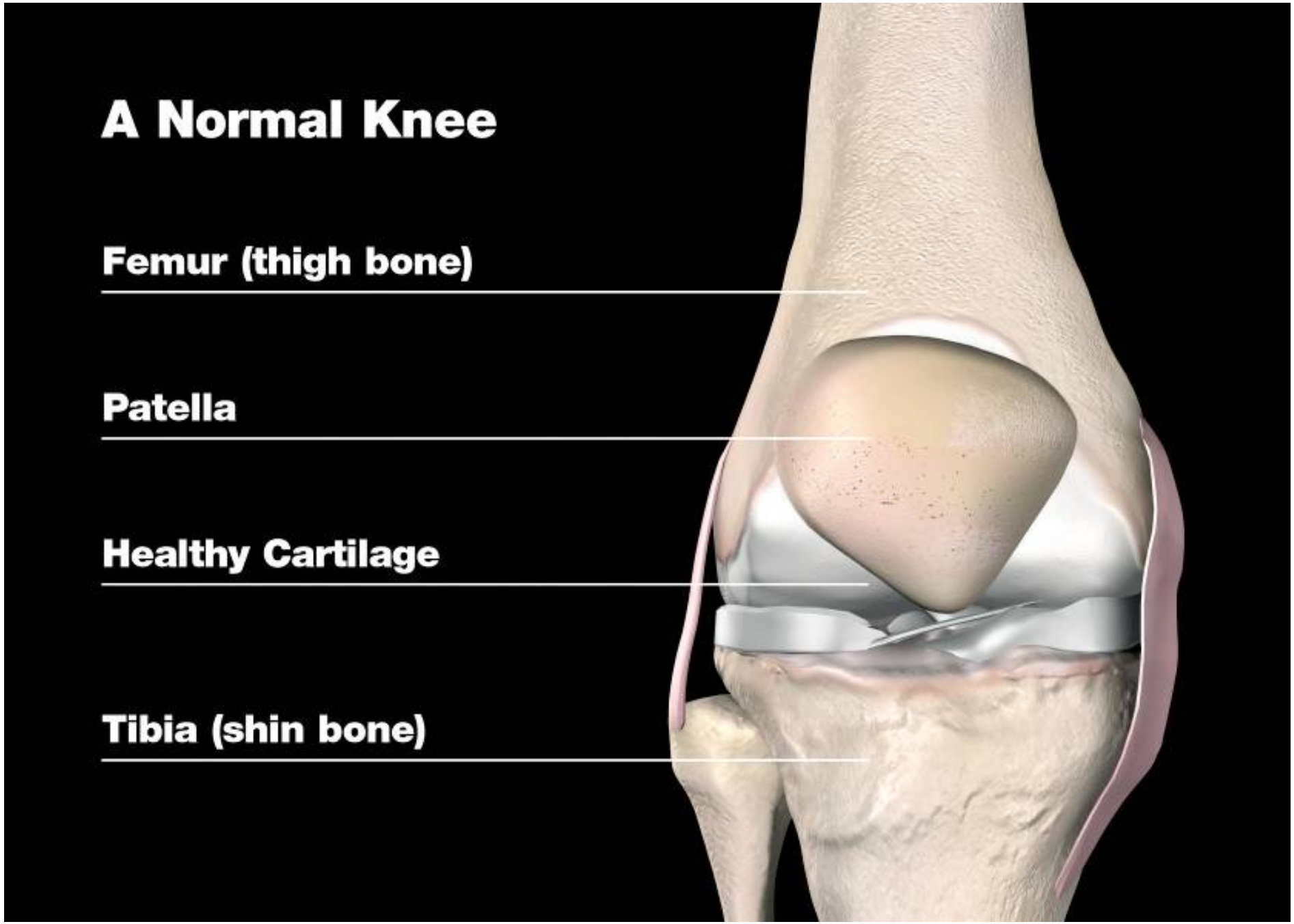


- • Average cost of a revision following a non-robotic primary knee replacement in the US: >$39,000[12]
- • Revision subsequent to a robotic arm-assisted primary knee arthroplasty surgery in the US: $22,941[12]

Mako Total Knee

Total Knee Joint Replacement

- End surface of femur replaced with metal
- End surface of tibia replaced with metal
- Plastic liner is inserted between femur and tibia
- Patella is resurfaced with plastic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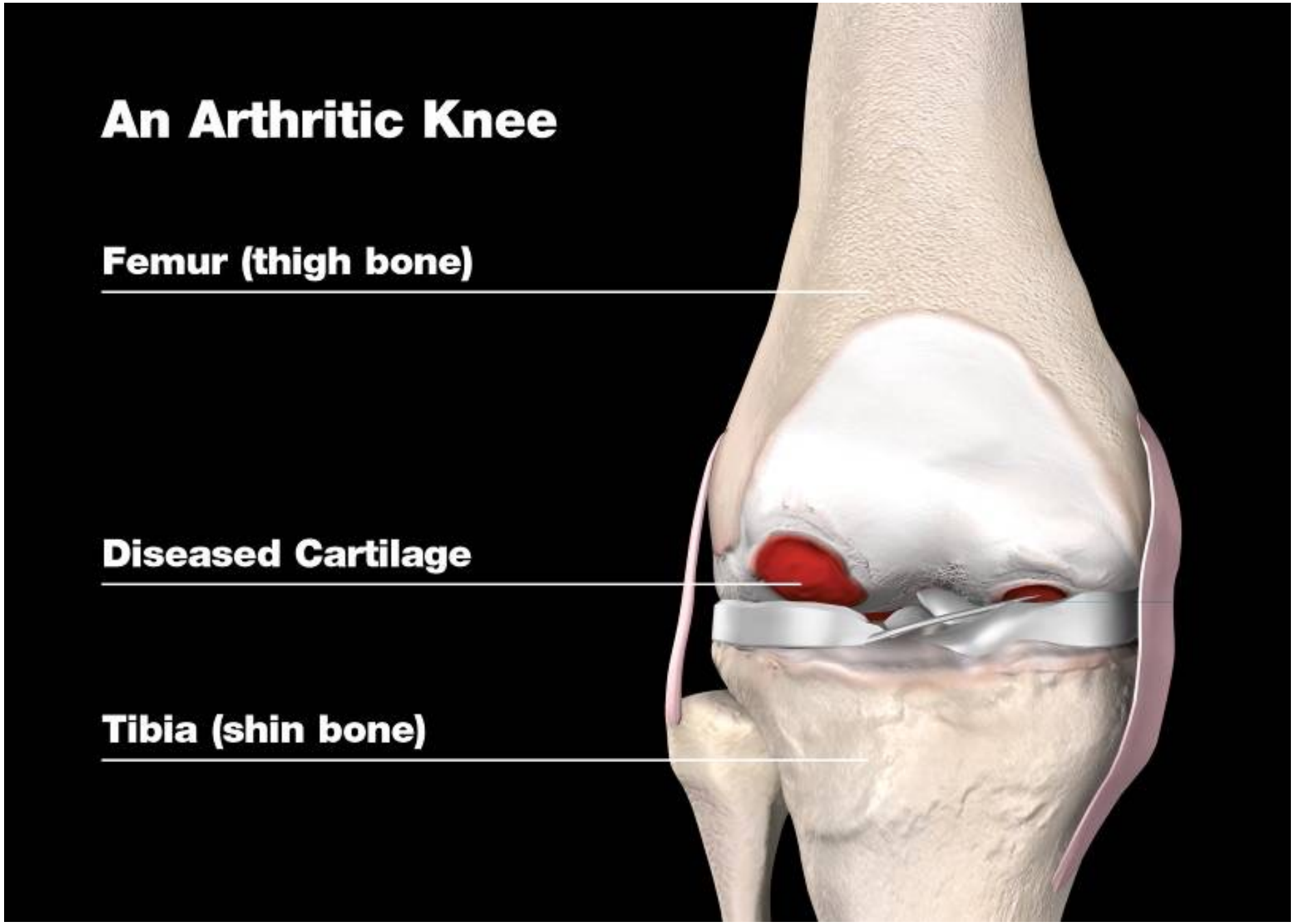
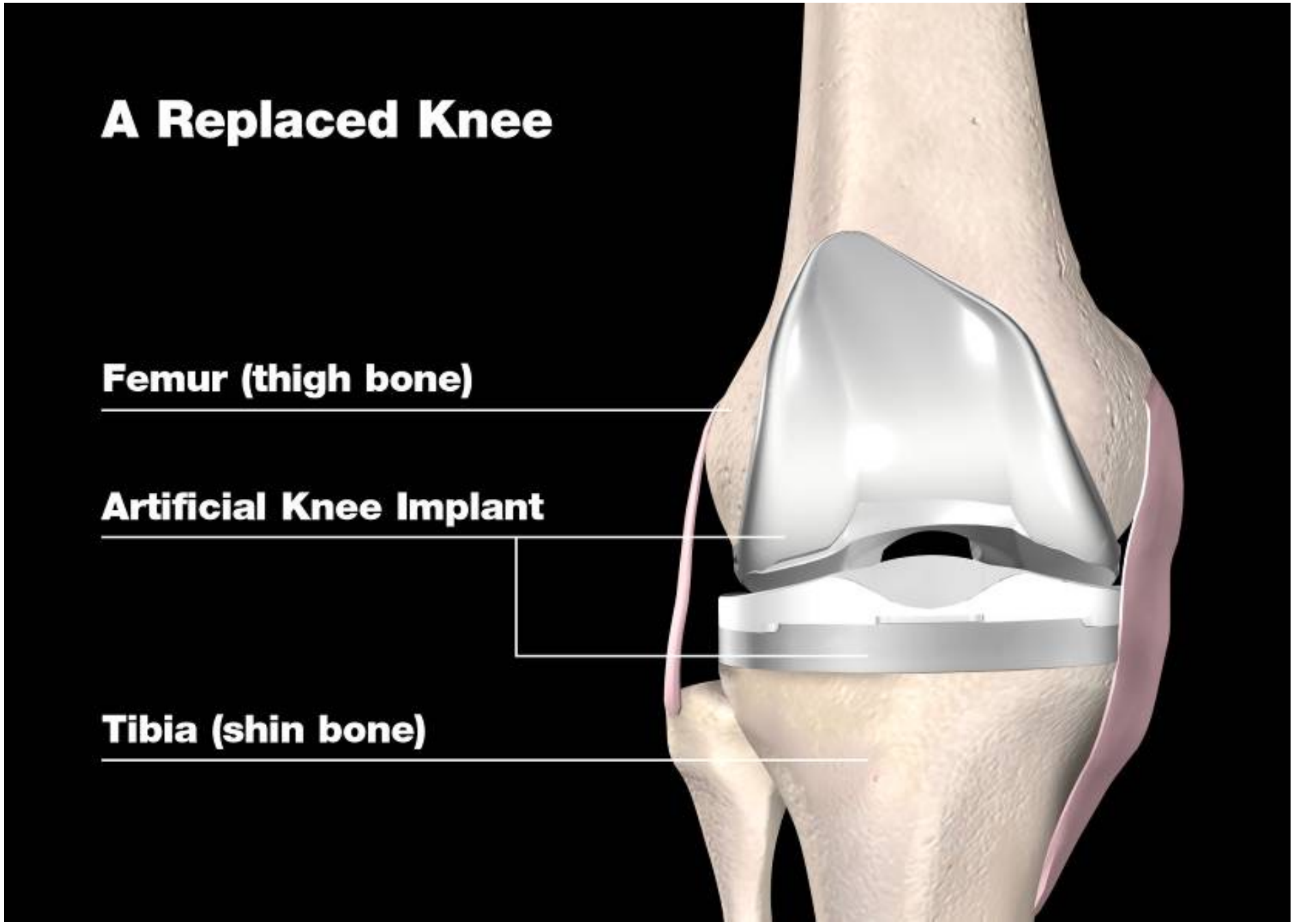
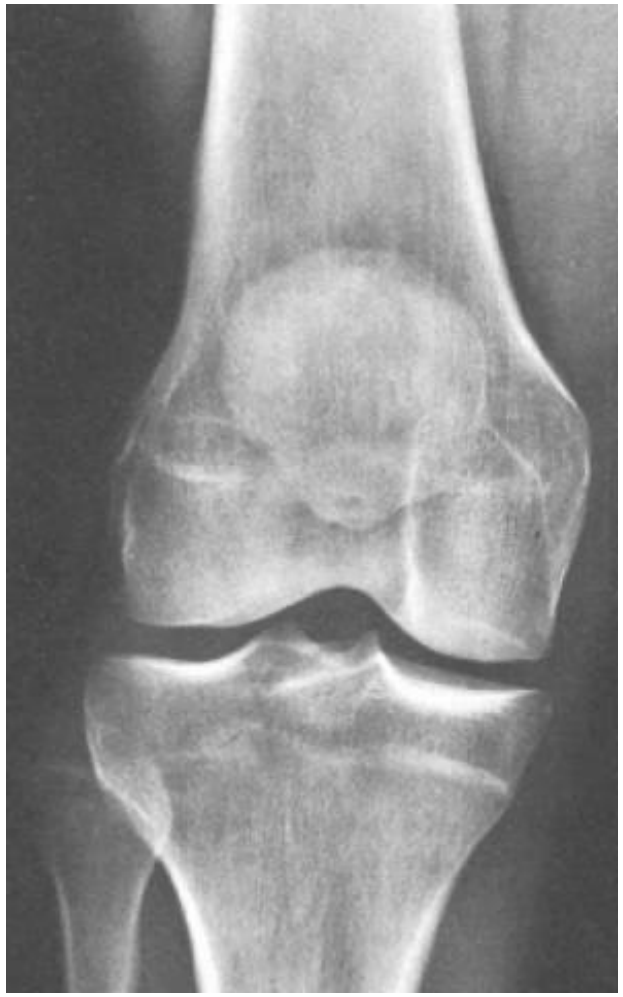

An Arthritic Knee
Femur (thigh bone)
Diseased Cartilage
Tibia (shin bone)

A Replaced Knee



Normal Knee X-ray



Arthritic Knee X-ray

Replaced Knee X-ray

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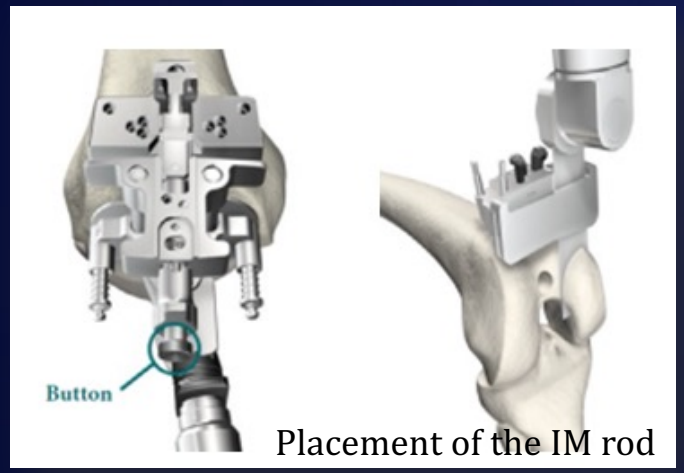
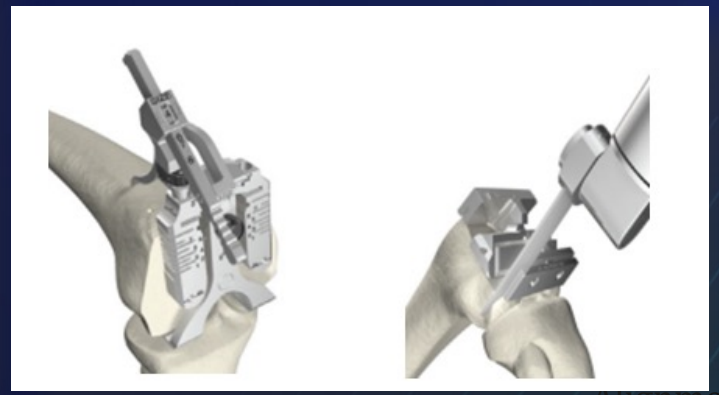
Anterior View

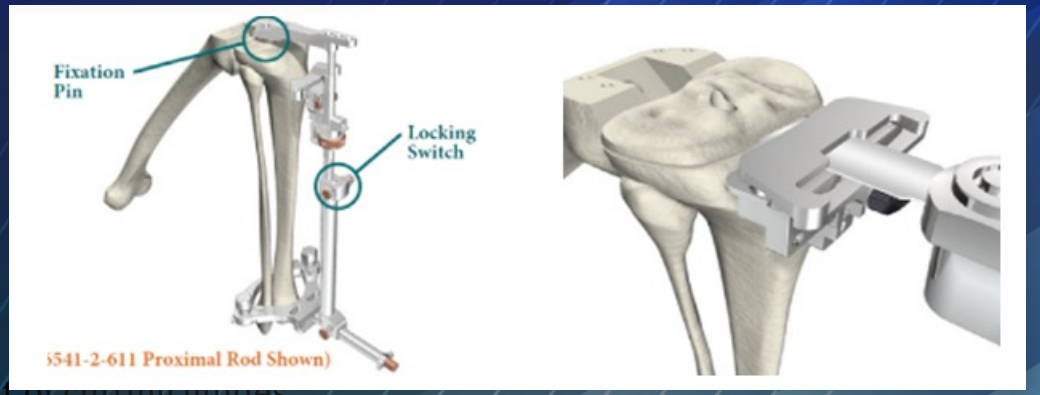
Lateral View

Variability of manual instrumentation



Placement of the IM rod





Alignment of cutting guides

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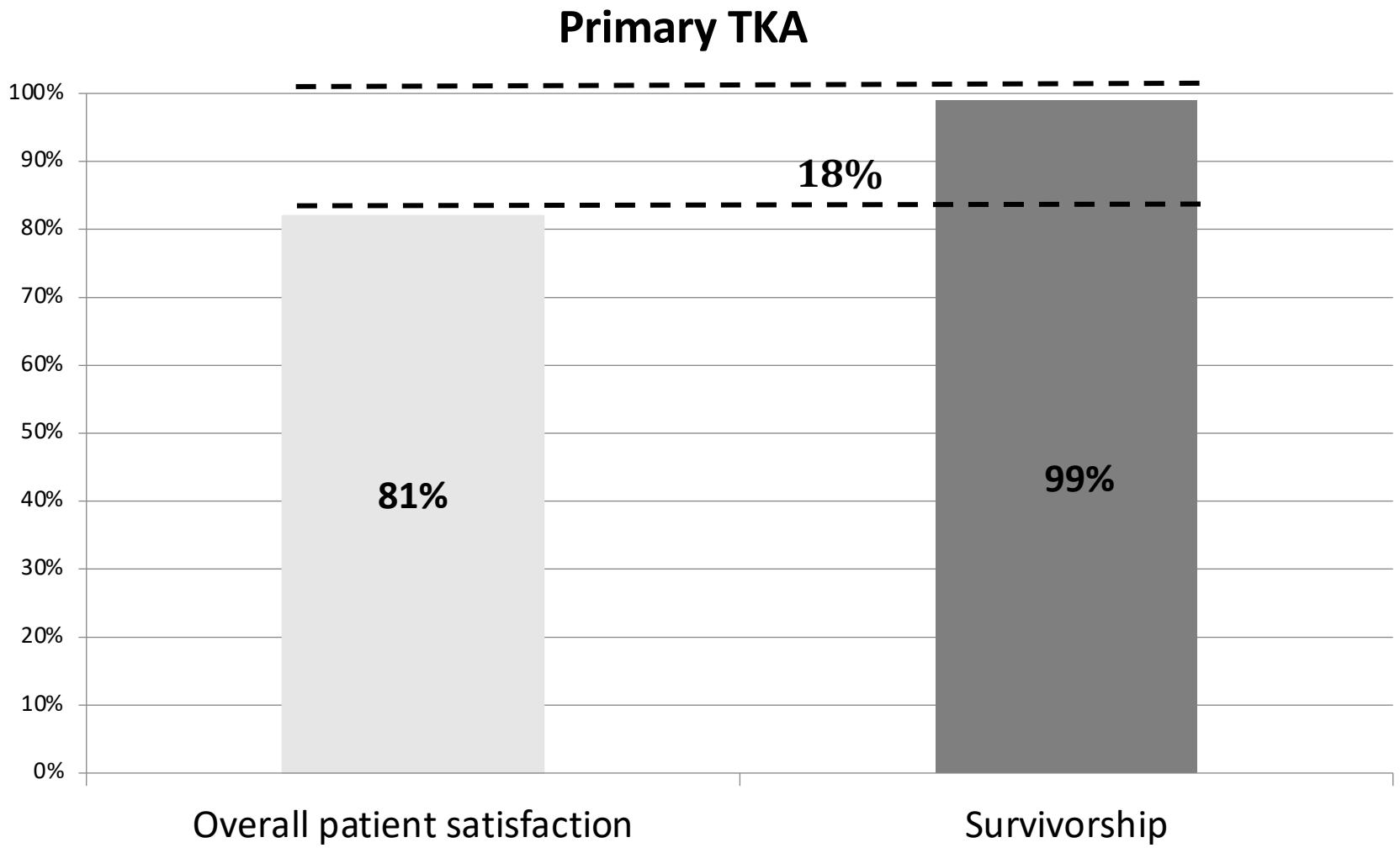
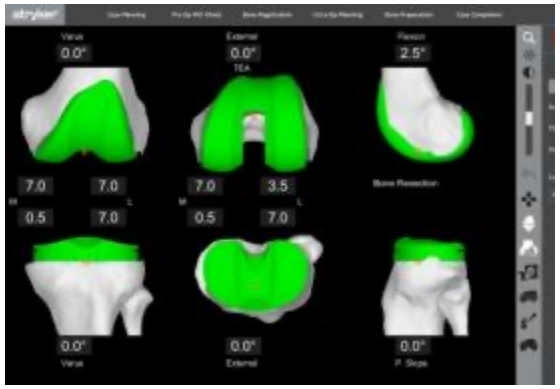
Bigger opportunity to move the needle[13,14]

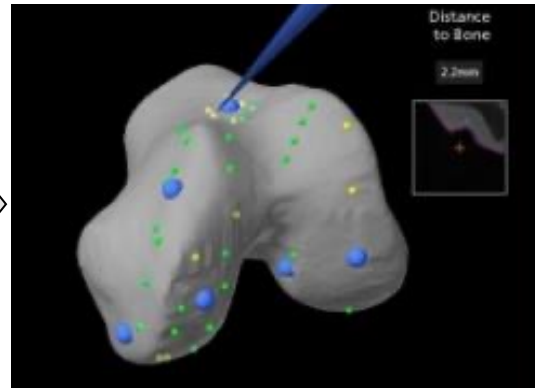


Mako Total Knee Workflow

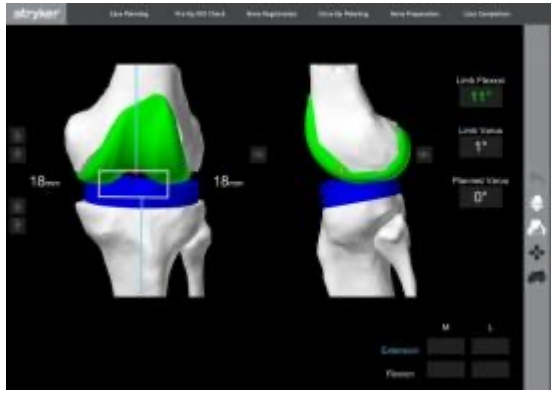


Pre–op planning

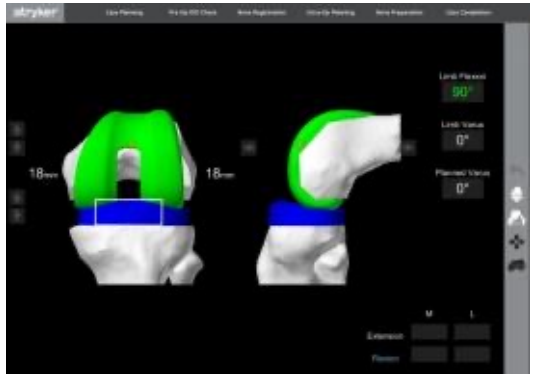
Array placement



Bone registration

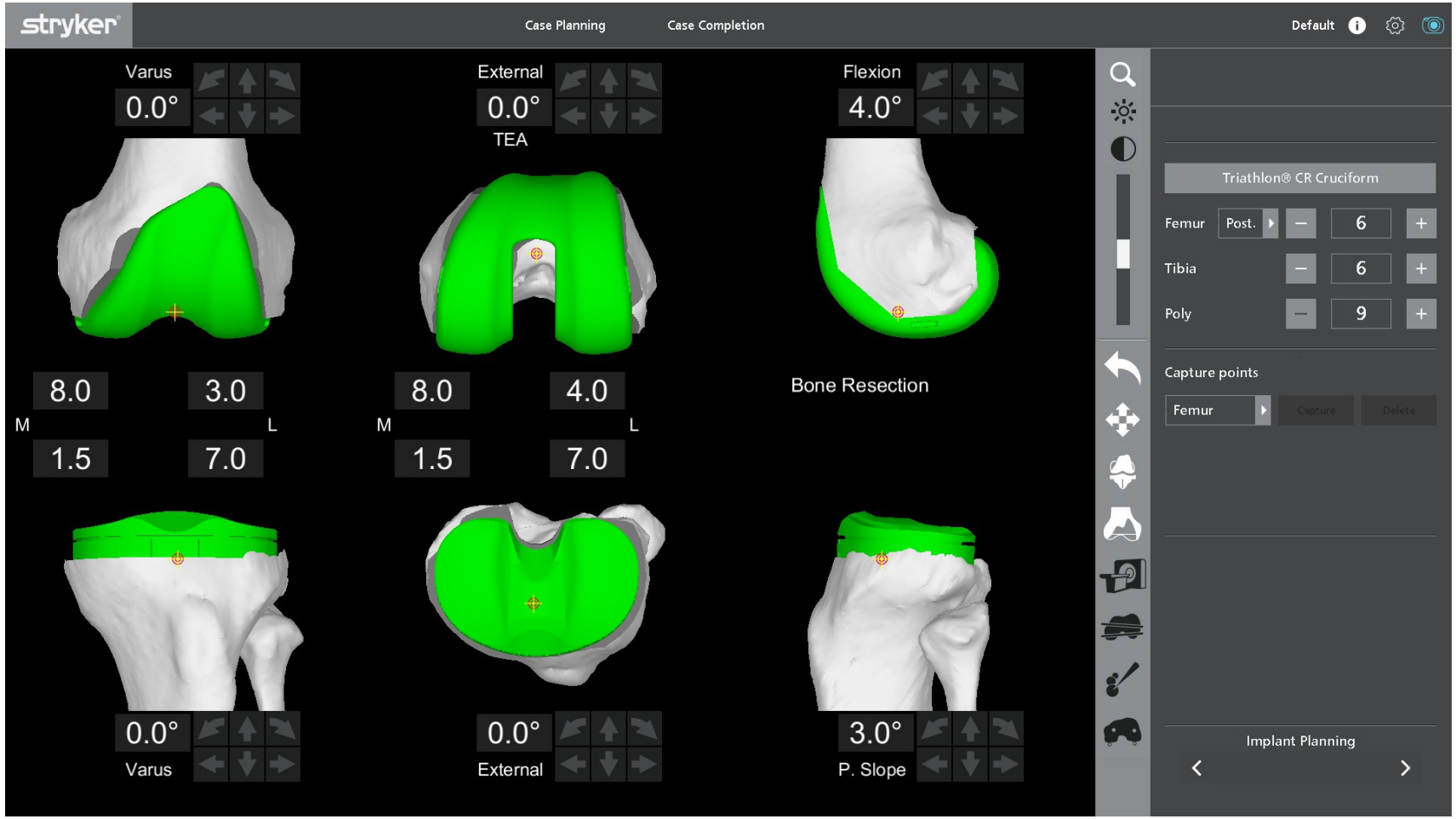


Ligament balancing assessment
Intra-op plan adjustments



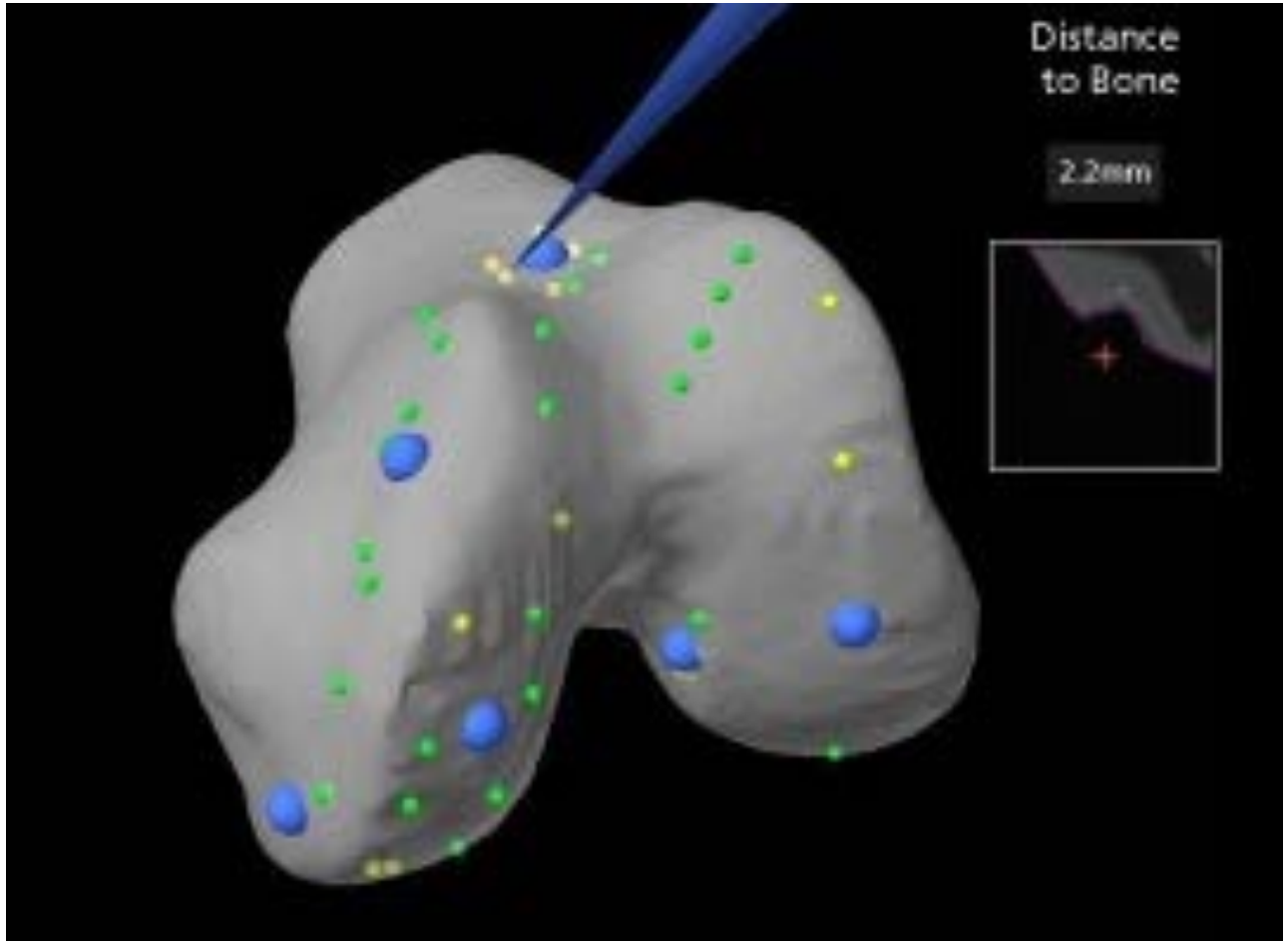
Bone resection

Preop Planning

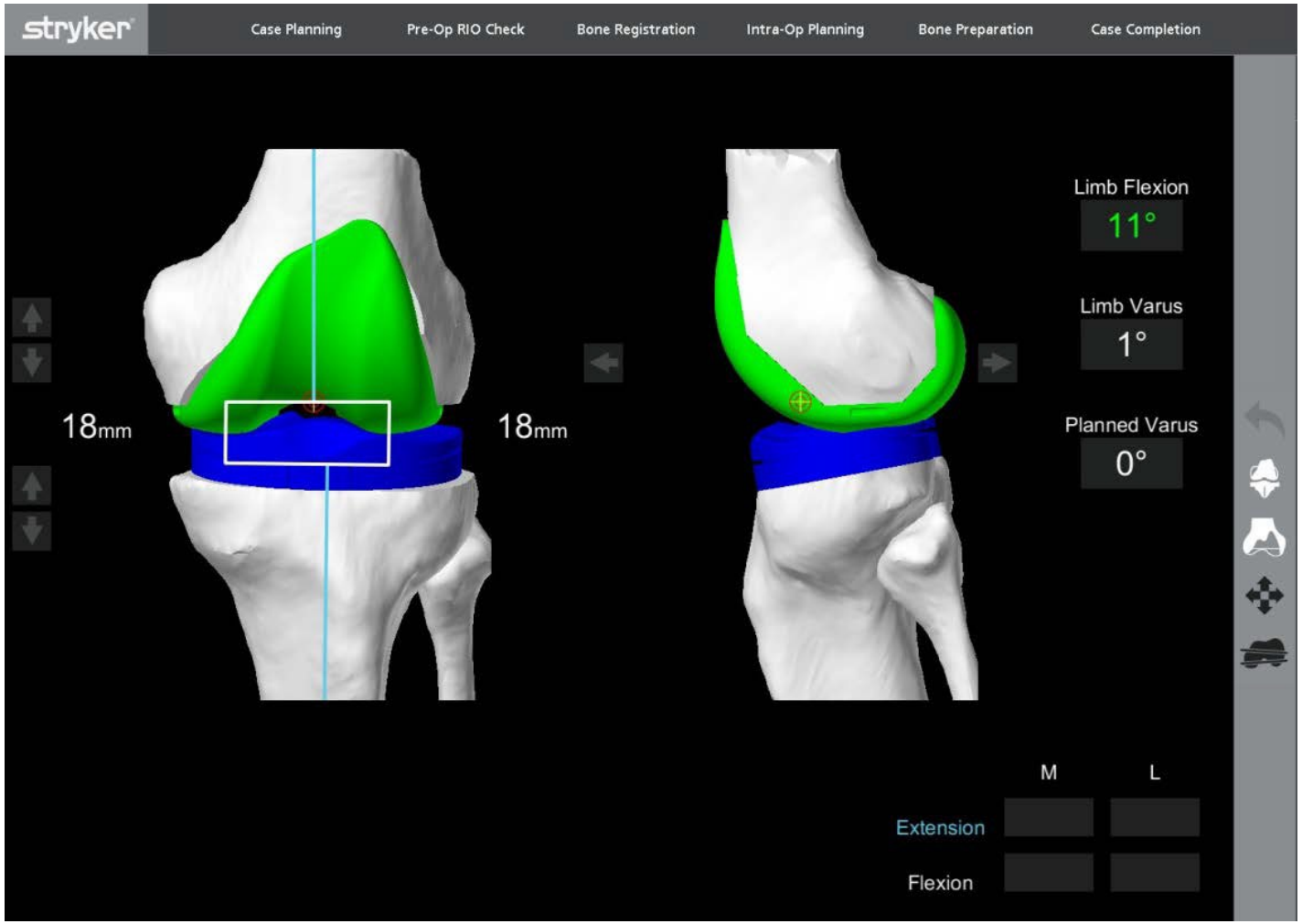


Array Placement

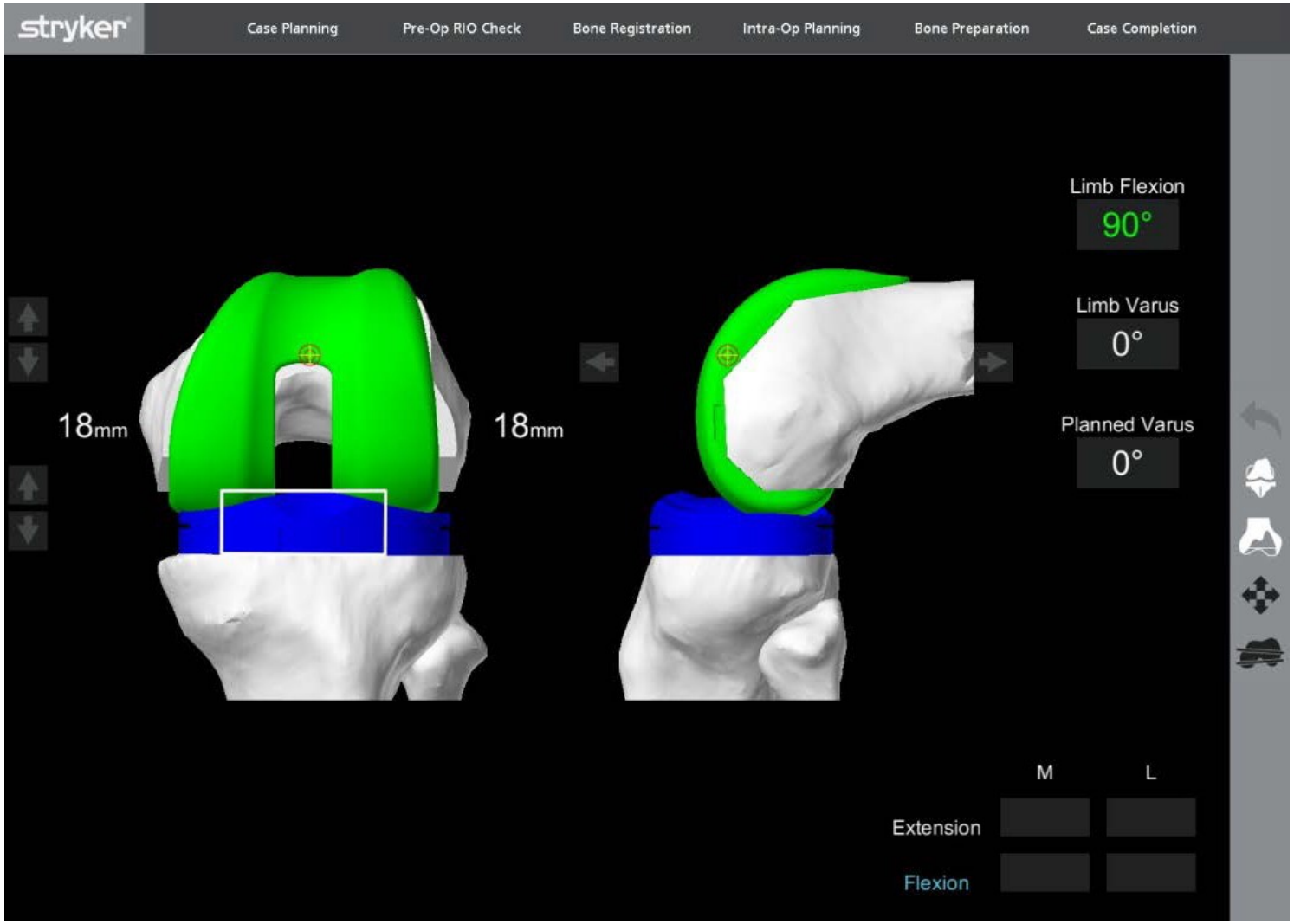
CT-guided Bone Registration



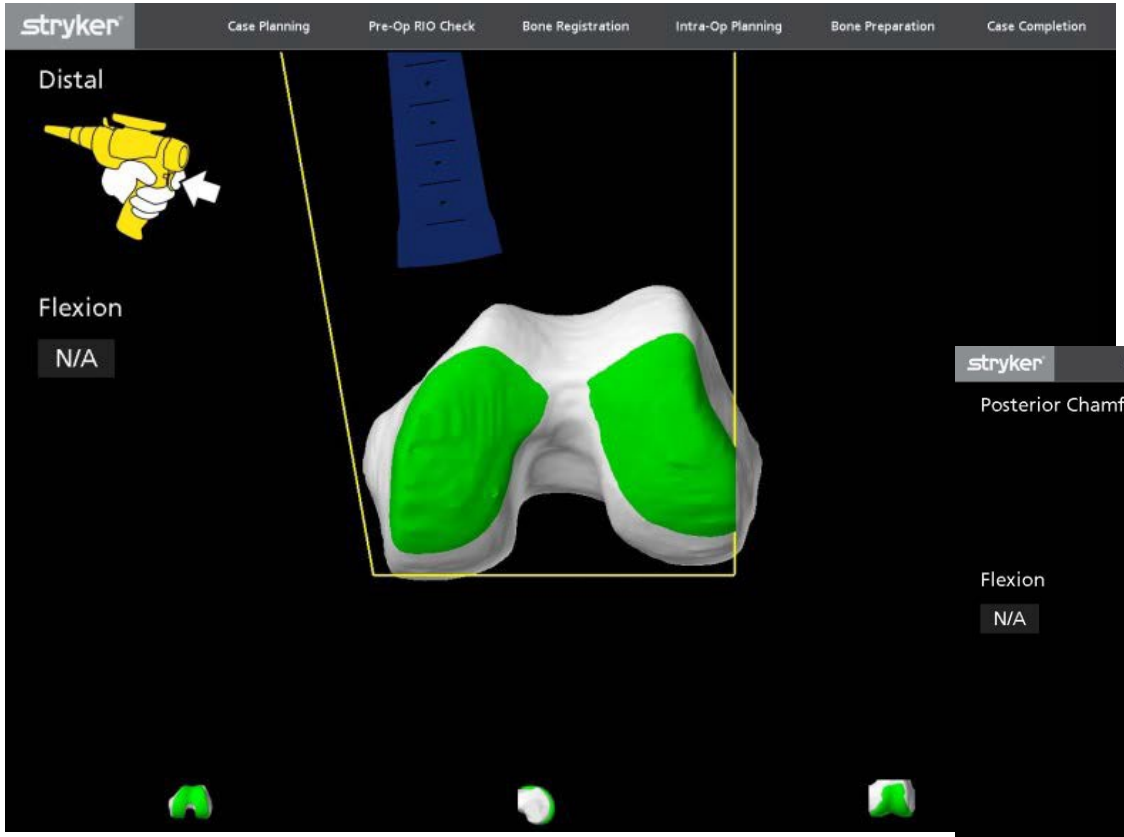
Dynamic Pre-resection Balancing

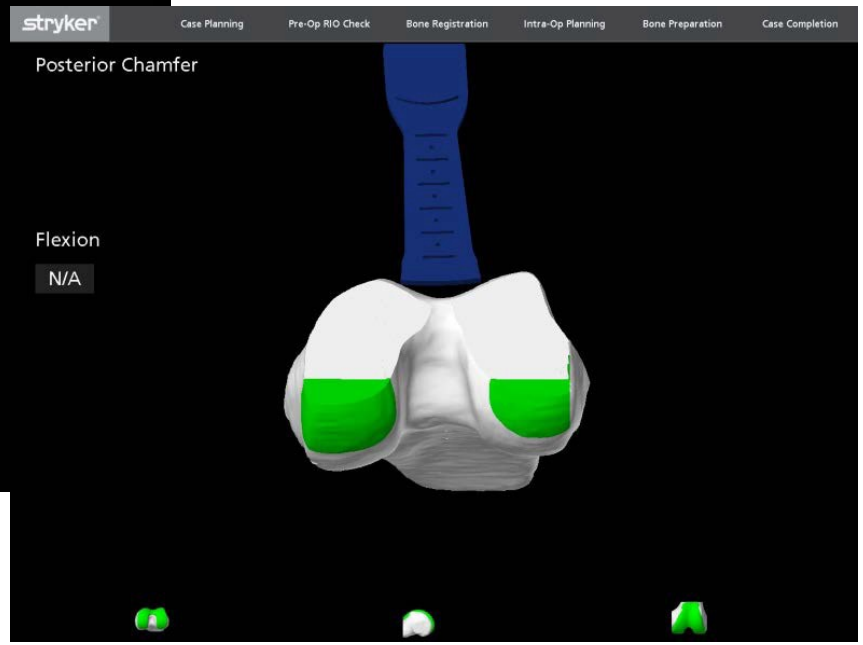


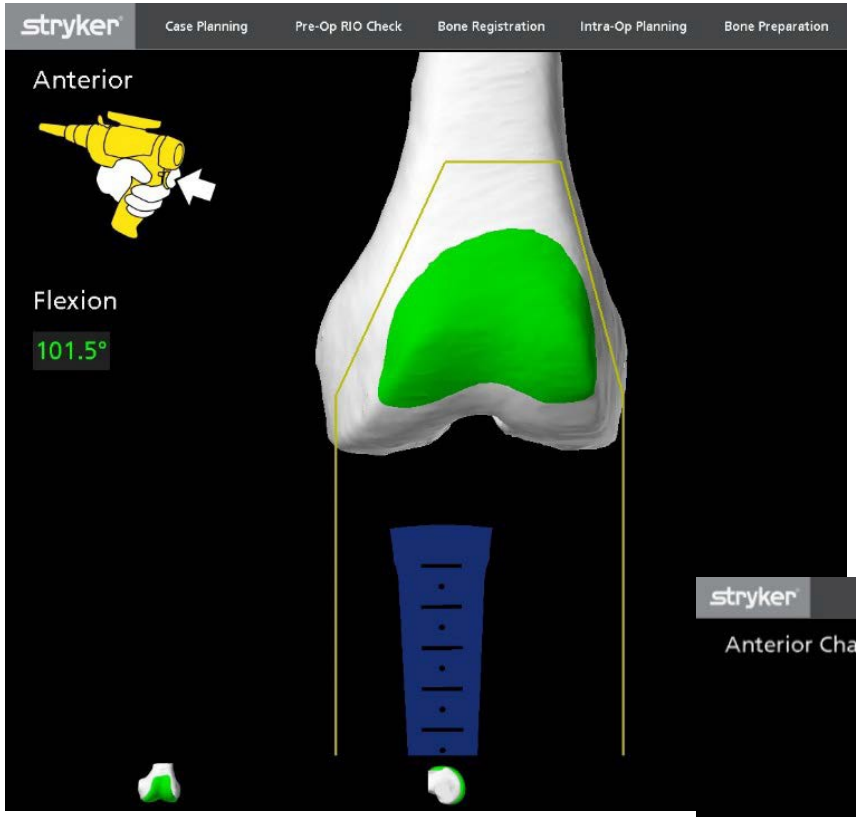
Joint Balancing

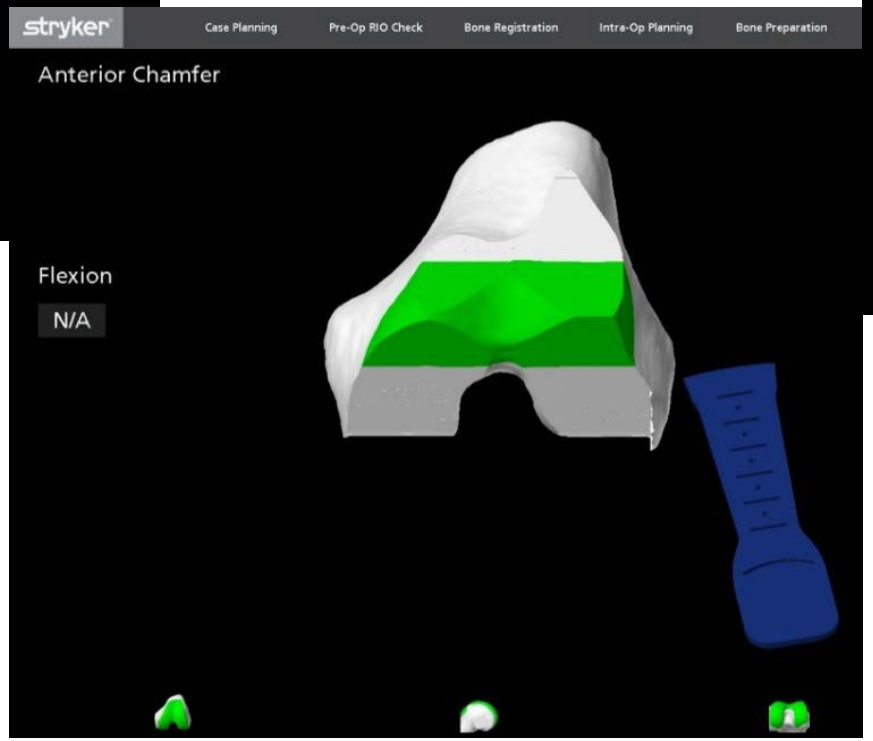


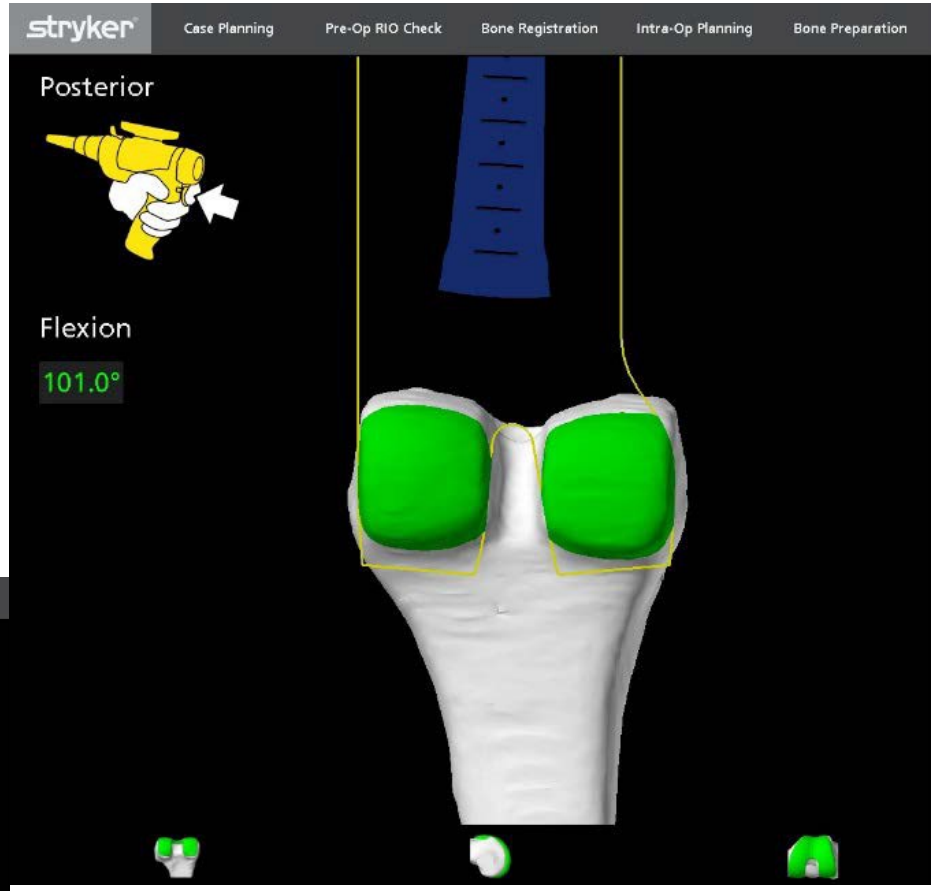
Distal Femur and Posterior Chamfer

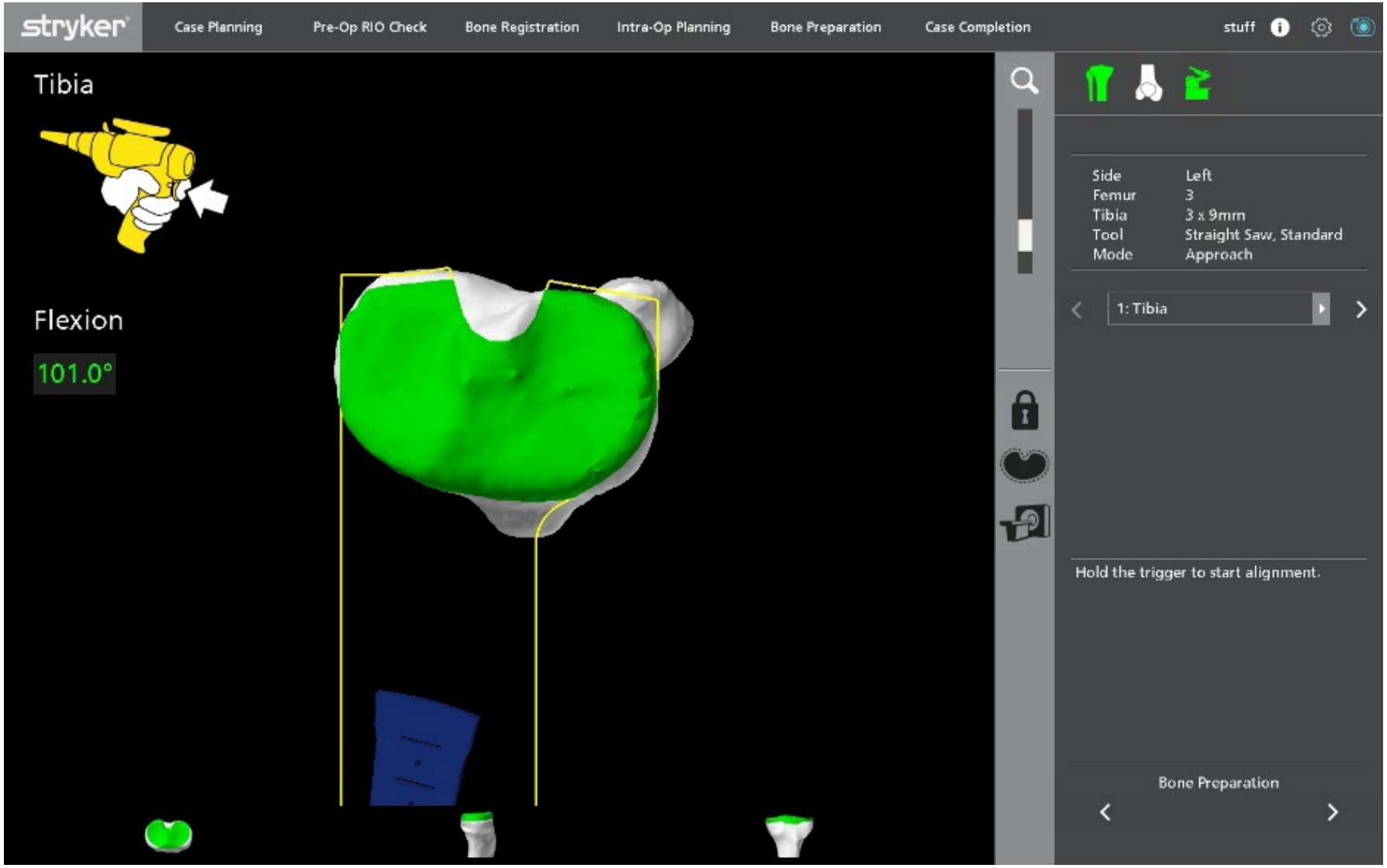





stryker
Case Planning
Pre-Op RIO Check
Bone Registration
Intra-Op Planning
Bone Preparation
Anterior
Flexion
101.5°


stryker
Case Planning
Pre-Op RIO Check
Bone Registration
Intra-Op Planning
Bone Preparation
Anterior Chamfer
Flexion
N/A


stryker
Case Planning
Pre-Op RIO Check
Bone Registration
Intra-Op Planning
Bone Preparation
Posterior
Flexion
101.0°


stryker
Case Planning
Pre-Op RIO Check
Bone Registration
Intra-Op Planning
Bone Preparation
Case Completion
stuff
Tibia
Flexion
101.0°
Side Left
Femur 3
Tibia 3 x 9mm
Tool Straight Saw, Standard
Mode Approach
1: Tibia
Hold the trigger to start alignment.
Bone Preparation

Early Clinical results

The Bone & Joint Journal
70 years of orthopaedic excellence

Knee

Free Access

Robotic-arm assisted total knee arthroplasty is associated with improved early functional recovery and reduced time to hospital discharge compared with conventional jig-based total knee arthroplasty

a prospective cohort study

B. Kayani, S. Konan, J. Tahmassebi, J. R. T. Pietrzak, F. S. Haddad

Published Online: 28 Jun 2018 | https://doi.org/10.1302/0301-620X.100B7.BJJ-2017-1449.R1

Table II Study outcomes for patients undergoing conventional jig-based total knee arthroplasty (TKA) and robotic-arm assisted TKA

Outcome	Conventional (n = 40)	Robotic (n = 40)	p-value
Mean operating time (mins)	61.2 (54.6 to 83.1)	70.4 (59.2 to 91.7)	0.34*
Mean fall in Hb (g/L)	26.1 (5.1 to 49.6)	18.7 (8.0 to 37.2)	< 0.001*
Mean postoperative Hb (g/L)	106.7 (77.3 to 138.4)	114.7 (86.4 to 139.1)	0.01*
Mean pain score (NRS) – Day 0	5.4 (3.0 to 7.0)	3.1 (2.0 to 5.0)	< 0.001*
Mean pain score (NRS) – Day 1	6.3 (4.0 to 8.0)	3.6 (2.0 to 6.0)	< 0.001*

Minimally Invasive TKA

- Provide early and exceptional analgesia
- Low trauma surgery
- Early discharge and rapid rehab

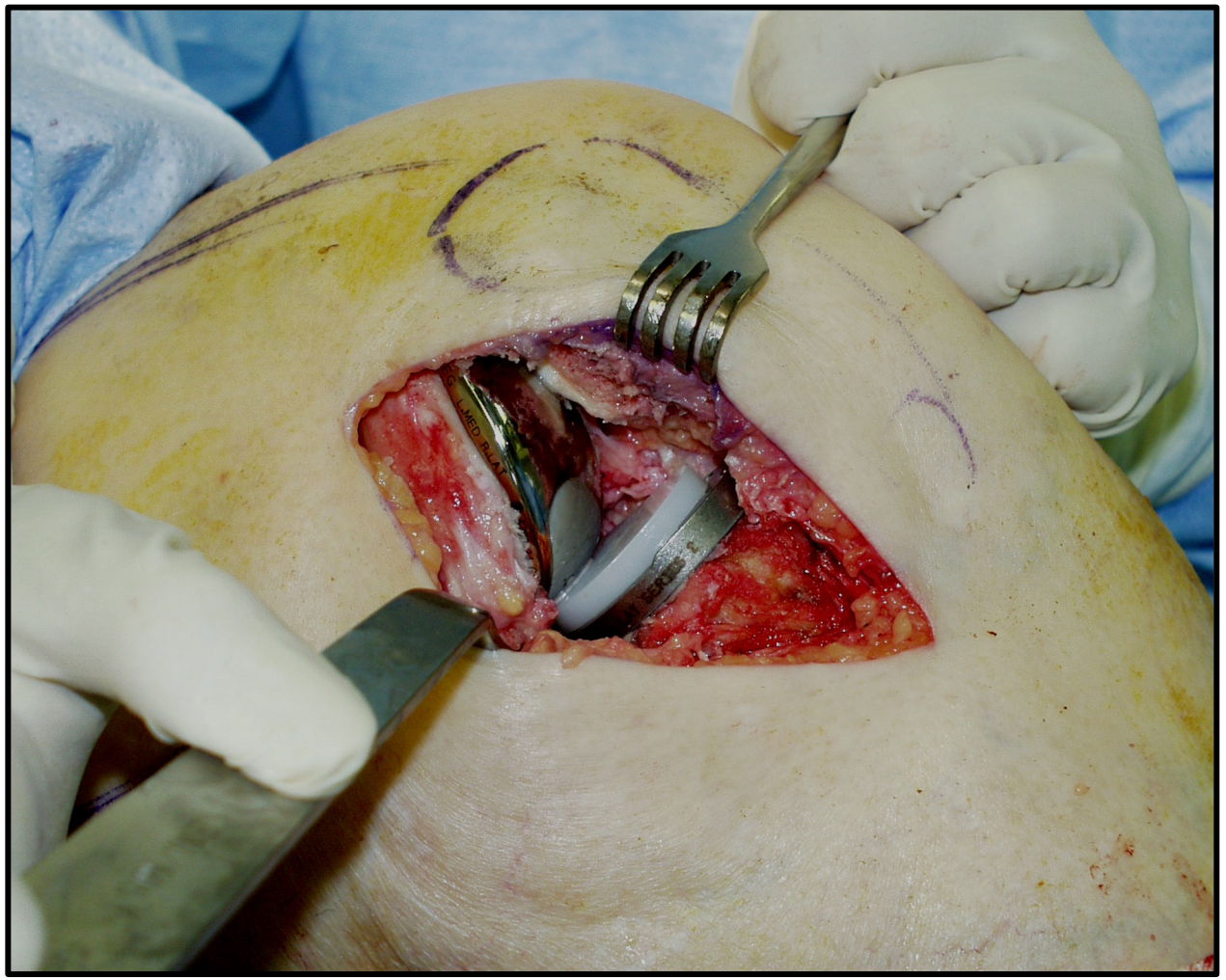
Prevent the Bad Effects

- Pre-emptive analgesia
  - Celebrex
  - Spinal Anesthetic

- Pre-emptive anti nausea
  - Pepcid

Operative Management

- SPINAL anesthetic
- IV sedation
- Capsular injection



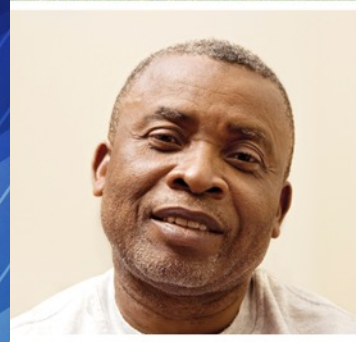
Post-Operative Management

- Early ROM with PT
- Ambulation same day

Post-Operative Management

- Gait training POD1
- Stairs and PT instruction
- Possible outpatient

Update on Hip Arthroplasty



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The Very Important Bearing Surface Hip Arthroplasty

- The bearing affects
  - Performance
  - Flexibility
  - Durability
  - Longevity

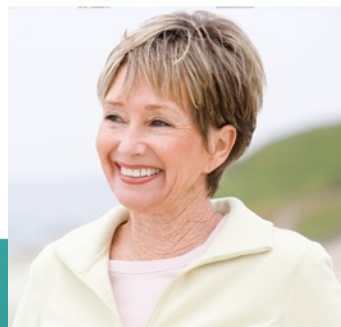
- Options for bearings in hip replacements
  - Ceramic-on-ceramic
  - Metal-on-plastic
  - Metal-on-metal
  - Ceramic-on-plastic

The bearing surface:
The two parts that glide together throughout motion

Femoral head and acetabular insert in hips


GREY'S ANATOMY
abc

MIS Hip Replacement
Direct Anterior Approach



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What is the ‘Direct Anterior Approach’?

- The direct anterior approach is a minimally invasive hip replacement technique that allows the surgeon good access to the hip without detaching any muscles or tendons.

Traditional vs. Direct Anterior Approach

Traditional Hip Replacement

- 8-12 inch incision
- Surgical approach - side (lateral) or back (posterior)
- Disturbance of the joint and connecting tissues

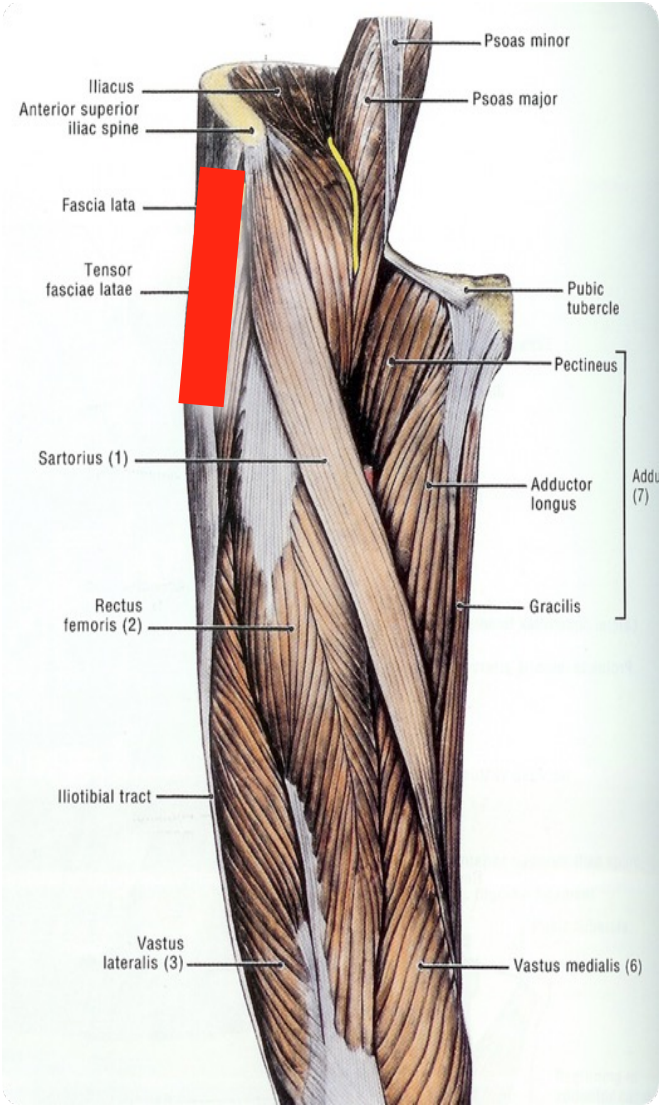
MIS with Direct Anterior Approach

- 4-5 inch incision
- Surgical approach – front (anterior)
- Muscles or tendons not detached

Why I Do The Direct Anterior Approach?

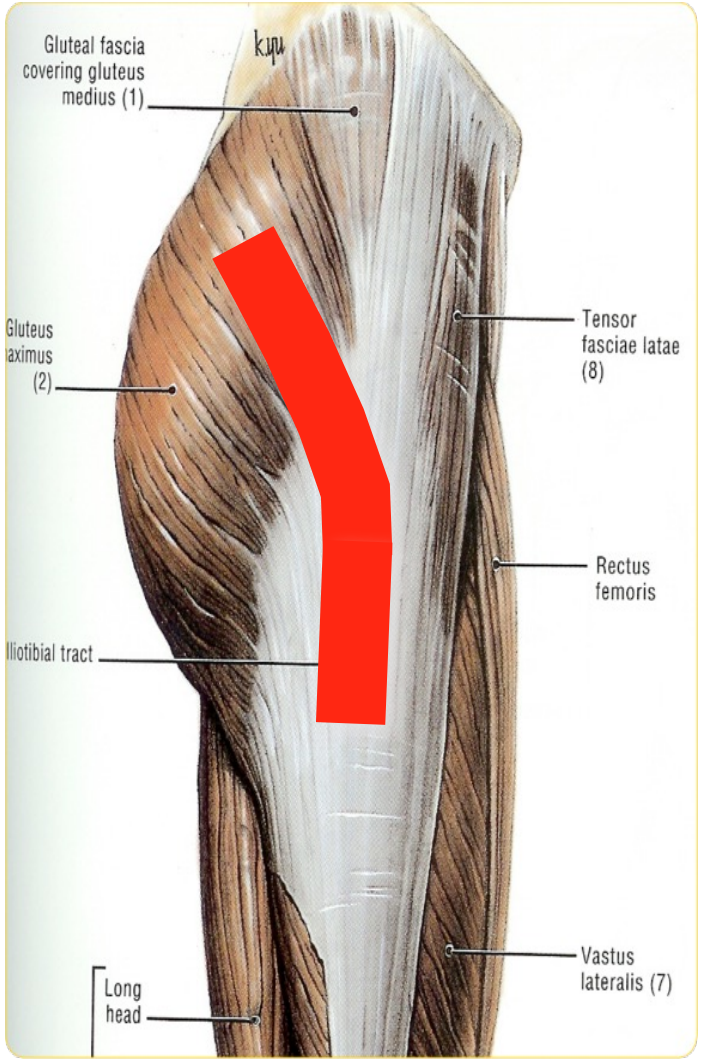
Why Direct Anterior?

- Hip closer to the front of the body
- Surgical anatomy
- Doesn't detach any major muscles
- Minimal risk to nerves
- Truly MIS



Why Direct Anterior?

- Less pain
- Quicker restoration of function
- Shorter hospital stay
- Probably more economical



Direct Anterior Hip Replacement

Why?

- Ideal soft tissue interval
- Ease of patient position
- Simple socket instrumentation

Direct Anterior Hip Replacement

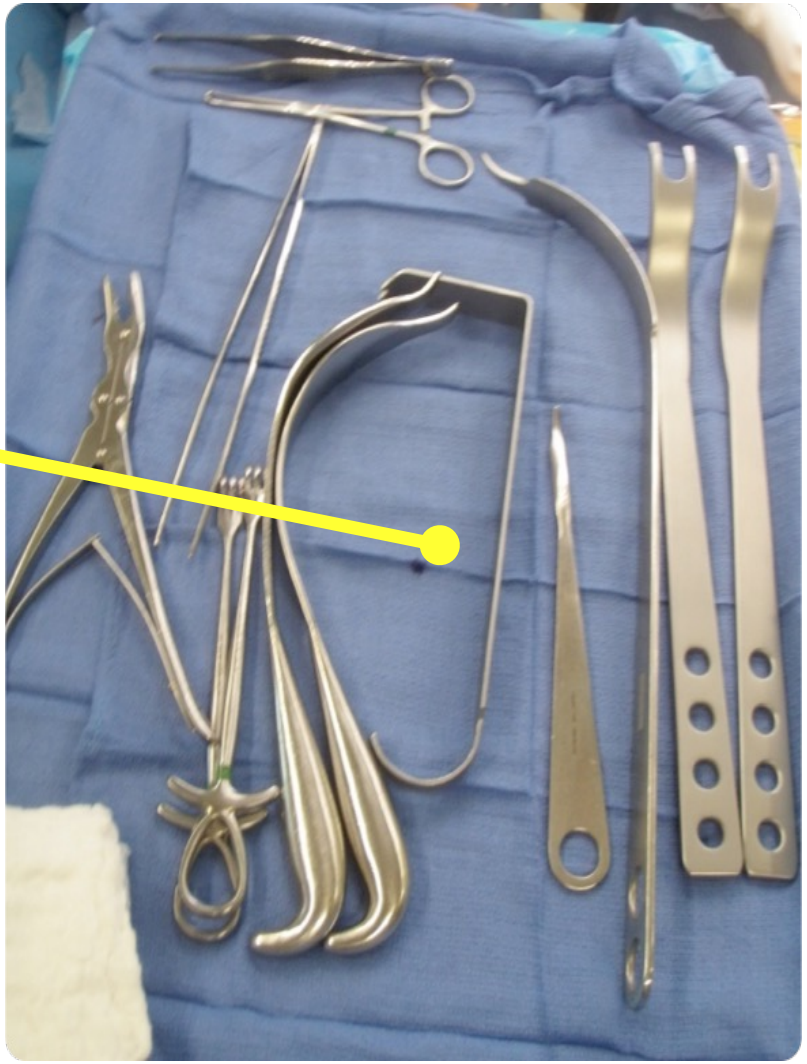
Why not?

- Unfamiliar territory
- Femoral exposure is difficult
- Specialized equipment

How it's done

Special Instruments

Retractors



Special Equipment

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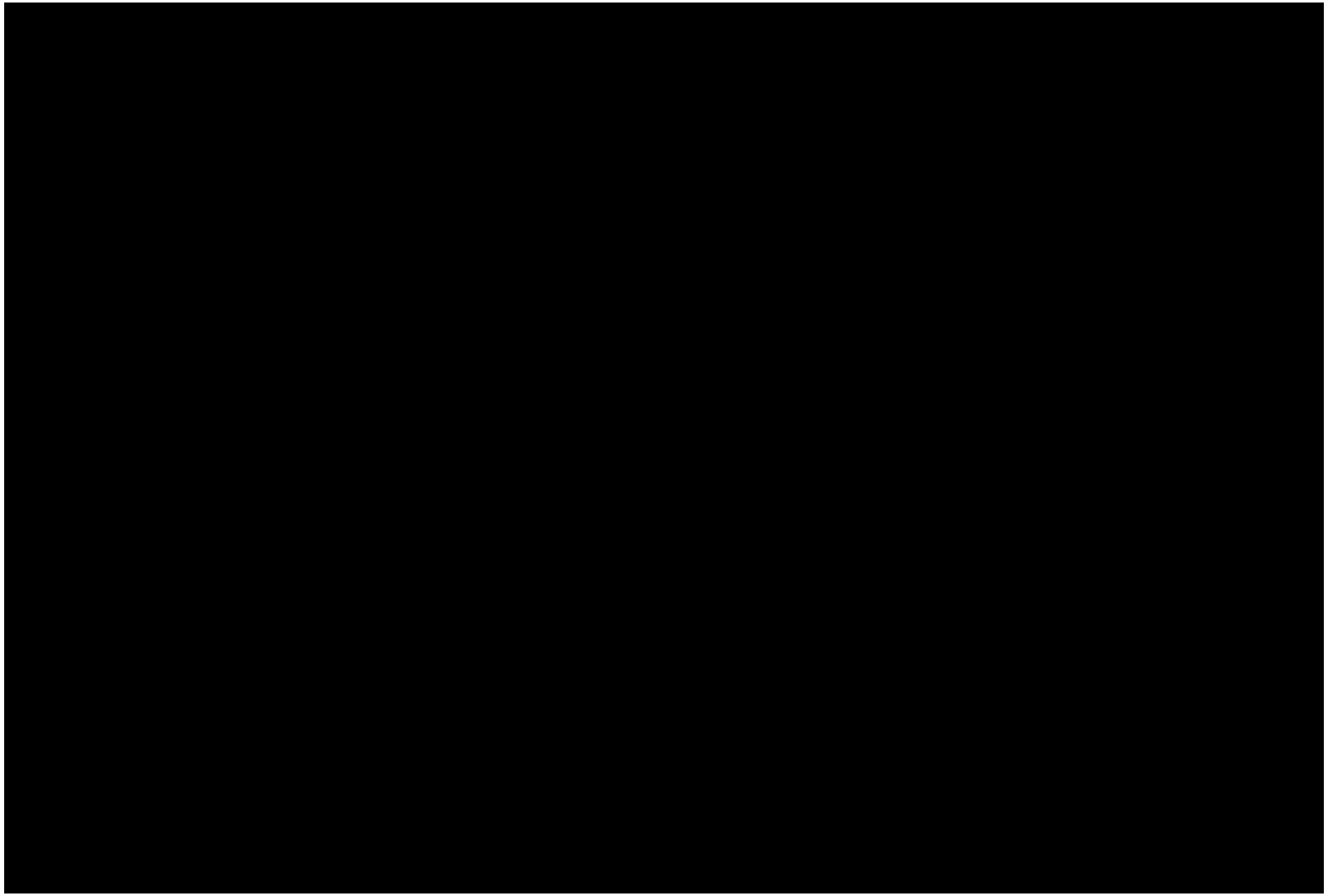
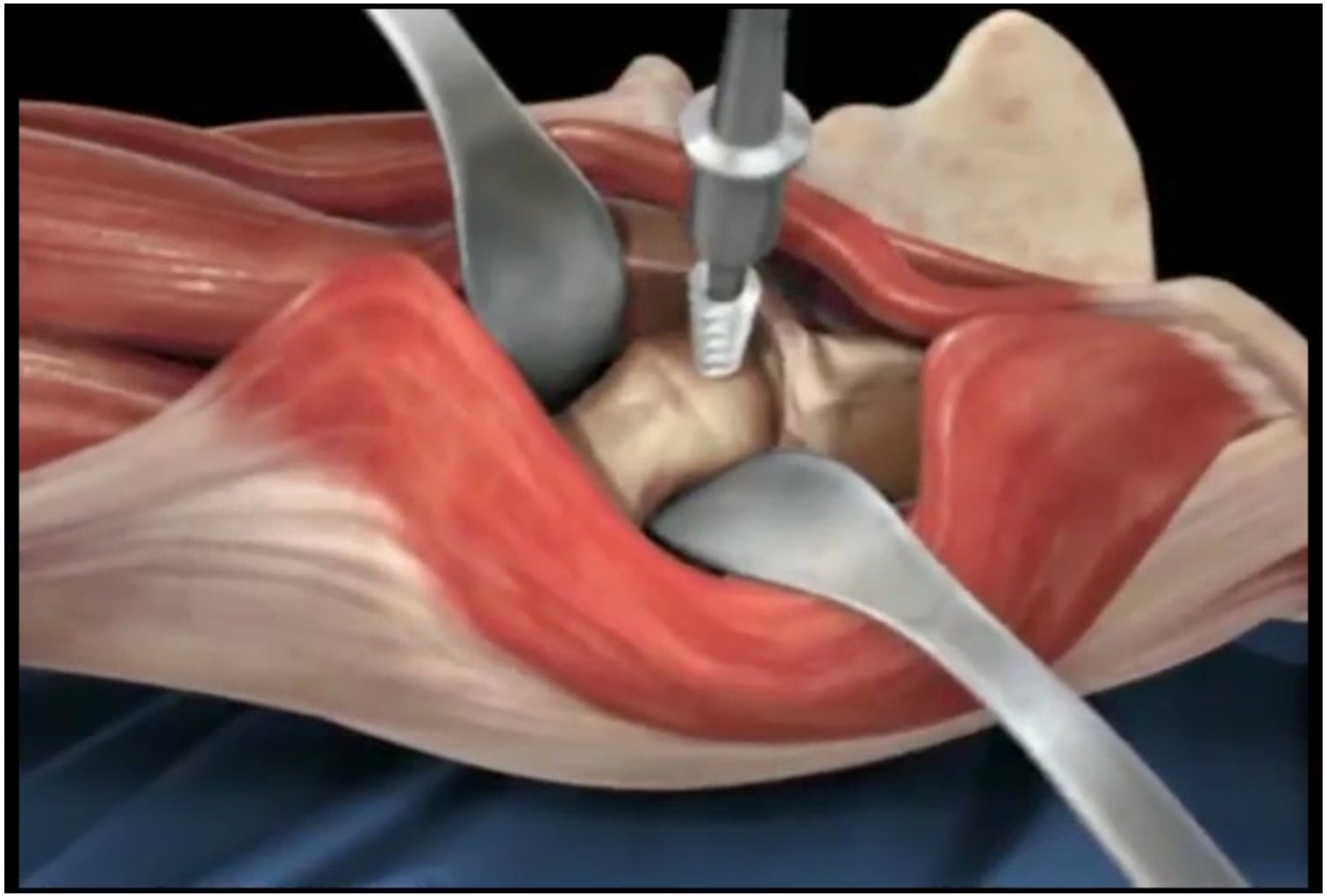
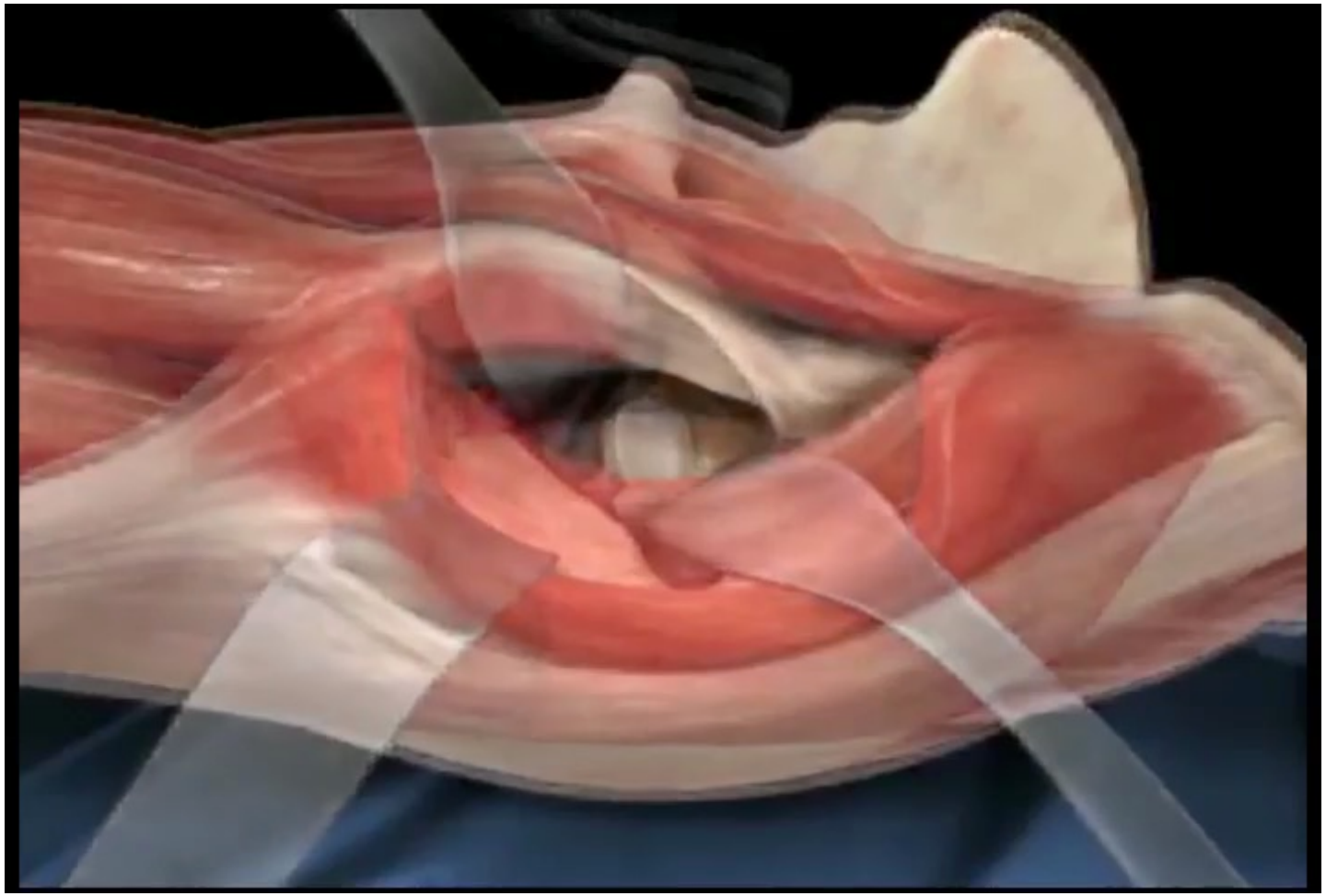
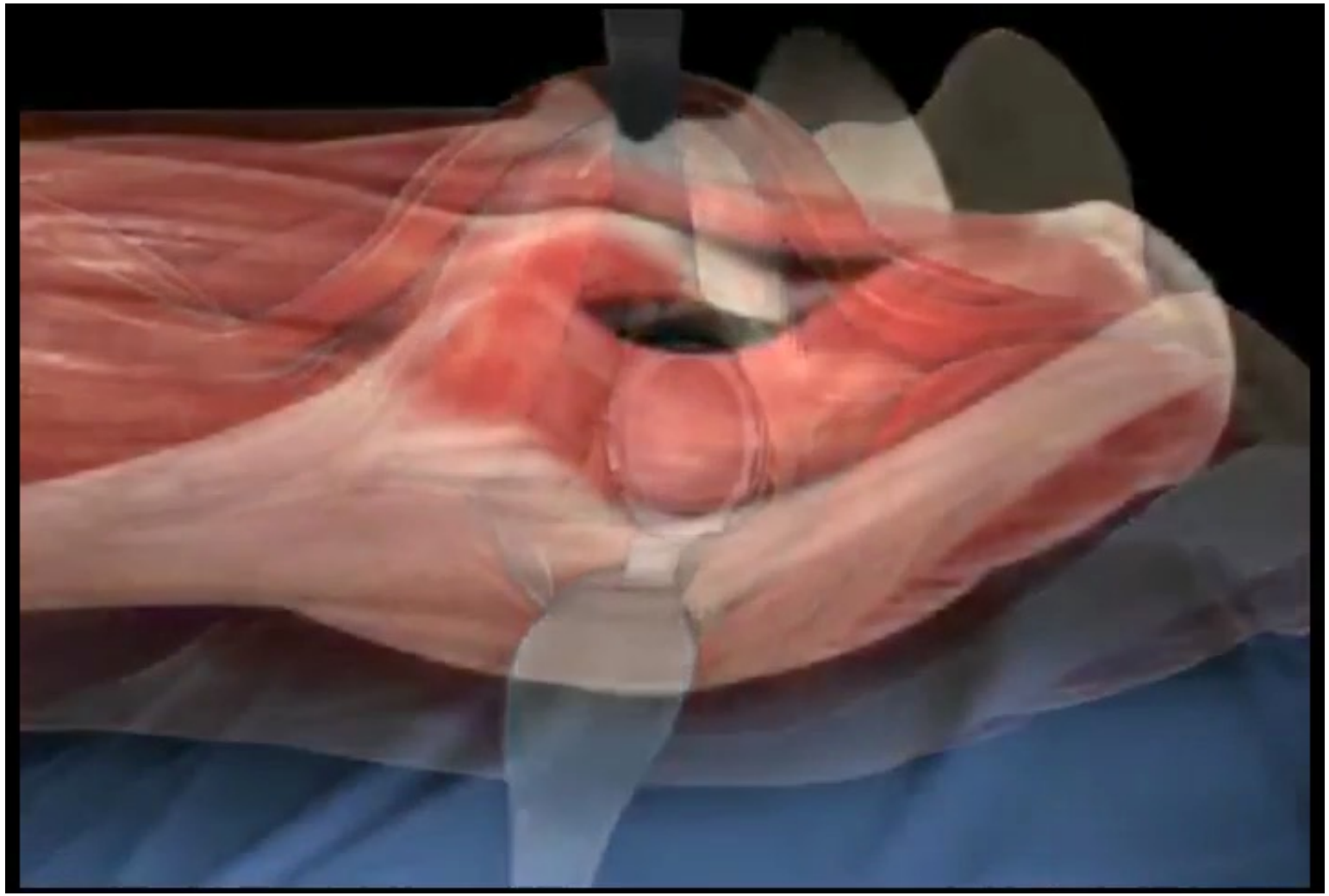
Lighting

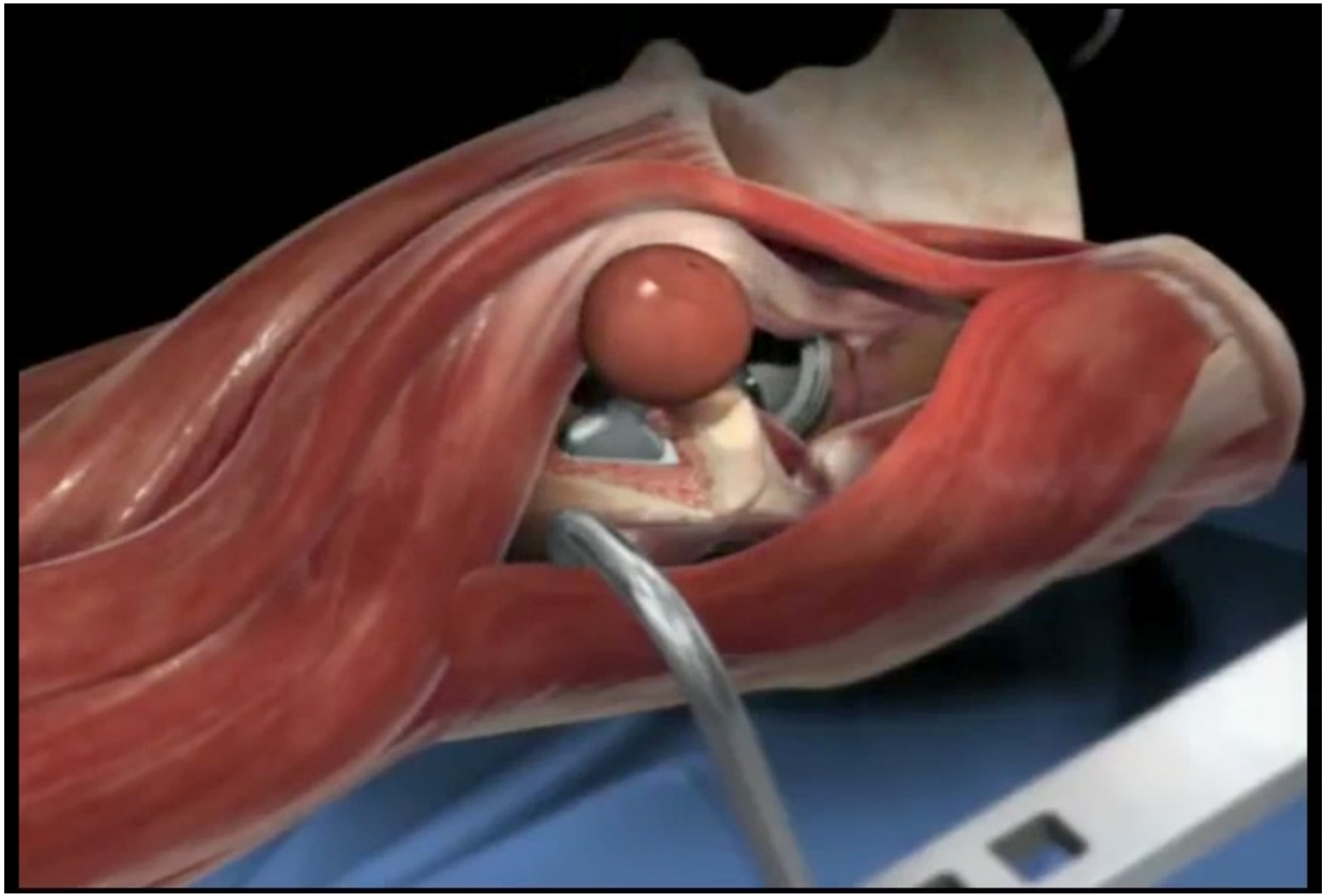
Arch table











Typical Precautions: Traditional vs. Direct Anterior

Traditional Hip Replacement

- Do not cross legs
- Do not bend hip more than a right angle
- Do not turn feet excessively inward or outward
- Use a pillow between your legs when sleeping

Direct Anterior Approach

- Under doctor's supervision, may be immediately allowed to move their hips
- May potentially avoid restrictions associated with traditional hip replacement[1]

1. http://www.anteriorhip.org/anterior-hip-replacement.html accessed Nov 2010.

Potential Benefits of MIS with Direct Anterior Approach

- Decreased hospital stay and quicker rehabilitation.[2]
- Smaller incision and reduced muscle disruption may allow patients a shorter recovery time and less scarring.[1]
- Potential for less blood loss, less time in surgery, and reduced post-operative pain.[1,3,4]
- Risk of dislocation reduced. [2]
- May allow for a more natural return to function and activity.[1, 3]

1. Wenz, J, Gurkan, I. ,Jibodh, S., "Mini-Incision Total Hip Arthroplasty: A Comparative Assessment of Peri-operative Outcomes," Orthopedics Magazine, 2002.
2. www.anteriorhip.org/anterior-hip-replacement.html accessed Nov 2010.
3. Keggi, Kristaps, I., "Total Hip Arthroplasty Through a Minimally Invasive Anterior Surgical Approach," JBJS, Vol. 85-A. 2003.
4. Baerga-Varela, L., Malanga, G.A., "Rehabilitation after Minimally Invasive Surgery." Hozack, W., Krismer, M., Nogler, M., Bonutti, P., Rachbauer, F., Schaffer, J., Donnelly, W., ed. Minimally Invasive Total Joint Arthroplasty. New York, NY: Springer-Verlag; 2004: 2-5.

Advantages of Direct Anterior

- MIS approach is better for patients
- No Hip Precautions
- Improved control over component position

The Use of Technology in Hip Replacement

Why Navigation?

- Increased level of precision
- Confidence in component position
- Recovery room film is too late for changes
- Optimize surgical results

rTHA- Better Plan

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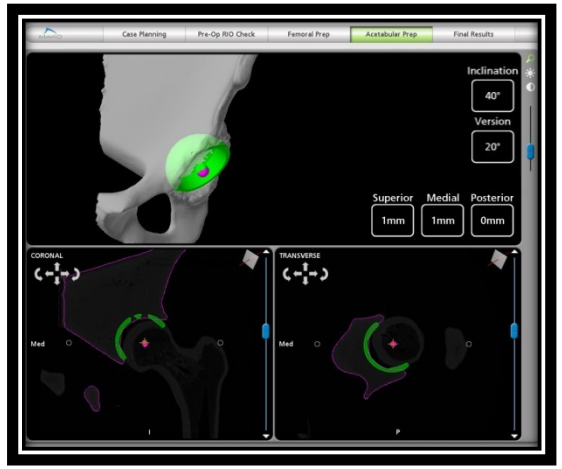
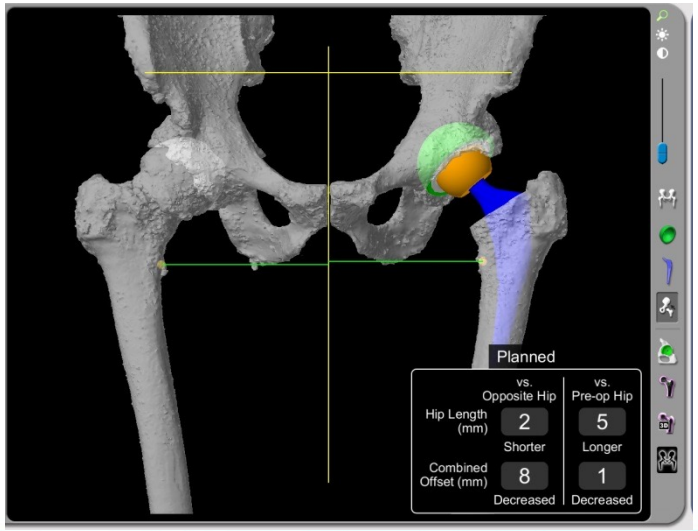
mTHA- Plain x-ray

rTHA- 3D CT

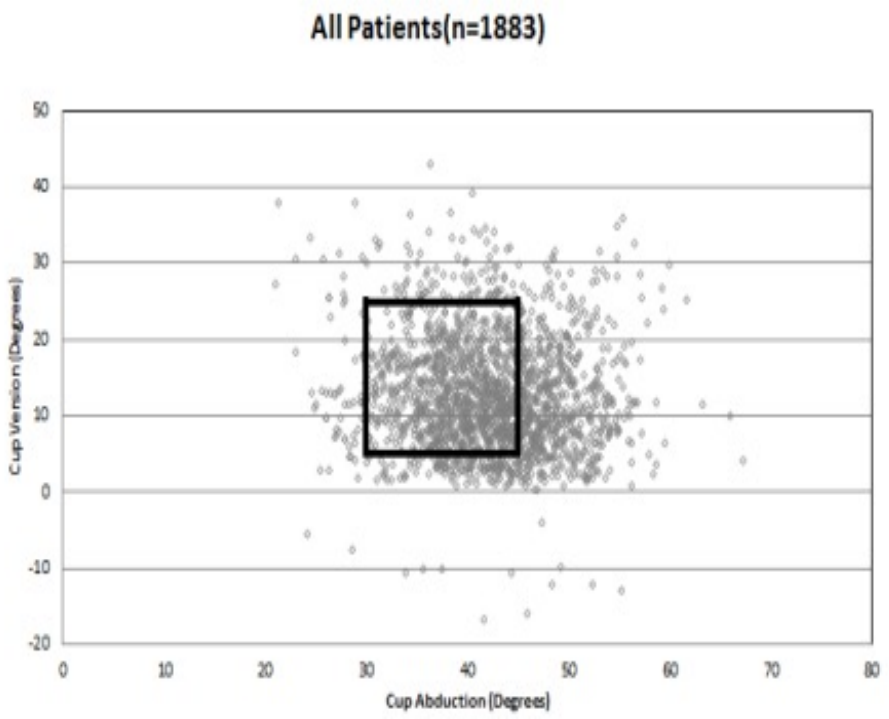




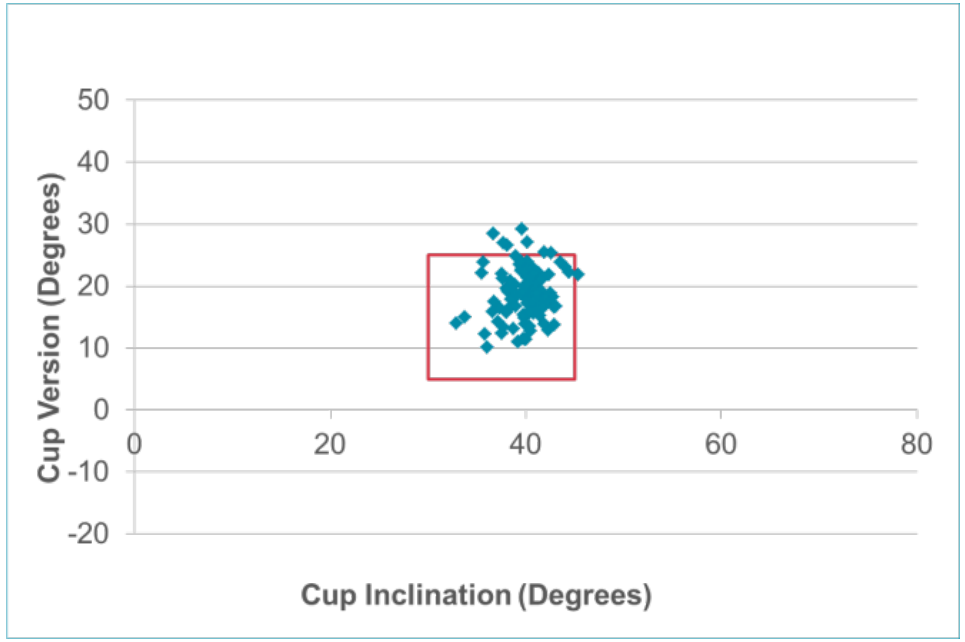
rTHA vs. mTHA: Multicenter study

MGH, University of Wisconsin, HSS (Malchau, Padgett, Dounchis, Illgen, Marchand)

Manual THA : N= 1883
47% inside target zone



Robotic THA: N=119
96% inside target Zone
95% within 4 degrees of plan



1. The John Charnley Award: Risk factors for cup malpositioning: Quality improvement through a joint registry at a tertiary hospital. *Clin Orthop Relat Res*. 2011 Feb;469(2):319-29.

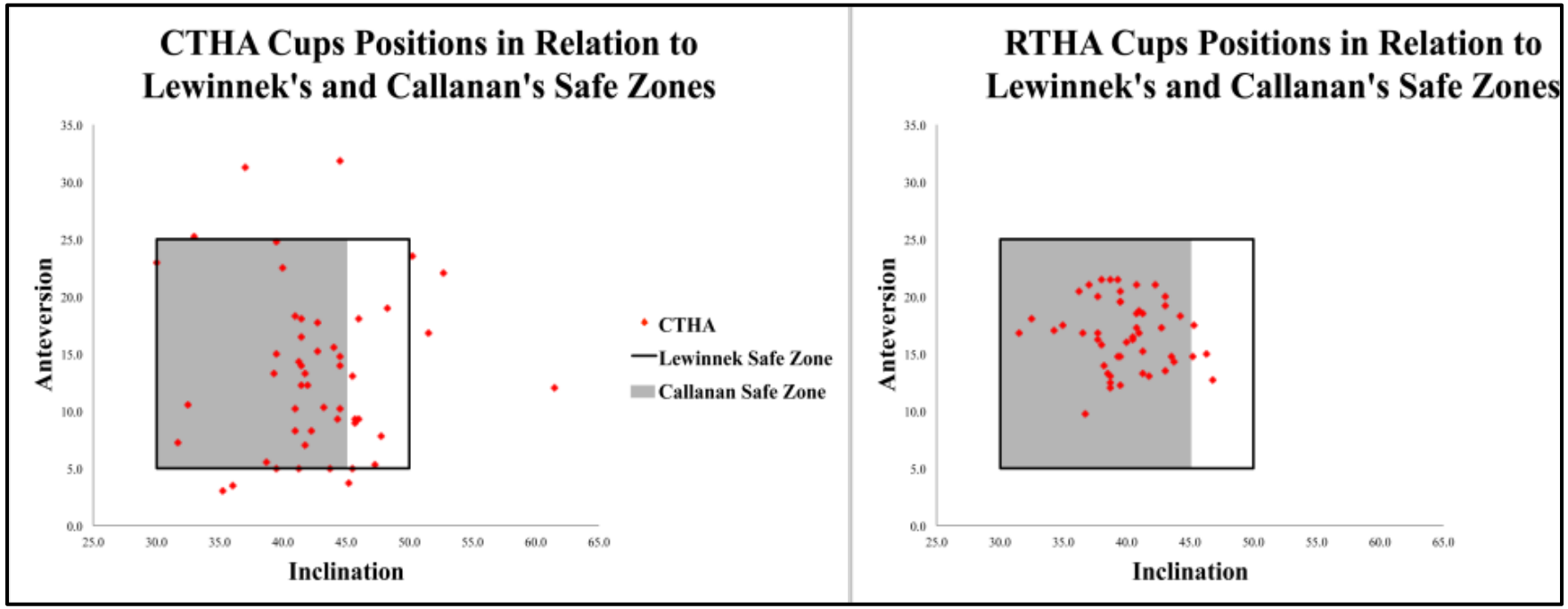
rTHA vs mTHA: Single Surgeon Data

A Matched-Pair Study- Dr. Domb – Hinsdale, IL CORR 2013

- rTHA (N=50) vs. mTHA (N=50), X-ray analysis (HAS)
- **rTHA vs. mTHA- 100% vs. 80%** in Lewinnek "Safe Zone"

Conventional THA

Robotic assisted THA



Technique with Technology

Surgical goals of hip replacement

- Pain relief
  - Restoration of function/lifestyle
  - Optimize patient outcomes
  - Economics

DA THA

- Provide early and exceptional analgesia
- Low trauma surgery
- Early discharge and rapid rehab

Prevent the Bad Effects

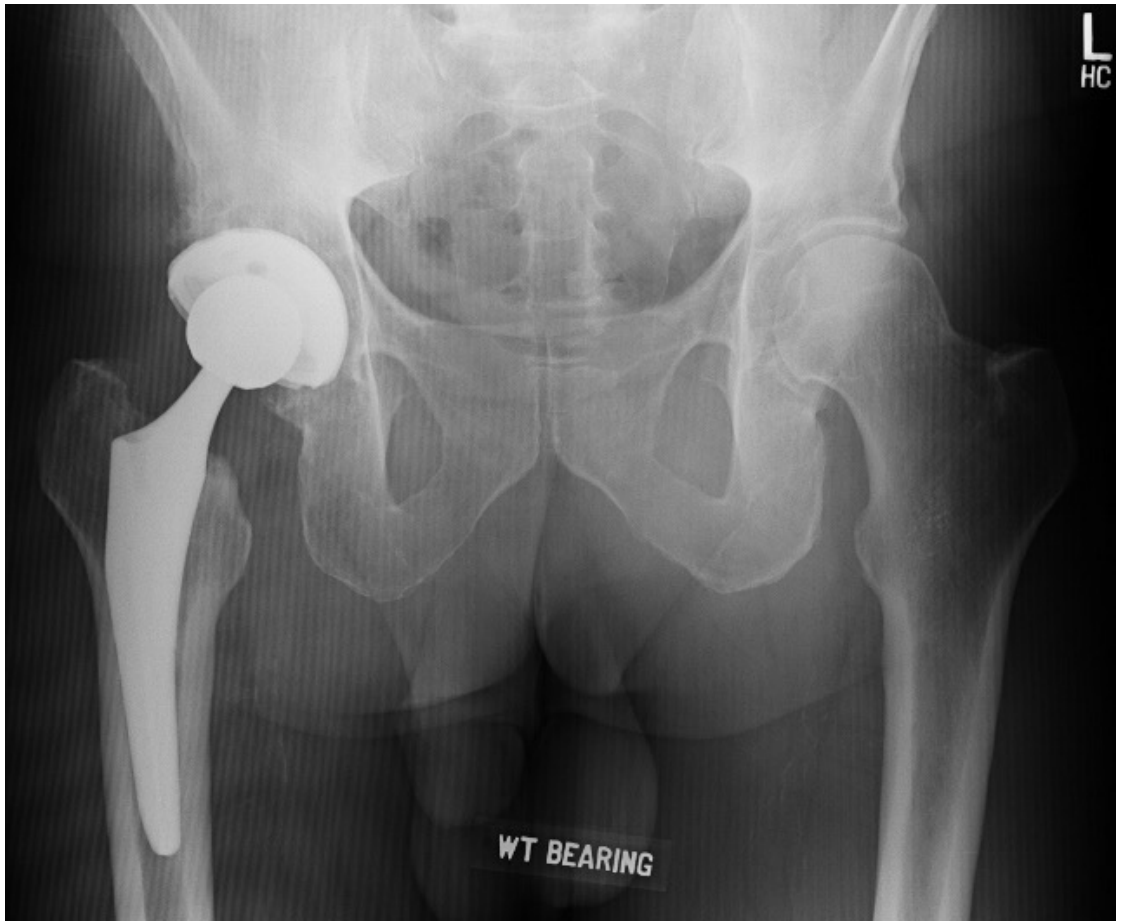
- Pre-emptive analgesia
  - Celebrex
  - Spinal anesthesia
- Pre-emptive anti nausea
  - Pepcid

Operative Management

- IV sedation
- Capsular injection

Post-Operative Management

- Gait training POD1
- Stairs and PT instruction
- Ideally same day ambulation



10,000 Miles in 18 mos after THA

Summary

- rTHA more accurate than mTHA- multiple studies
- Improved accuracy with rTHA correlated with improved clinical outcomes at 1 year
  - Lower dislocation rate
  - Less LLD
  - Less blood loss
  - Excellent PROM
    - Better HHS and UCLA activity scores than mTHA
- Robotic-assisted THA:
  - Longer OR time than mTHA, no infections
  - Cost benefit analysis requires further study

Risks of Surgery

Including but not limited to:

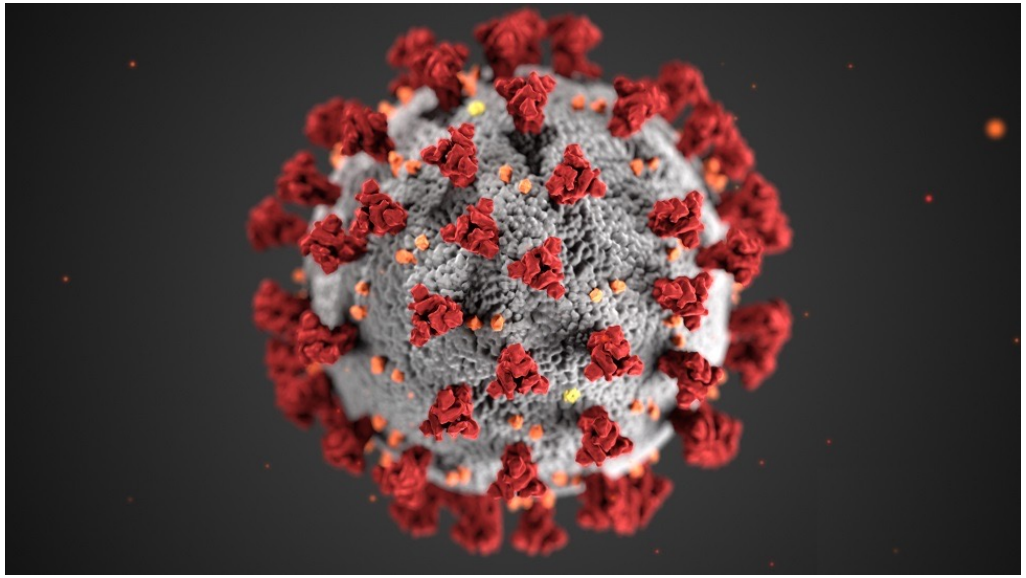
- Bleeding
- Infection
- Damage to nerves and vessels
- Blood clots (DVT)
- Blood clots in lungs (PE)

And rare things like:

- Stroke
- Heart attack
- Death

COVID Protocol

- Elective surgery has been going since April 2020. There are no current plans to stop but that may change.
- Every patient gets COVID test and all staff follow proper PPE protocol.



Questions?

Innovative Treatments for Hip and Knee Pain

C. Brian Blackwood, MD
BoulderCentre for Orthopedics
Co-Medical Director Joint Program
www.boulderhipandknee.com
720-386-2225

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