Innovative Treatments for Hip and Knee Pain

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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

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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

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Lowest Complication Rate in Boulder

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for Orthopedics

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What is Arthritis?

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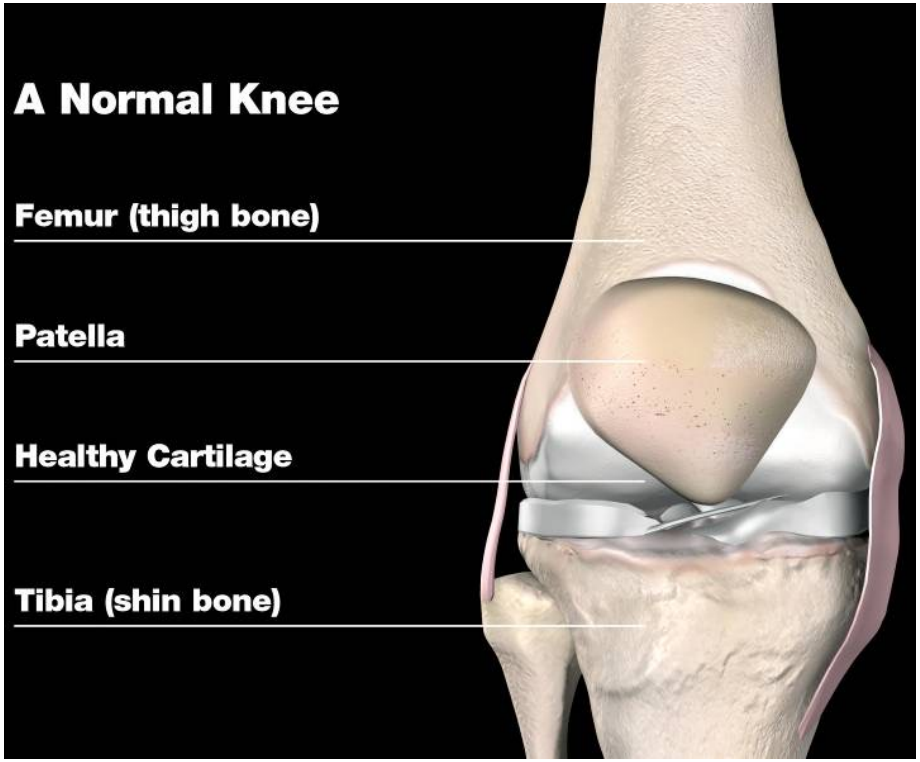

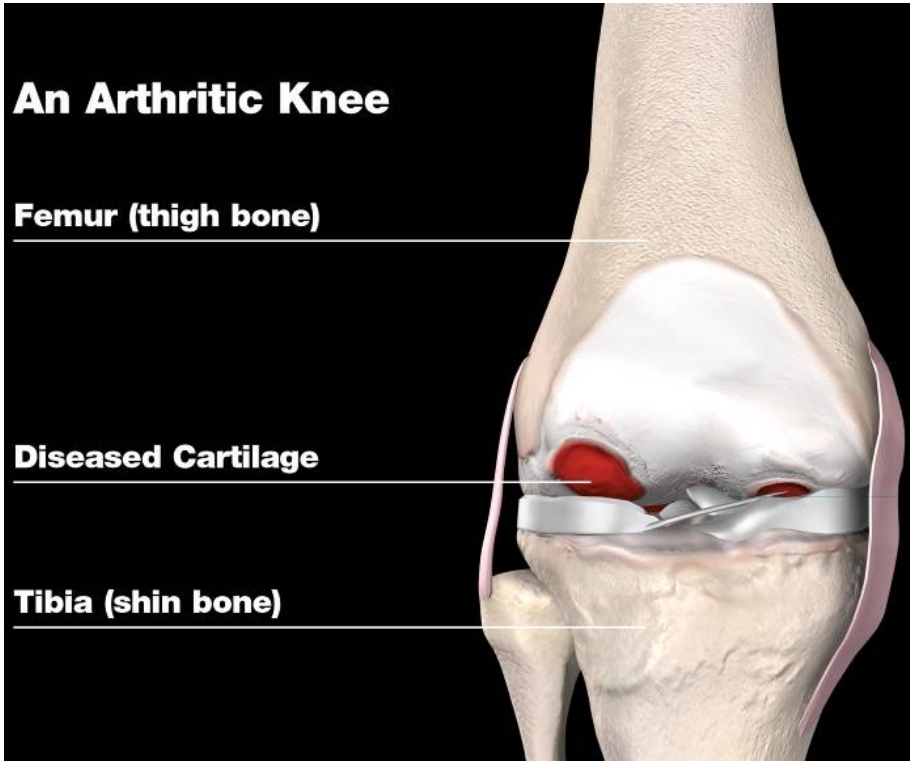

Osteoarthritis- Worn out articular cartilage

Inflammatory Arthritis- Systemic Process

ex: Rheumatoid, Psoriatic, etc.

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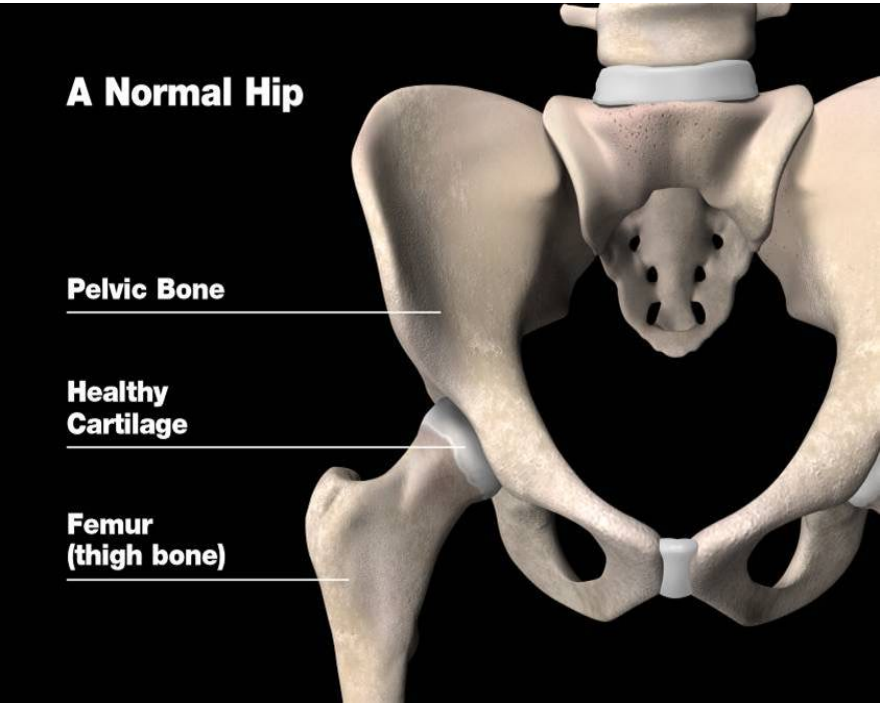
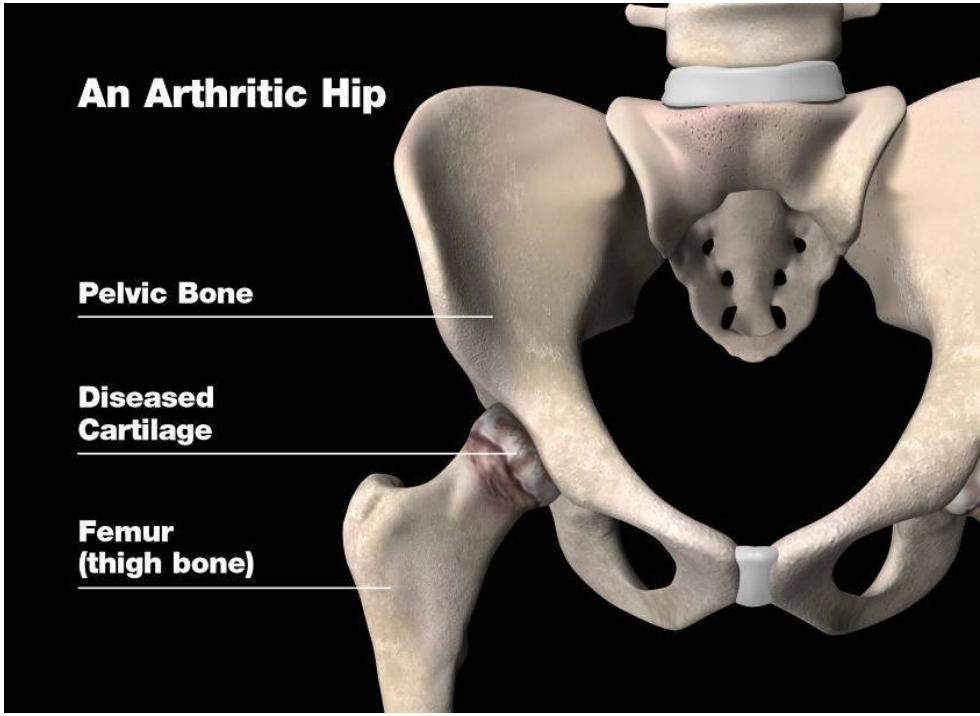
Hip Stages





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X-ray Showing Arthritis

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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

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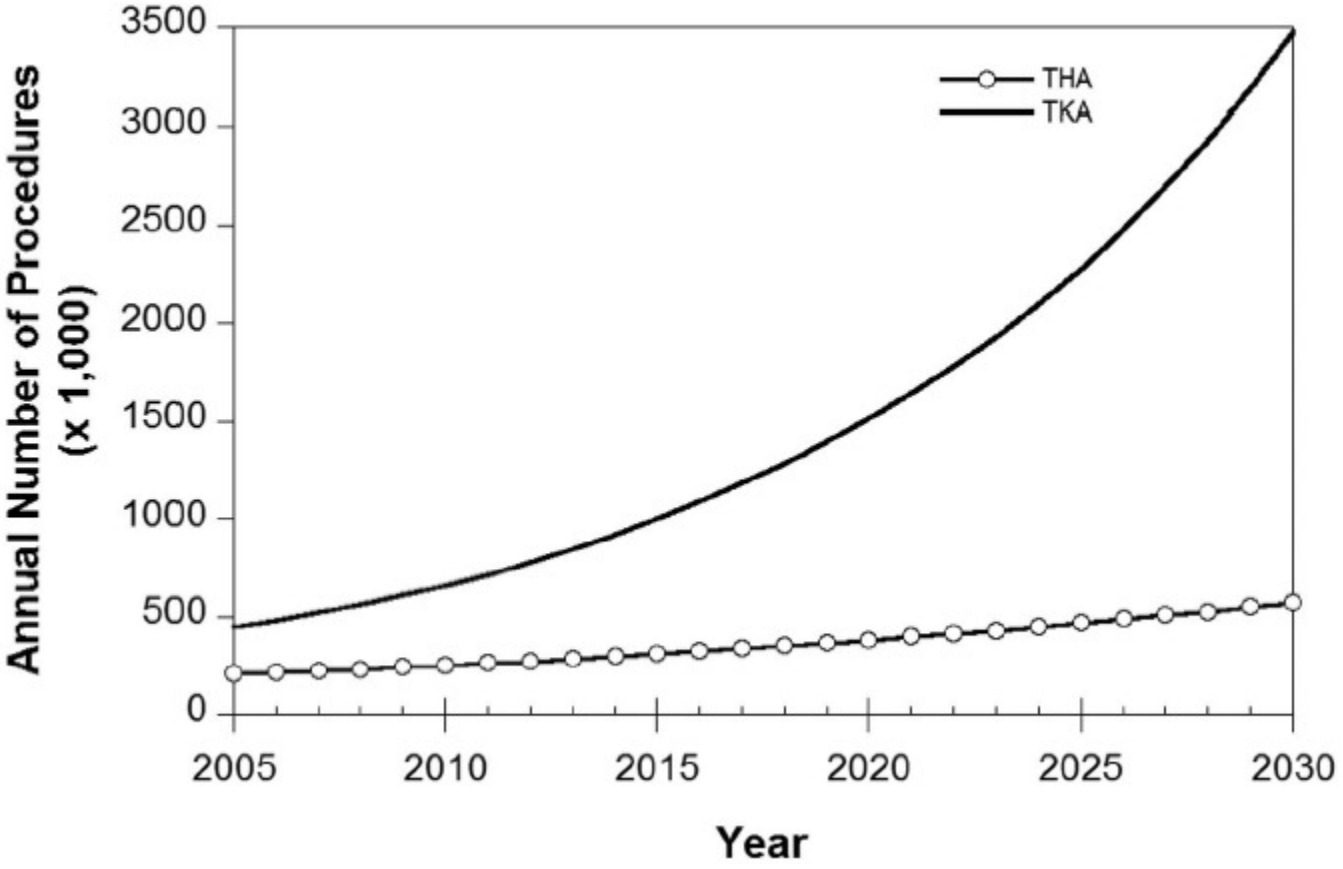
Primary Hip and Knee Replacement

Proiection 2005-2030



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

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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)

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How Can I Avoid/Delay a Joint Replacement?

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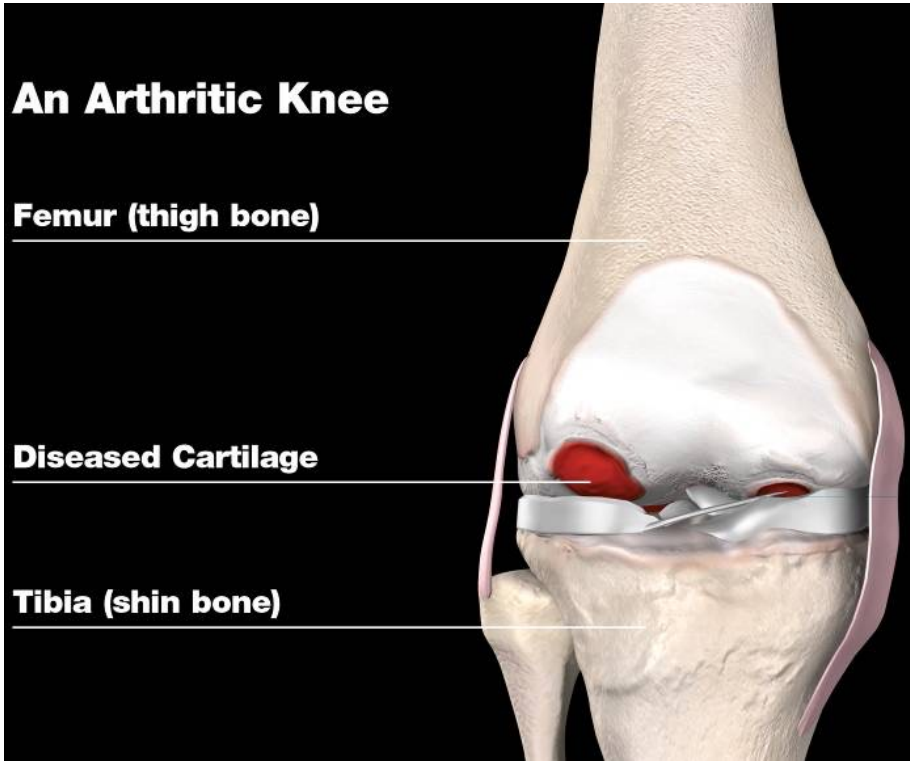
Treatment Options for Knee and Hip Pain

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



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AAOS Guidelines

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)

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RICE and NSAIDs

Rest, Ice, Compression, Elevation

Ibuprofen, Alleve, Tylenol, Celebrex

Topical compounds

Glucosamine

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Activity Modification and Weight Loss

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

Weight Loss: Goal BMI<40

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Joint Injections

Cortisone

Visco-supplementation

Platelet rich plasma (PRP)

Stem Cells

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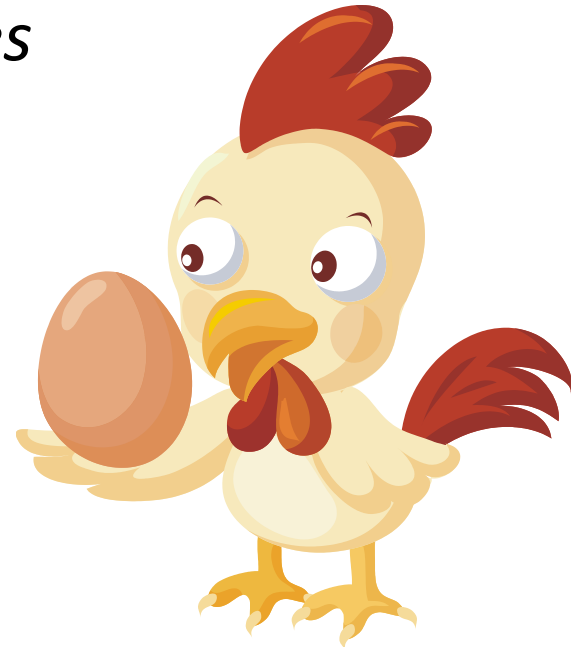
Visco-supplementation

"Chicken Shots"- Hyaluronic acid injections

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



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PRP: Platelet Rich Plasma

Injections of concentrated blood products to enhance healing

**Not covered by insurance, expensive*

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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*

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My Future?

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Stem Cell Results:

Regenexx-SD vs. knee and hip replacement?

Data Collection

This data was collected by Regenexx network physician Mitch Sheinkop, M.D. As an orthopedic surgeon, he collected knee and hip replacement data in 2007. He also used the same methods to collect data on the Regenexx-SD procedure for knee and hip arthritis. Regenexx had no involvement in the data collection nor it's preparation.

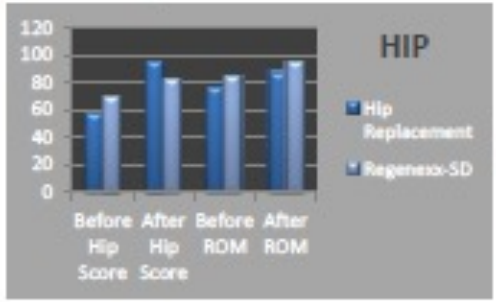
Vs.

Caution! This is a comparison trial, which is not the same as a drug company style controlled trial.

How does a major surgery compare to an injection of stem cells?

What does this mean?

The Harris Hip Score and hip range of motion improved in both hip replacement and Regenexx-SD patients. While hip replacement patients saw greater improvements, given that the Regenexx-SD patients had a dramatically less invasive injection, the risk/benefit ratio is good.



73% of Regenexx-SD hip patients returned to sporting activities!

What does this mean?

The Knee Society Assessment Score and the Function Score improved in both knee replacement and Regenexx-SD patients. Regenexx-SD knee patients saw greater post procedure levels in both measures. Given that the Regenexx-SD patients had a dramatically less invasive injection, the risk/benefit ratio is excellent

Details: Hip-94 THA surgeries performed in 2007, mean age of 62 years, mean BMI of 30. 28 Regenexx-SD procedures performed in 2012, mean age of 51 and BMI of 26. 24 THA patients were available for follow-up at one year and 18 Regenexx-SD patients were available at 1 year. Harris Hip Score administered to both groups by the same technician and clinician. Knee- 111 knee TKA knee surgeries performed in 2007, mean age 67 years, mean BMI of 32. 37 Regenexx-SD procedures performed in 2012 with a mean age of 55 years and a BMI of 27. At one year there were 71 TKA and 26 Regenexx-SD patients available for follow-up. Knee Society Assessment Score and Knee Society Function Score administered to both groups by the same technician and clinician.

Regenexx SD™

The Regenexx-SD procedure is a same day bone marrow stem cell procedure that isolates the fractions of bone marrow that have the most stem cells.

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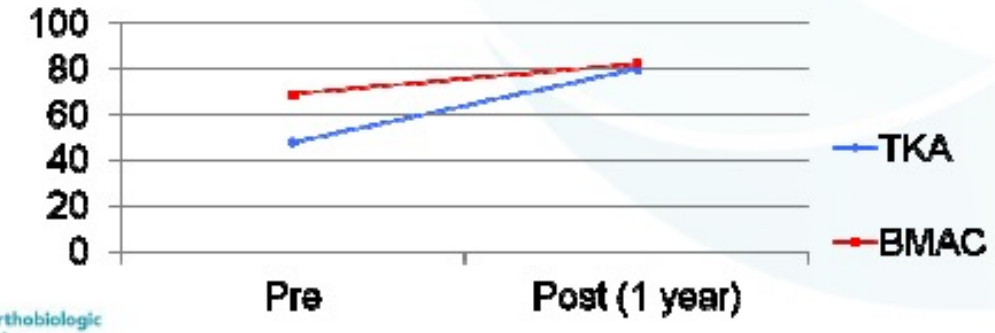
Knee Society Assessment Score

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



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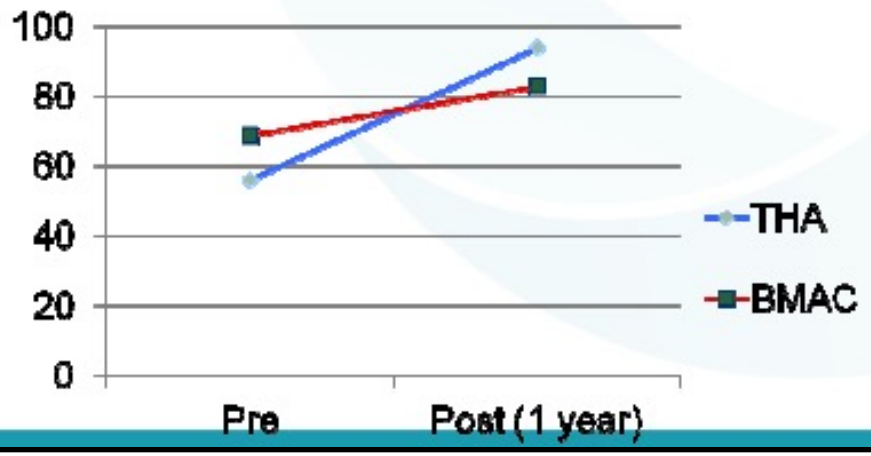
Mean Harris Hip Score

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



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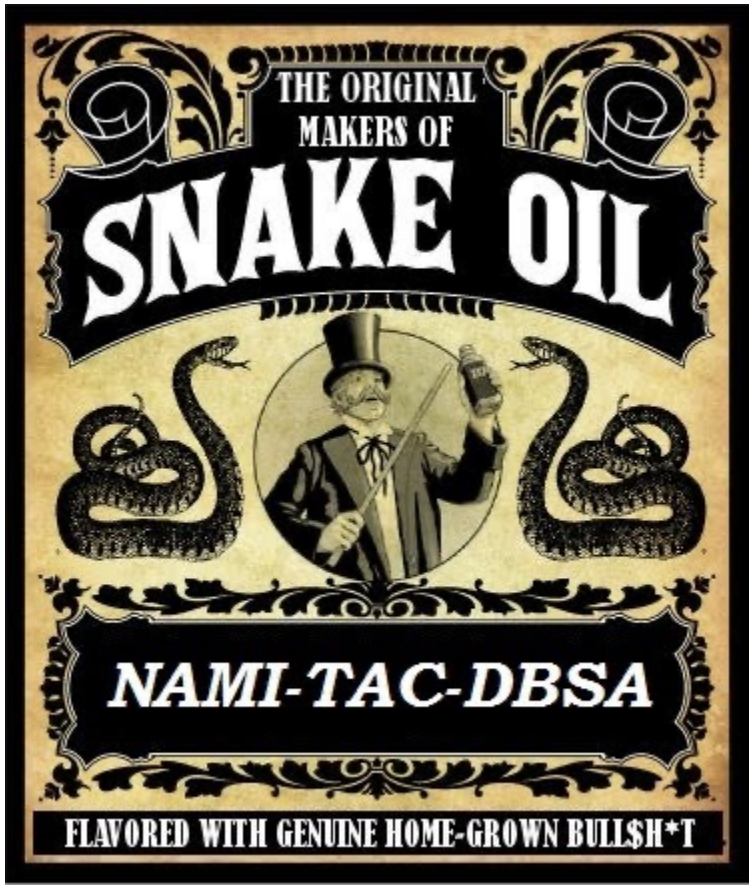
Stem Cells =Snake Oil?



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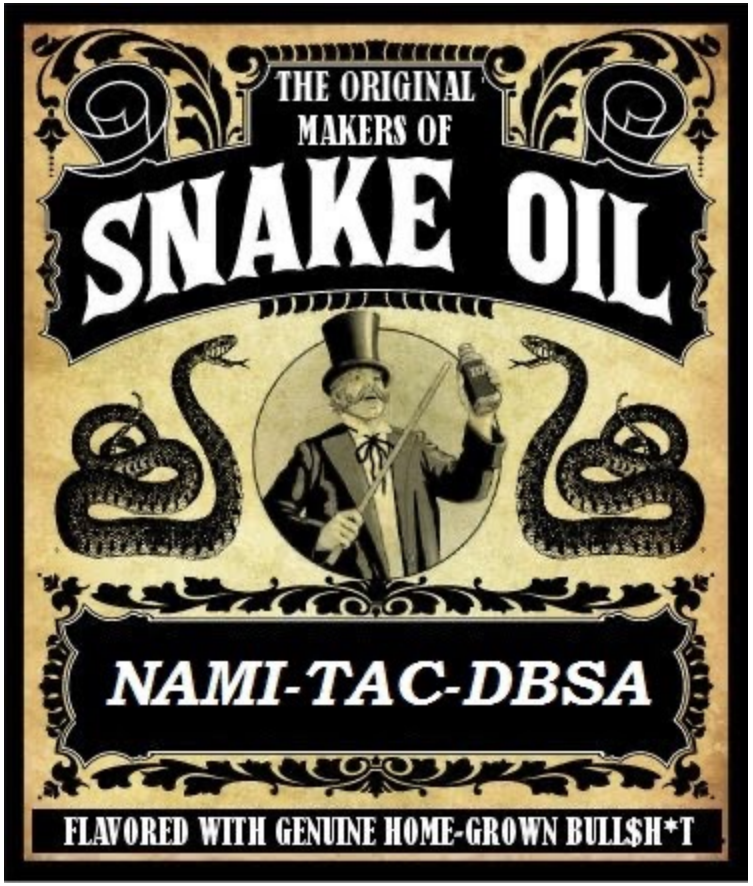
STEM CELLS?



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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.

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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.

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What is Mako?

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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.

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Early Arthritis

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

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Early Arthritis

- Can also be isolated to the patella femoral joint.

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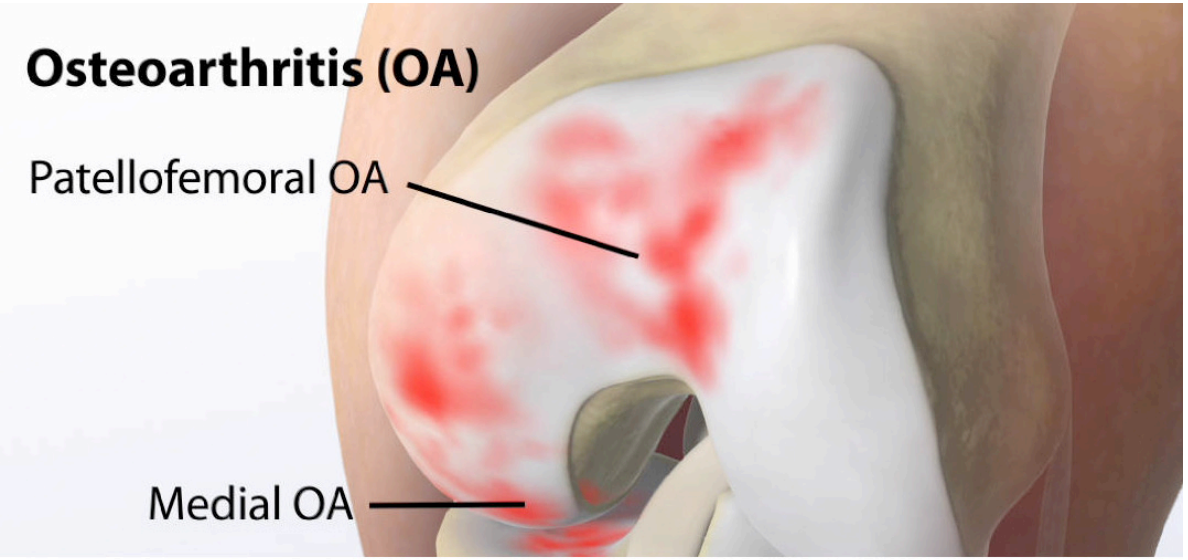
Mid-stage Arthritis

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



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Mid-stage Arthritis

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

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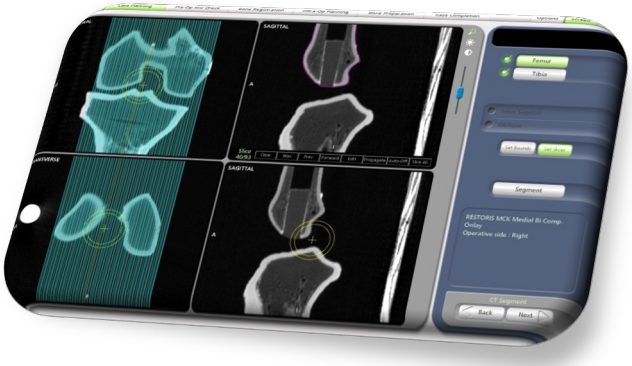
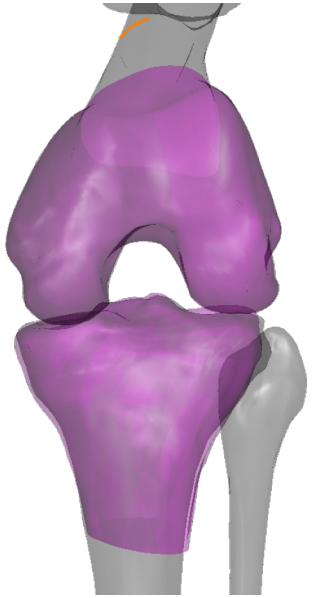
Makoplasty Procedure

- 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.





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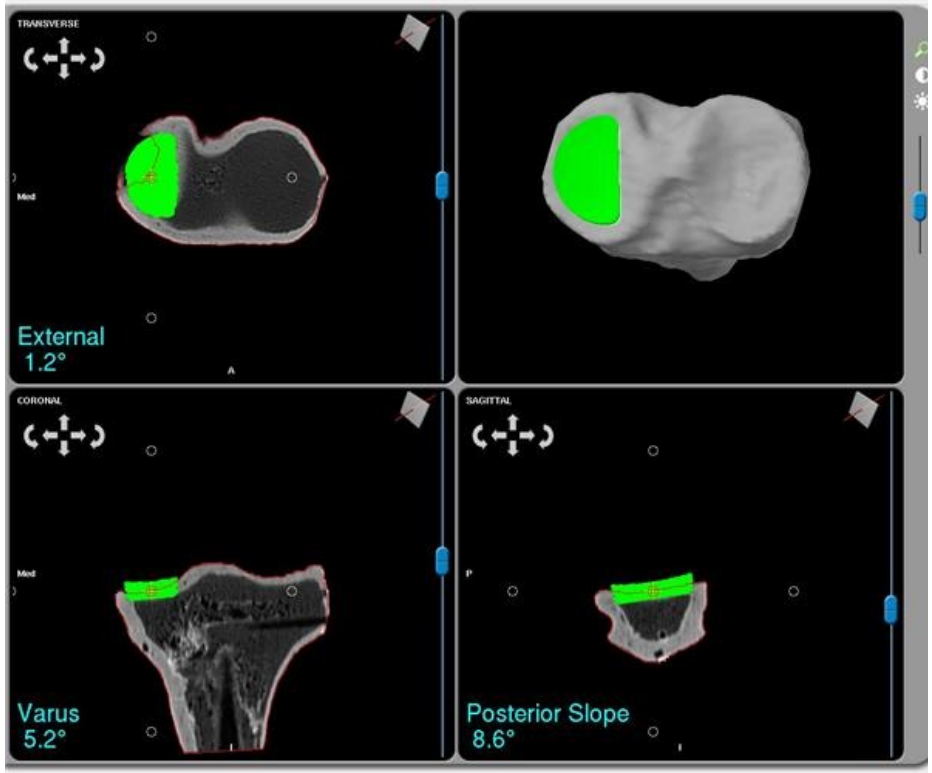
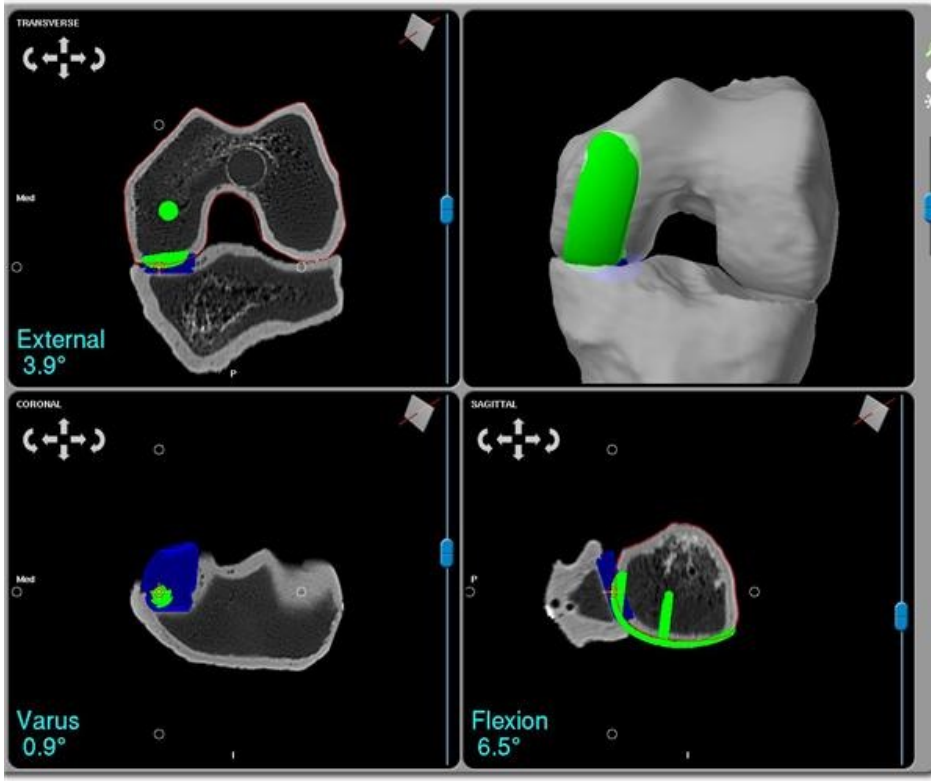
Makoplasty Procedure

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.



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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.

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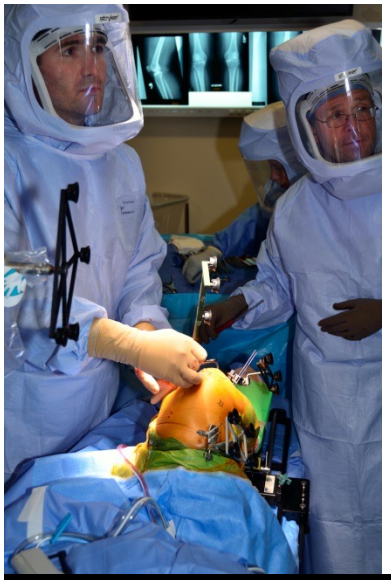
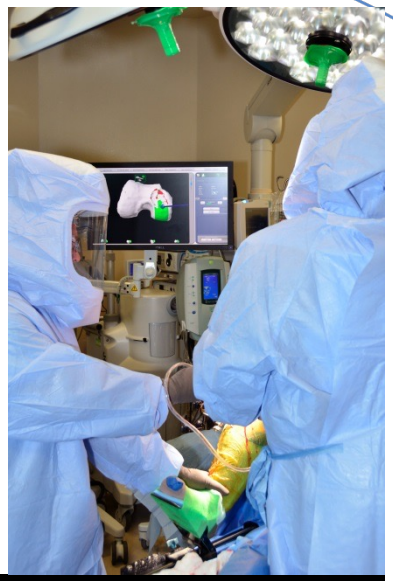
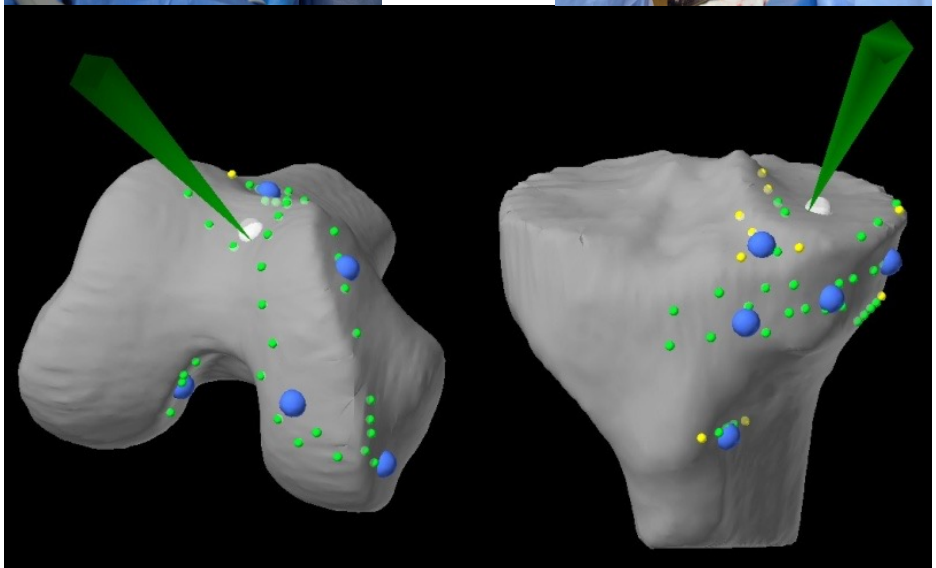
Surgical Technique

- 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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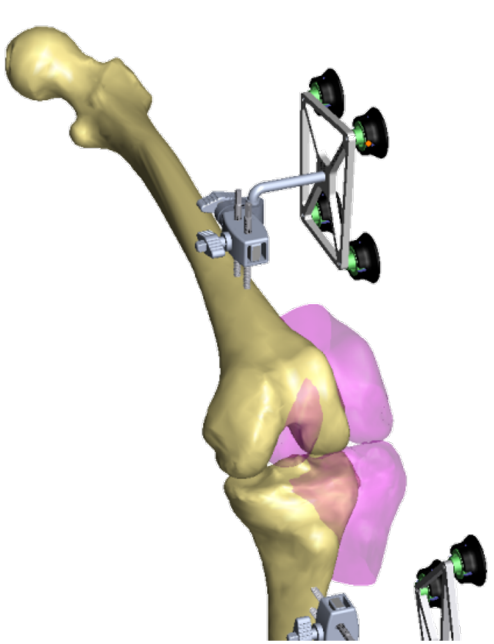

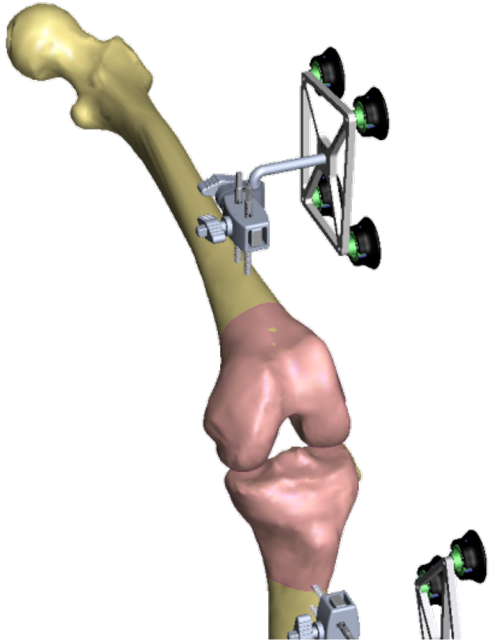

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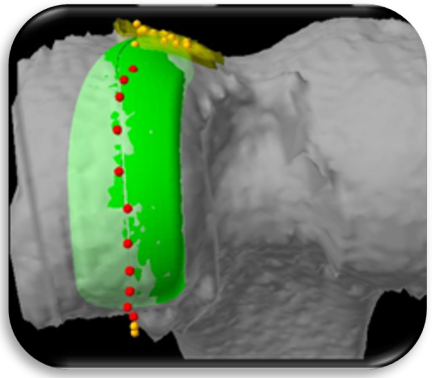
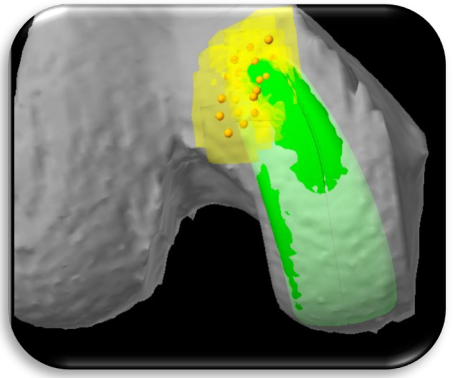
Surgical Technique (cont.)

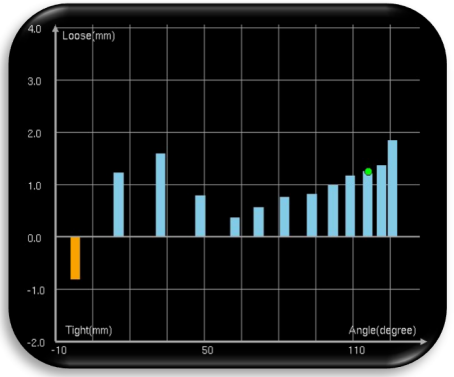
- After obtaining anatomic landmarks, evaluation of coronal and sagittal alignment, flexion and extension laxity and ROM can be measured.
- Infinitely Personalized Process.



Implant Tracking



Cartilage Mapping



Joint Balancing

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Bone Preparation

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

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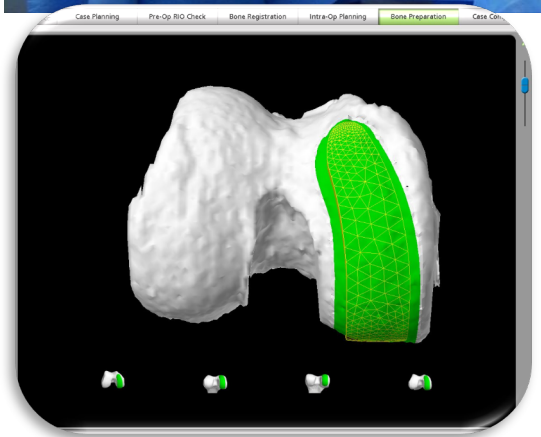
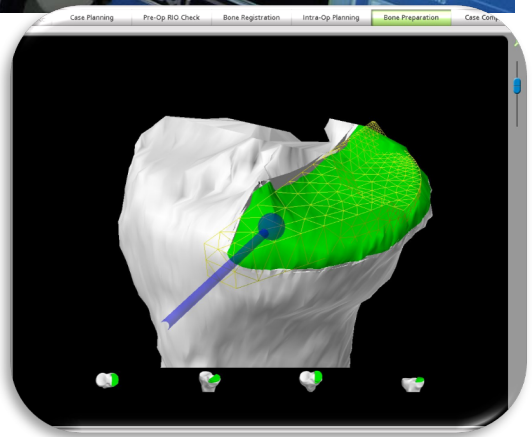
Surgical Technique (cont.)

- 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.





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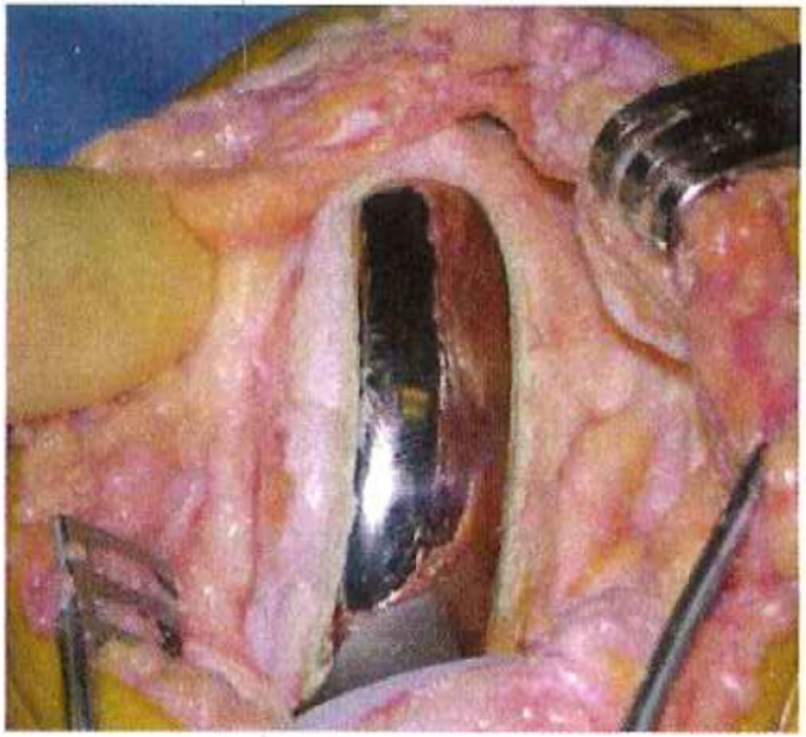
Surgical Technique (cont.)



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Clinical benefits

Pre-op

Post-op

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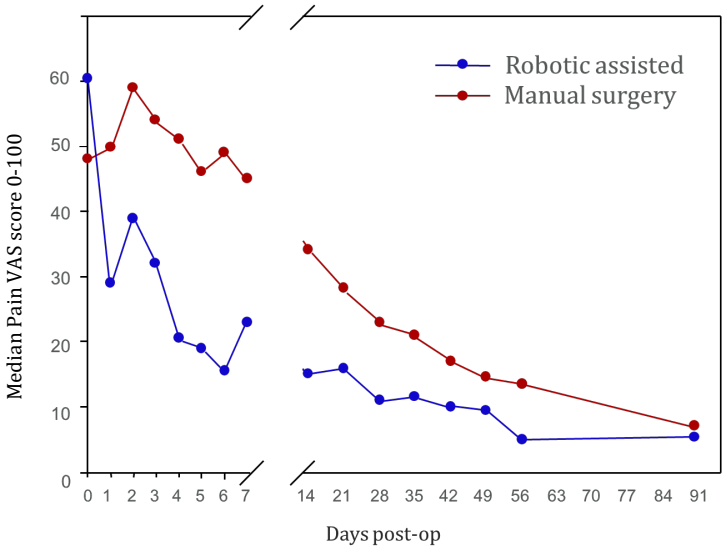
Makoplasty

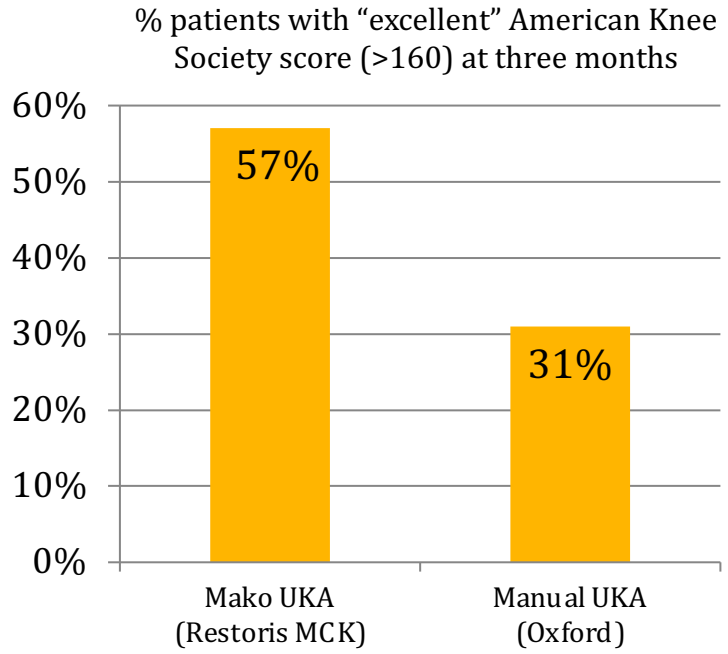
- Less invasive
- Accurate
- Reproducible
- Bone conserving

Patient satisfaction: Mako Partial Knee[6]

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

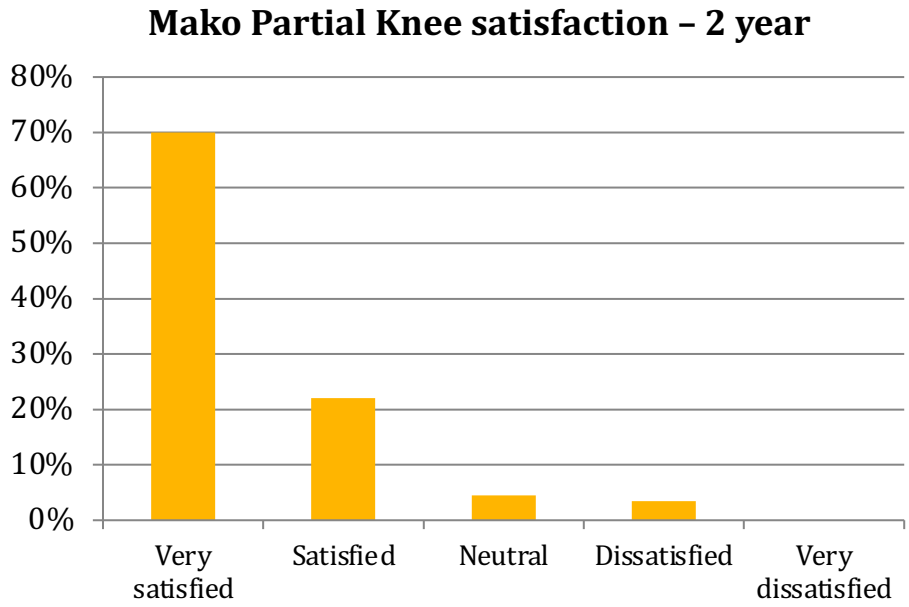
Early results showed higher functional outcomes scores and less early post-operative pain for Mako Partial Knee vs. manual procedures with Biomet Oxford.

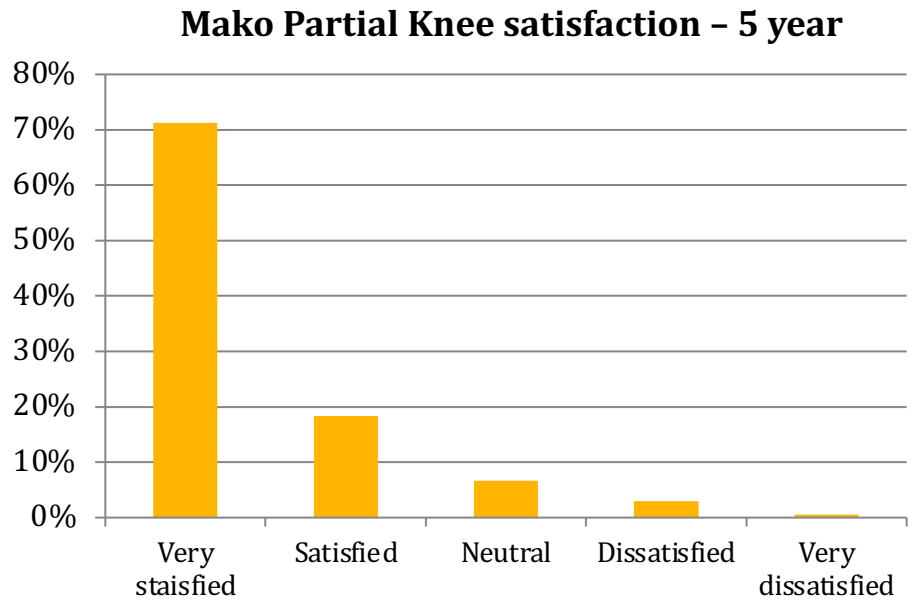




Patient satisfaction: Mako Partial Knee[7-9]

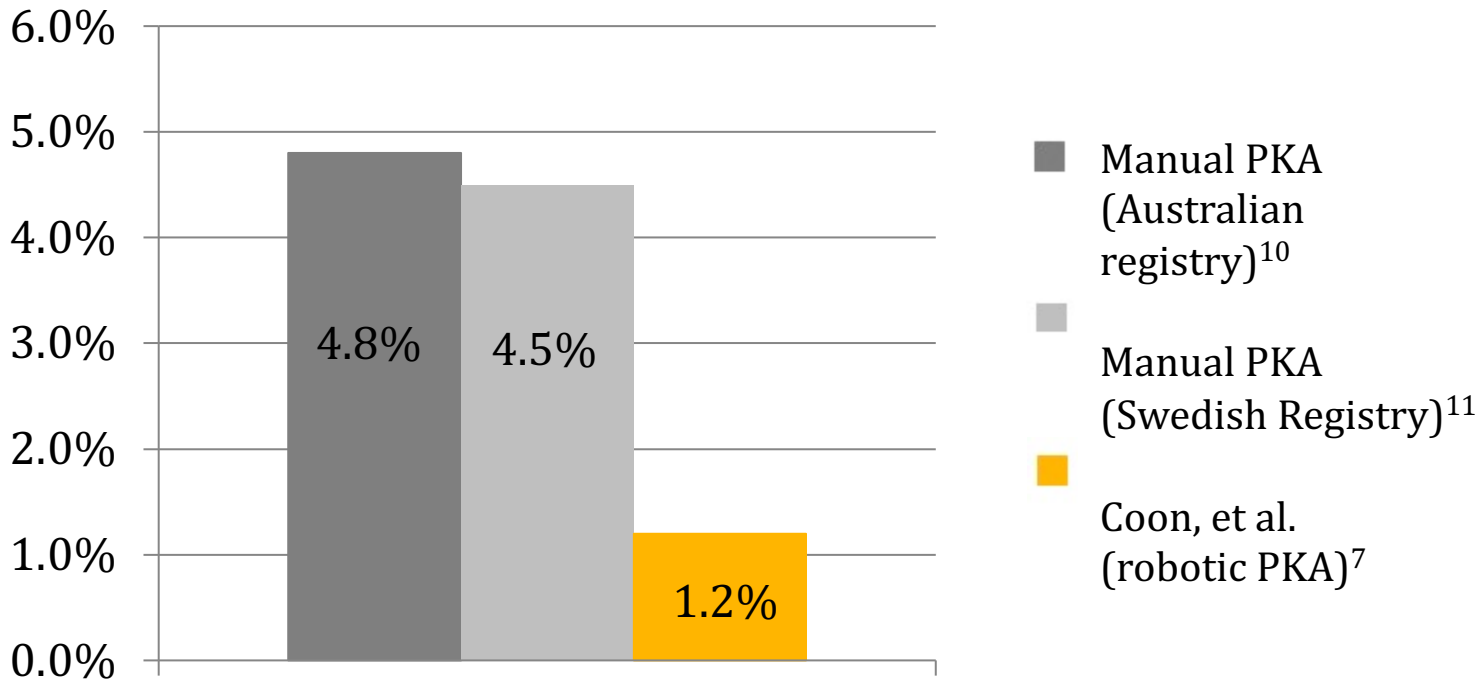
Mako Partial Knee showed high patient satisfaction at two-year and five-year follow-up.





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

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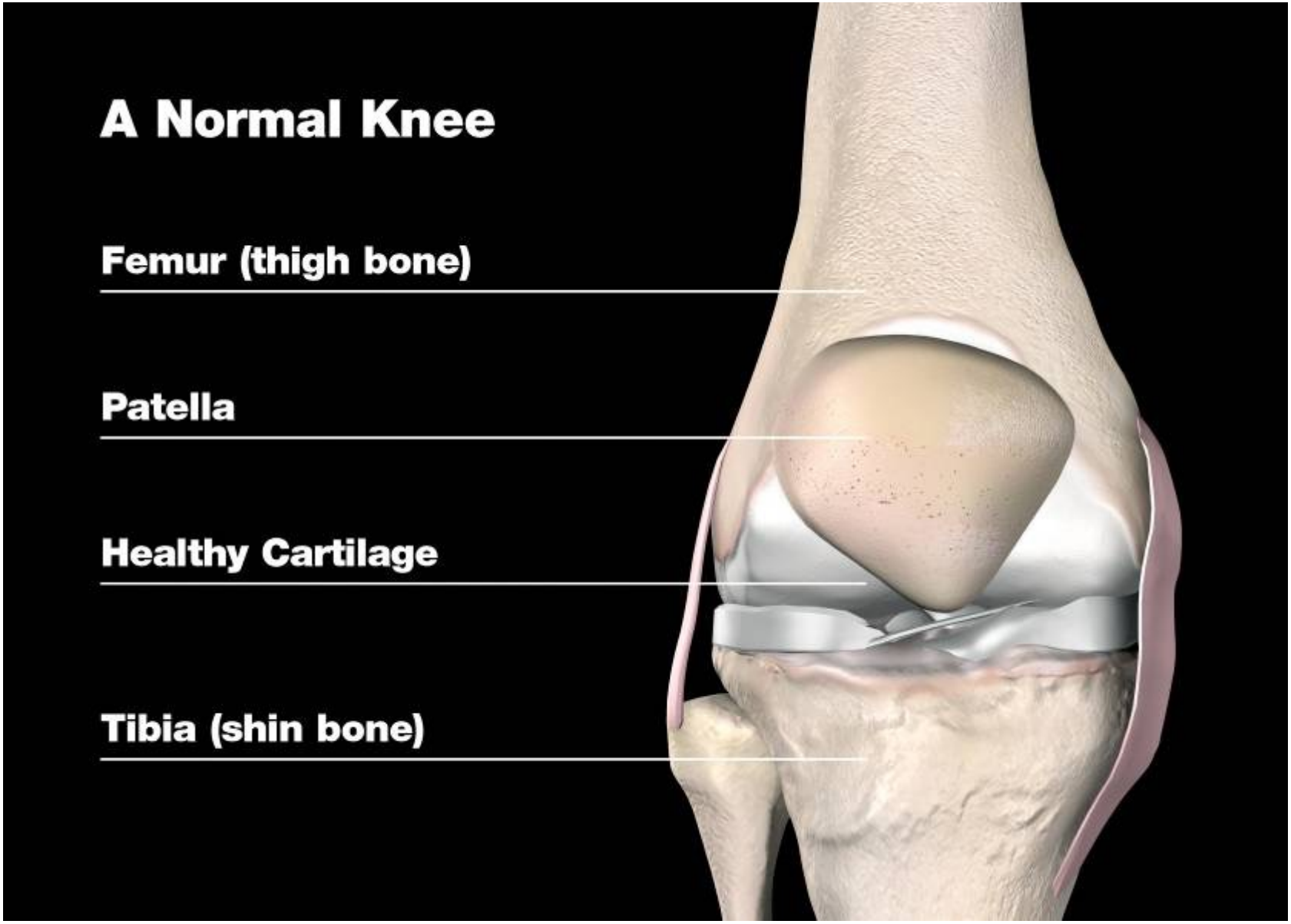
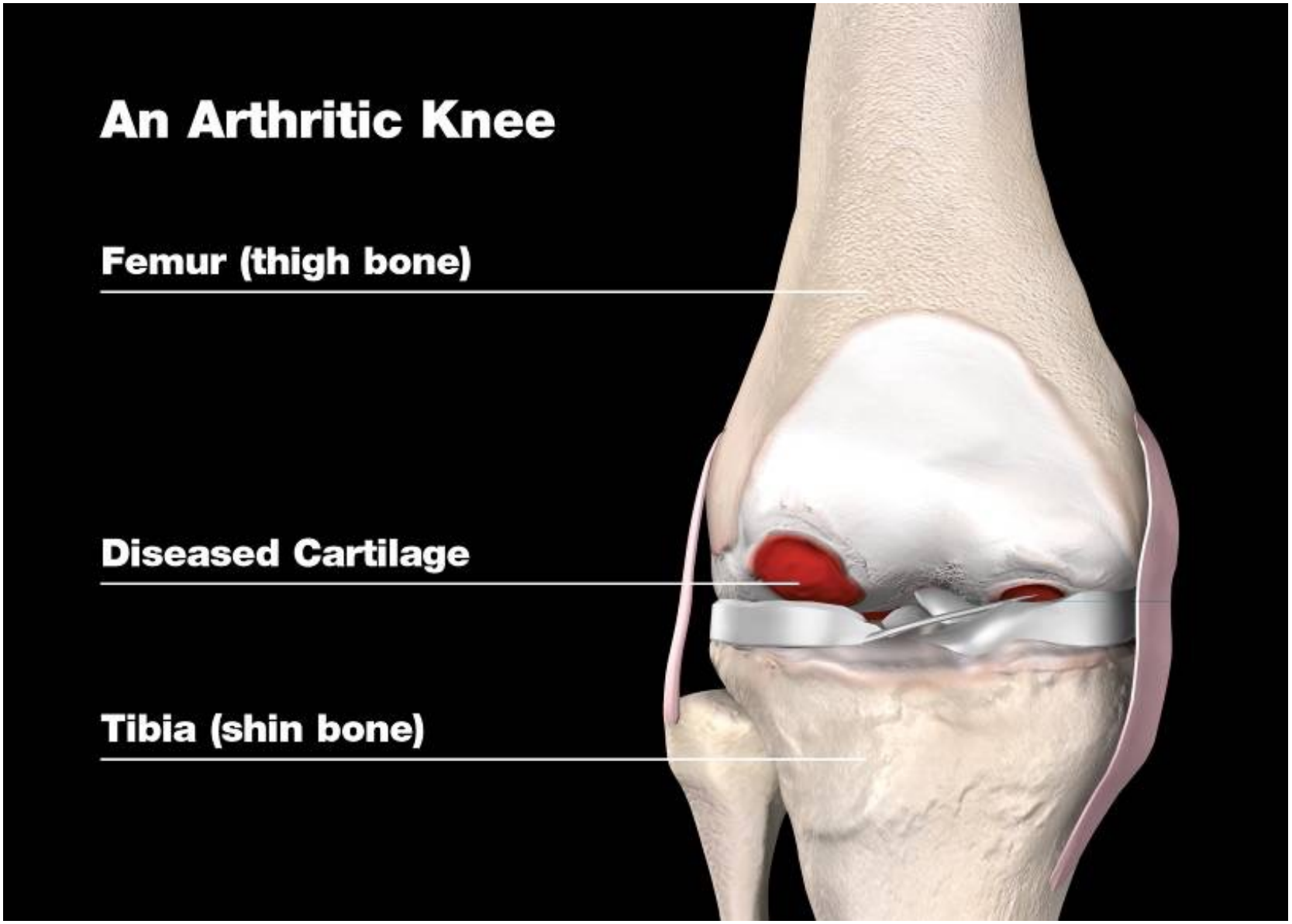
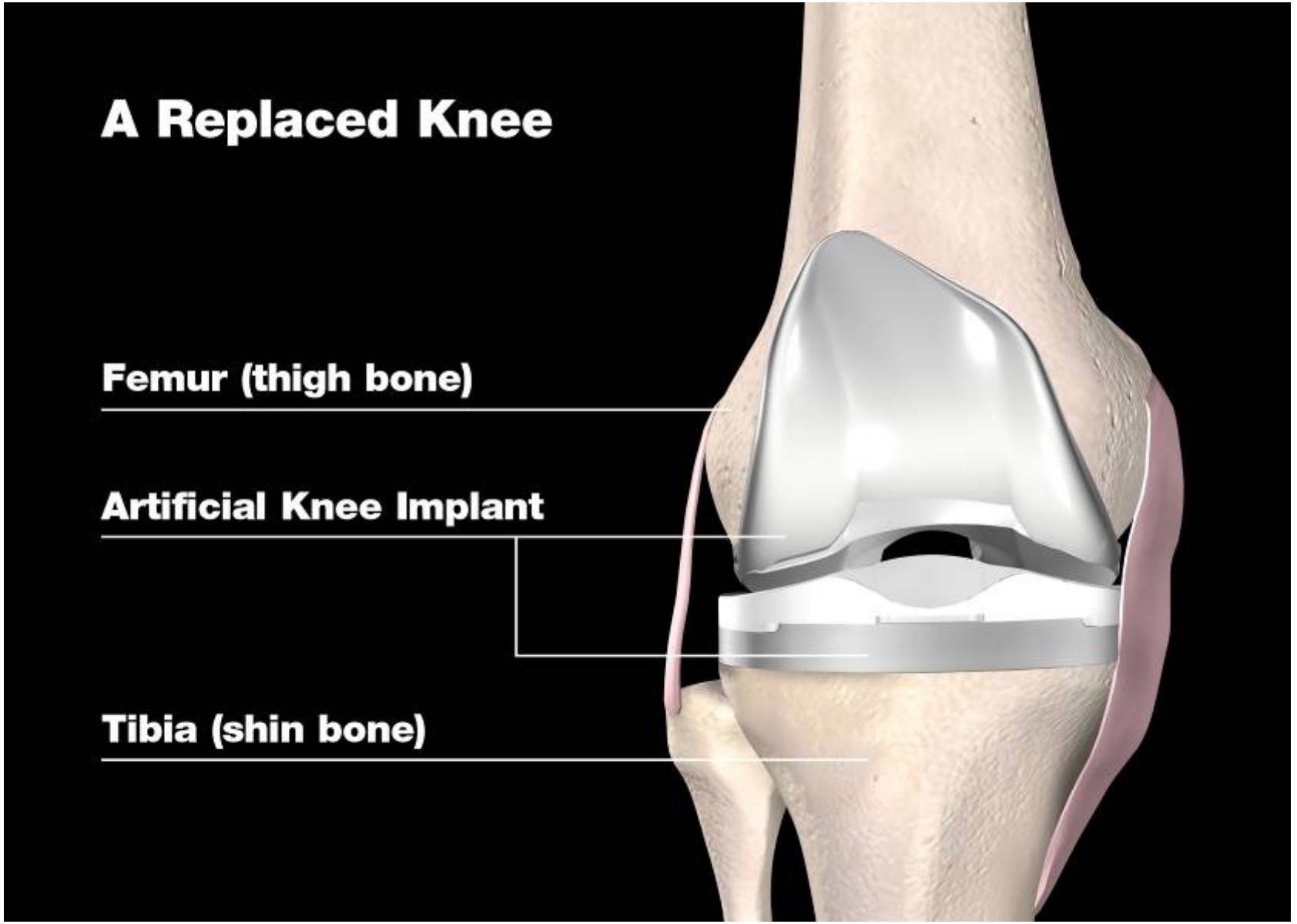
Total Knee Joint Replacement

- 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


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


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

A Replaced Knee



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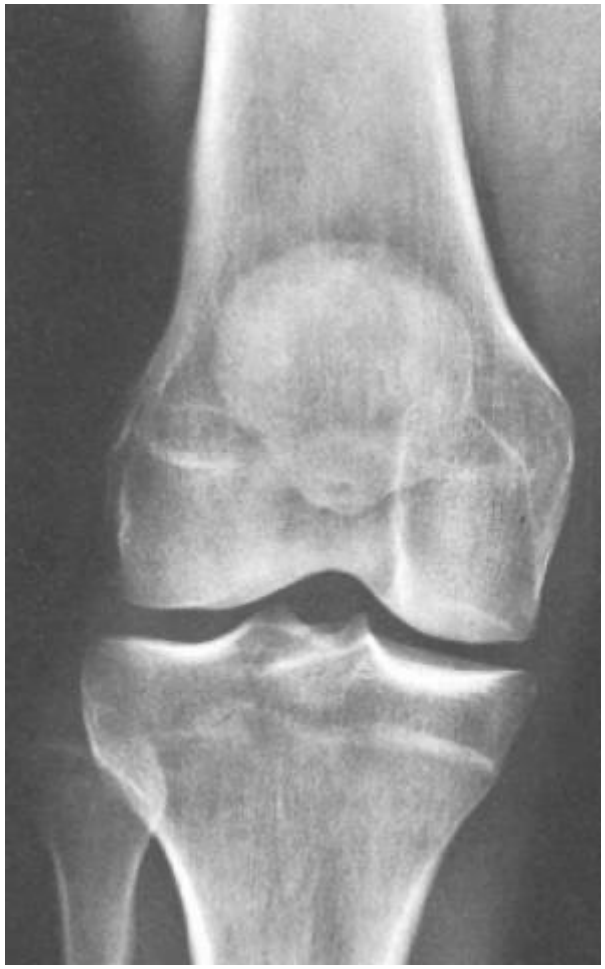
Normal Knee X-ray



Arthritic Knee X-ray

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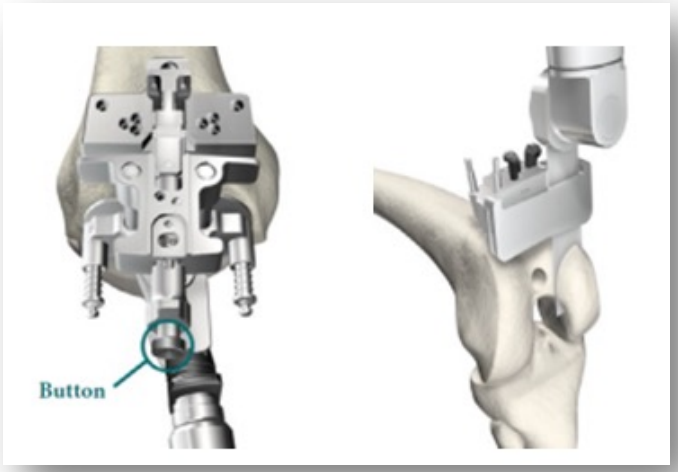
Replaced Knee X-ray

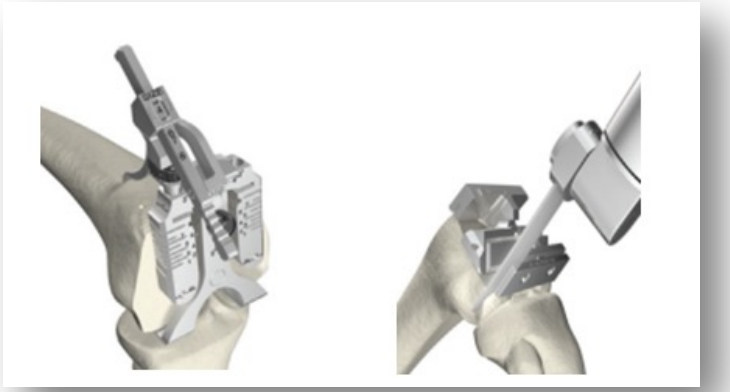
Anterior View

Lateral View

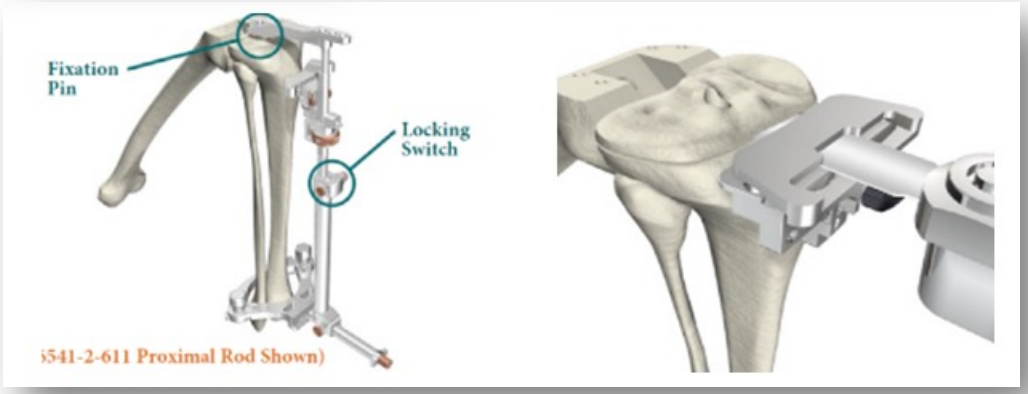
Variability of manual instrumentation



Placement of the IM rod

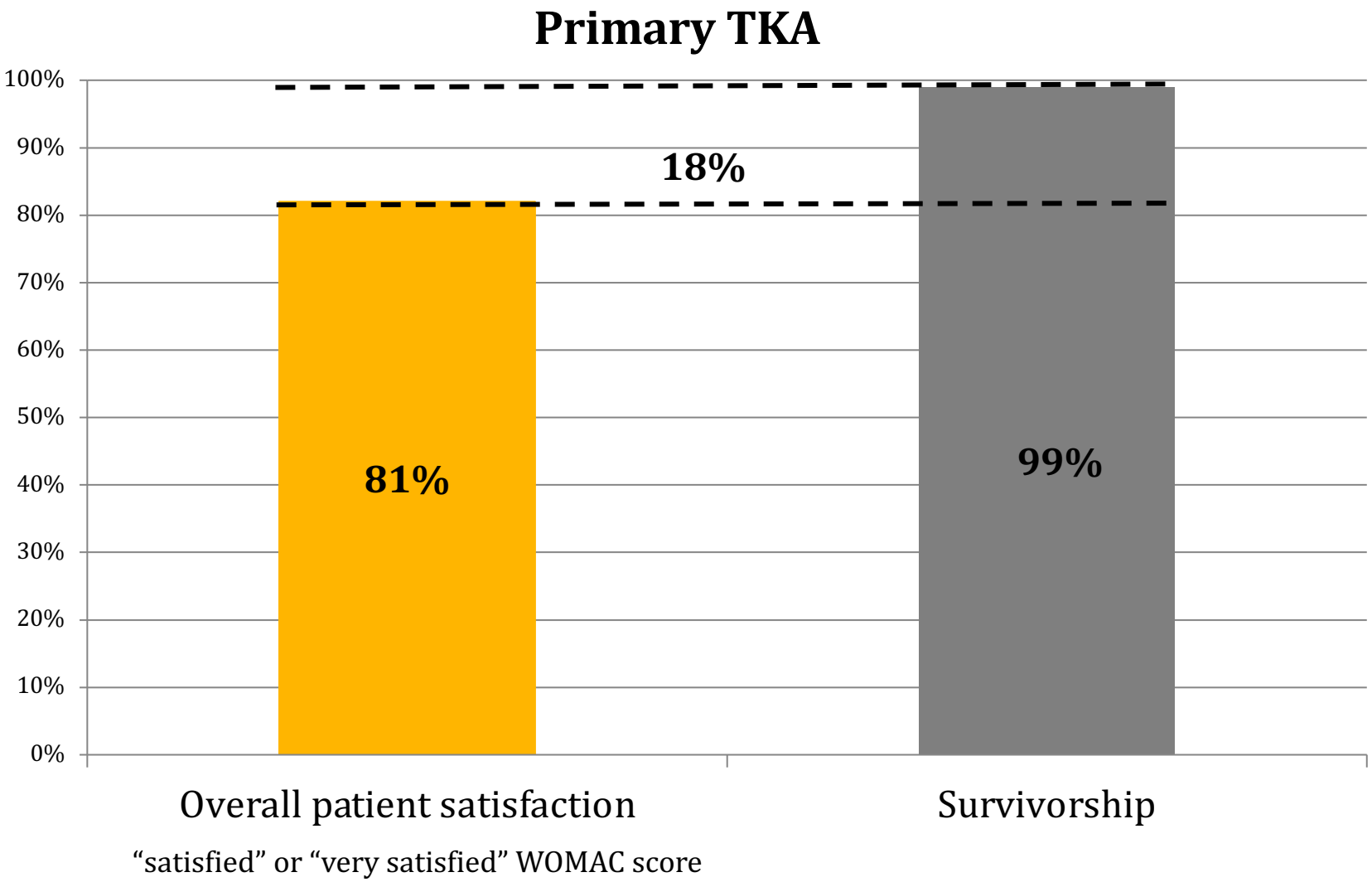


Alignment of cutting guides

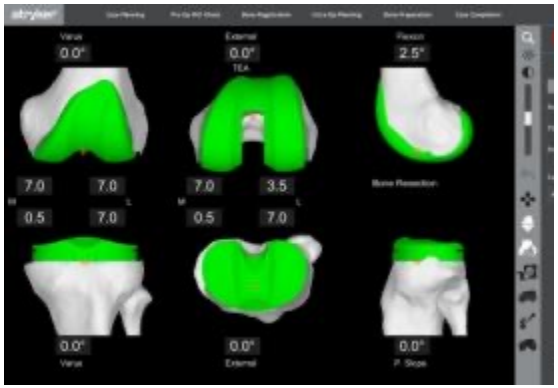


Placement of extramedullary guides sawblade excursion and toggle

Bigger opportunity to move the needle[13,14]

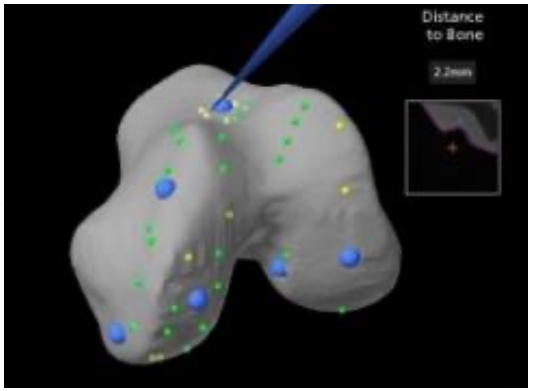


Mako Total Knee workflow

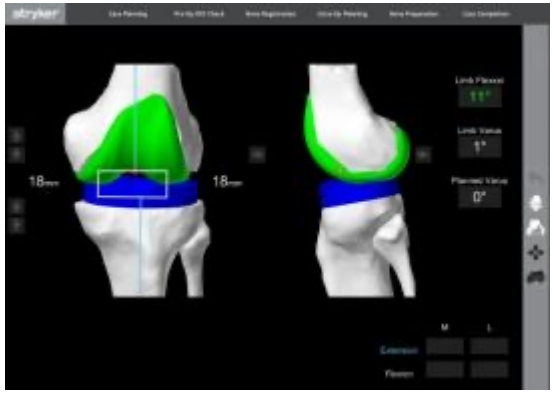


Pre–op planning

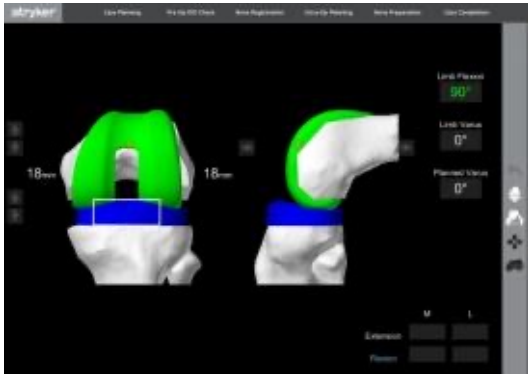
Array placement



Bone registration

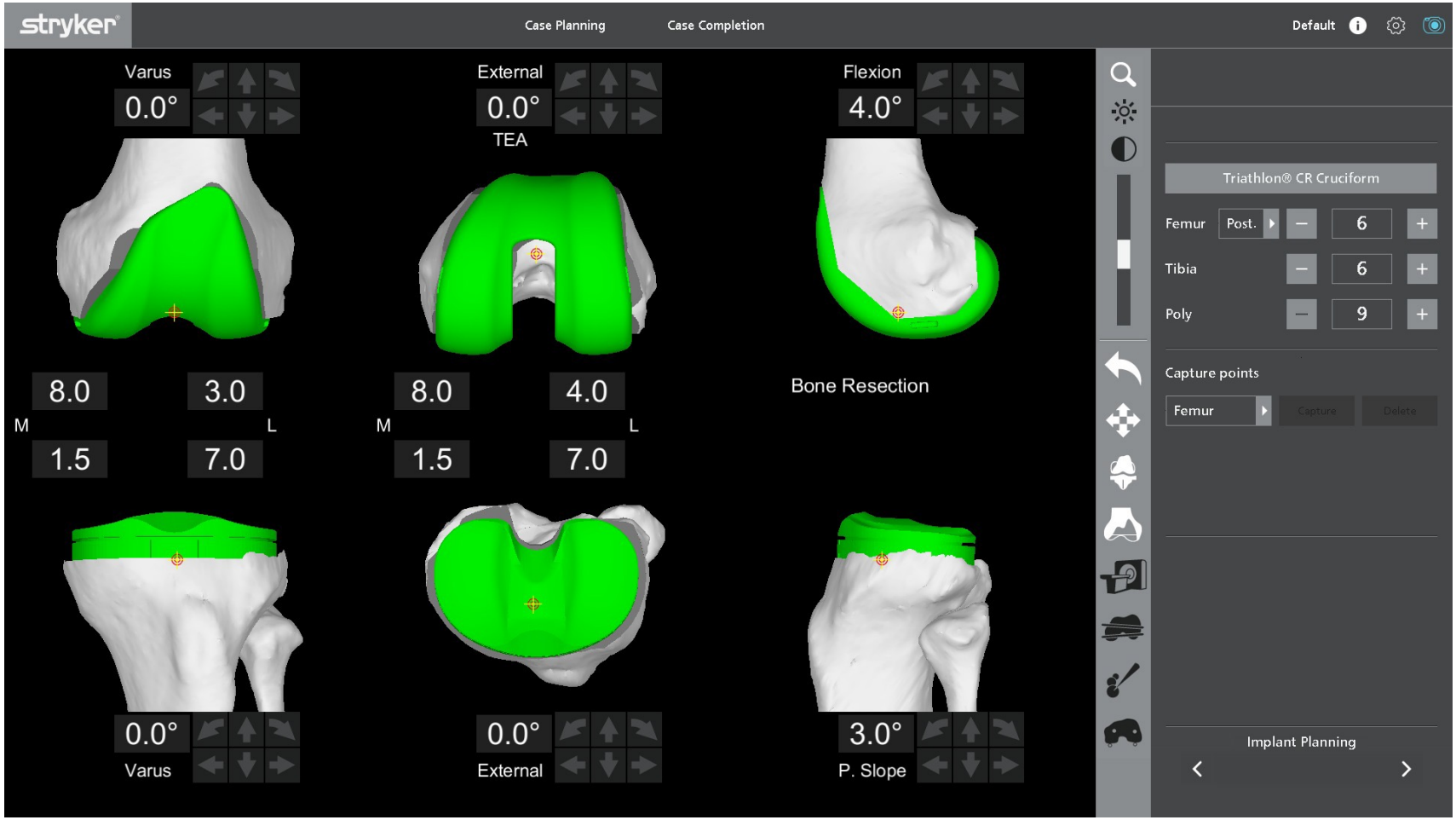


Ligament balancing assessment
Intra-op plan adjustments



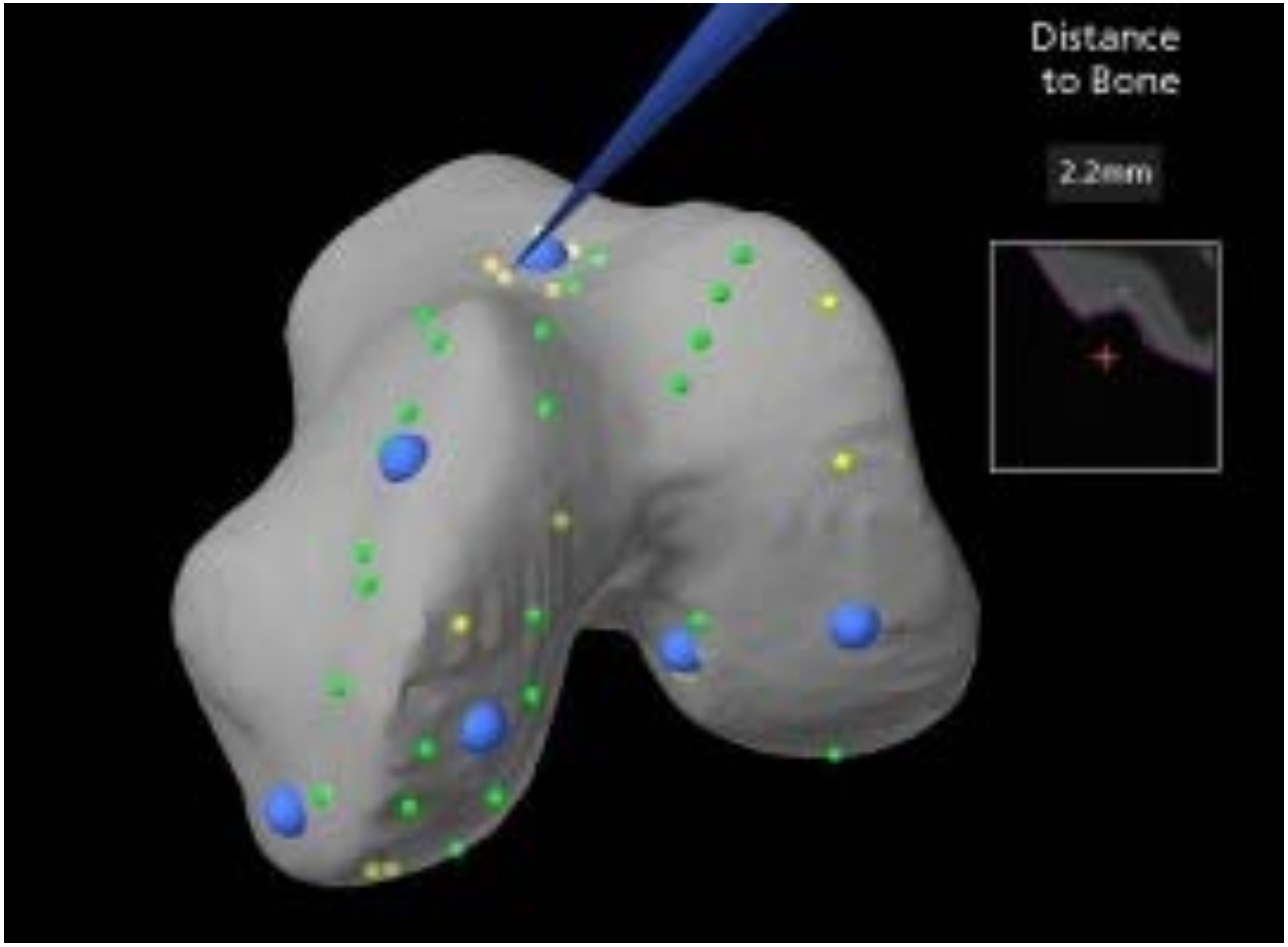
Bone resection

Preop Planning

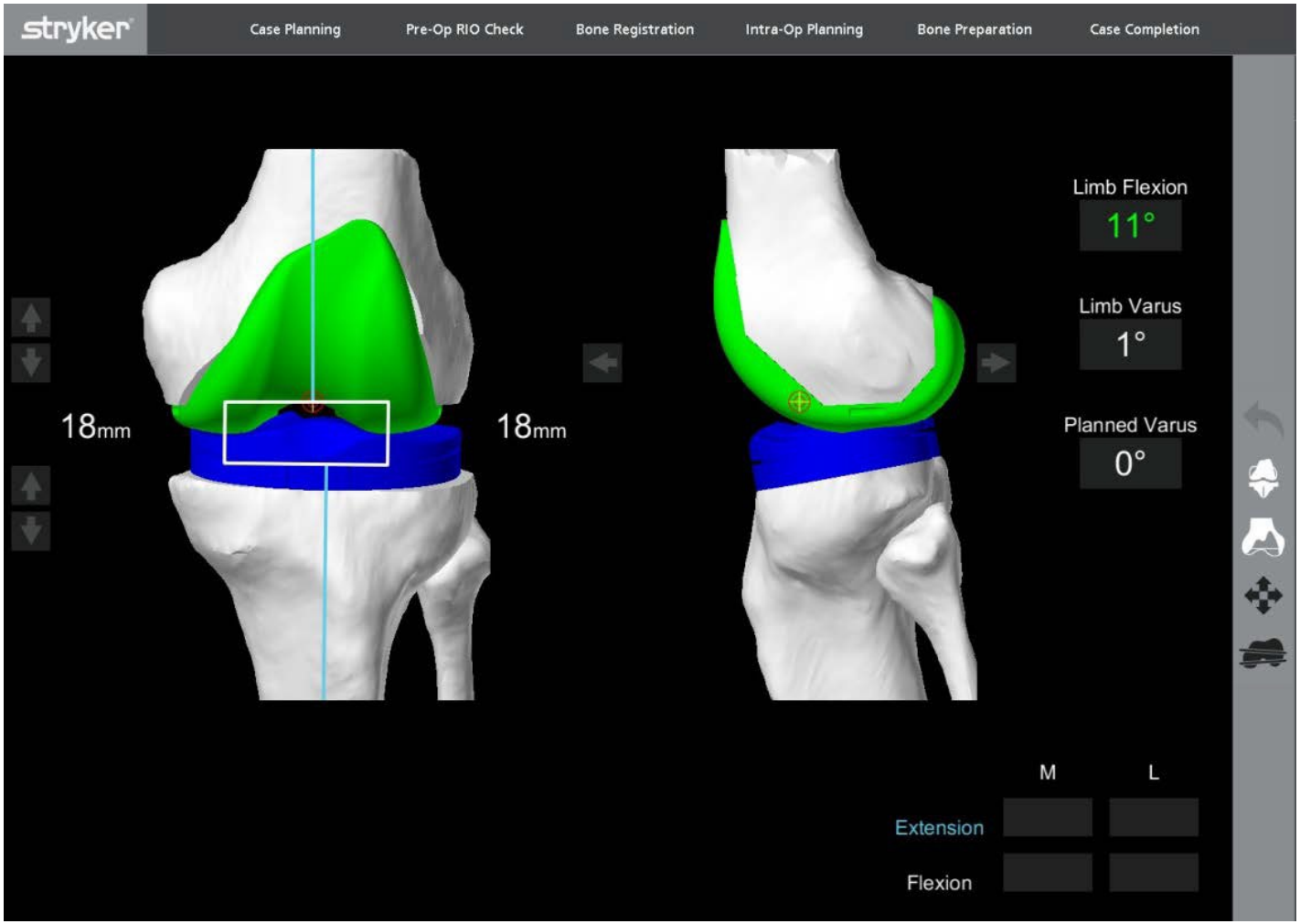


Array Placement

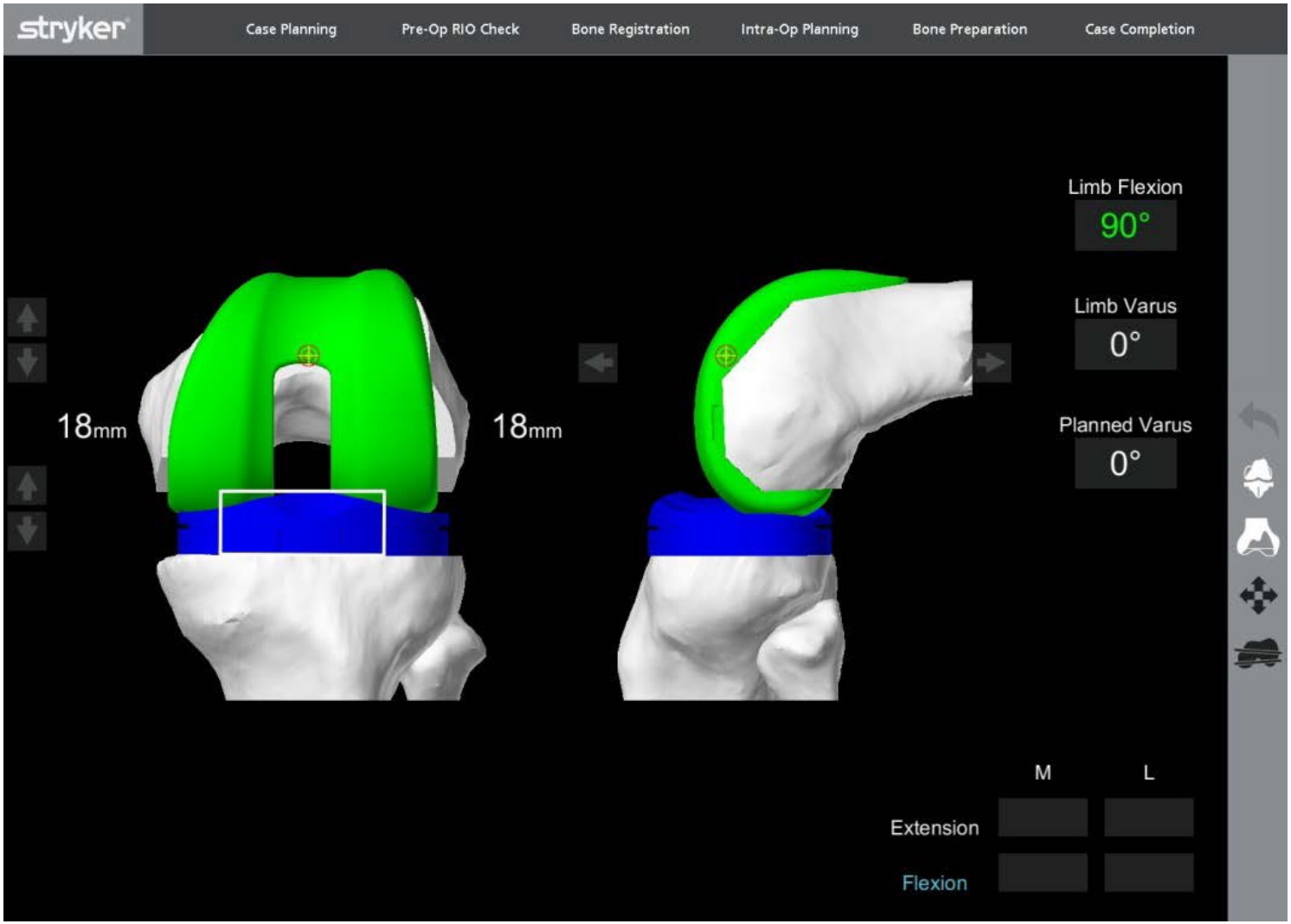
CT guided bone registration



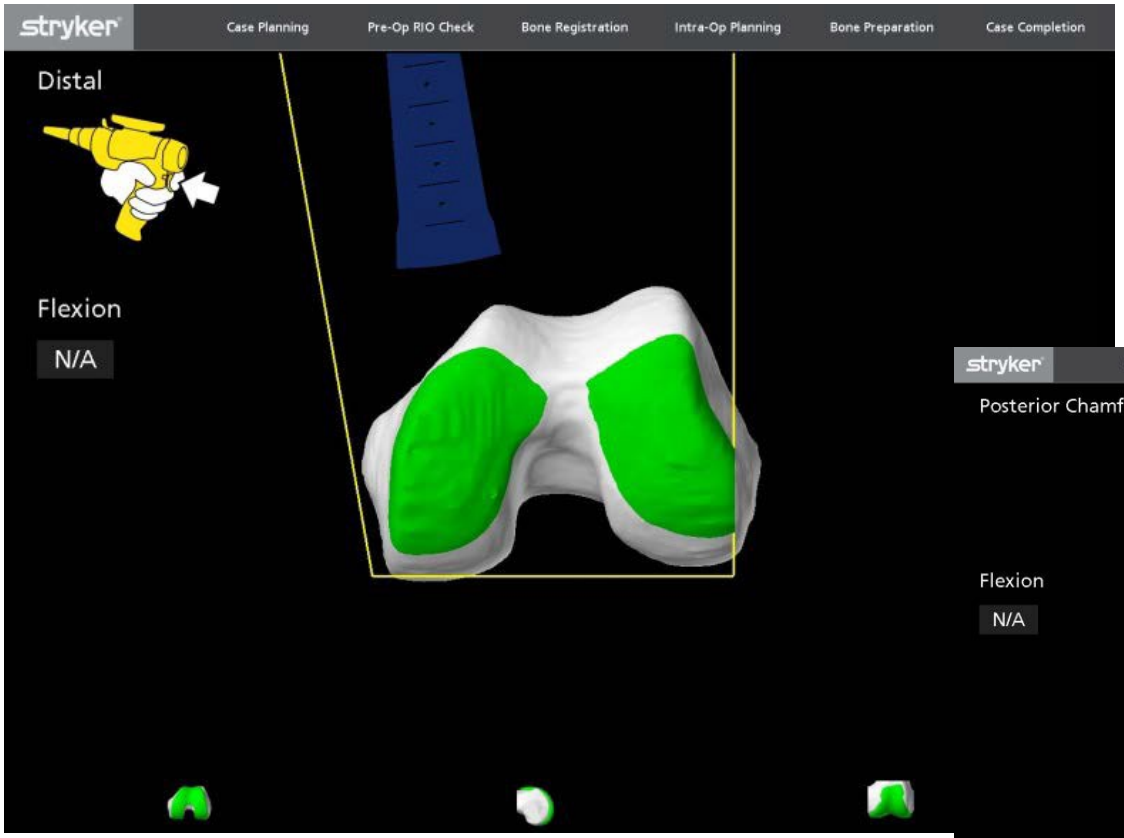
Dynamic pre-resection balancing

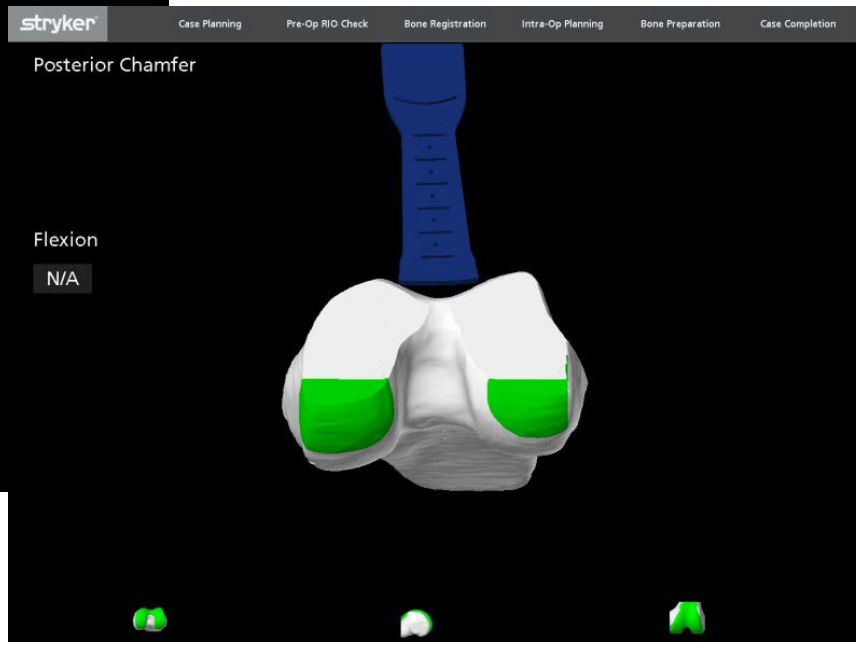


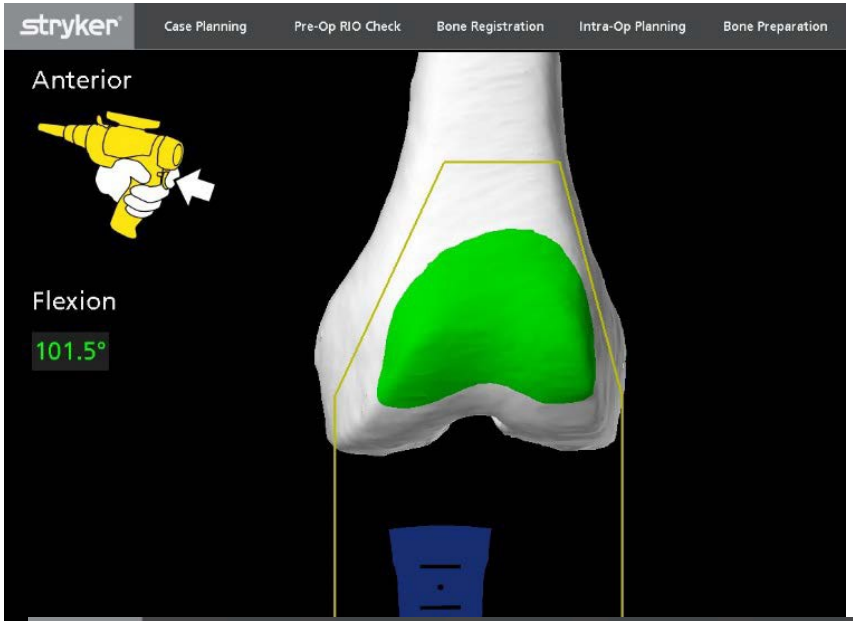
Joint Balancing

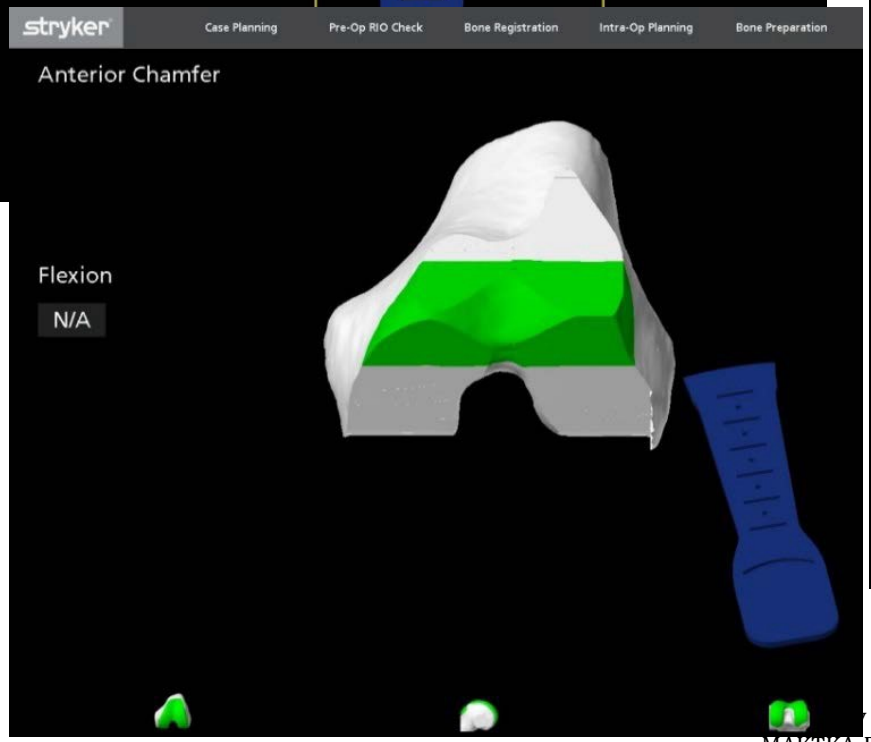


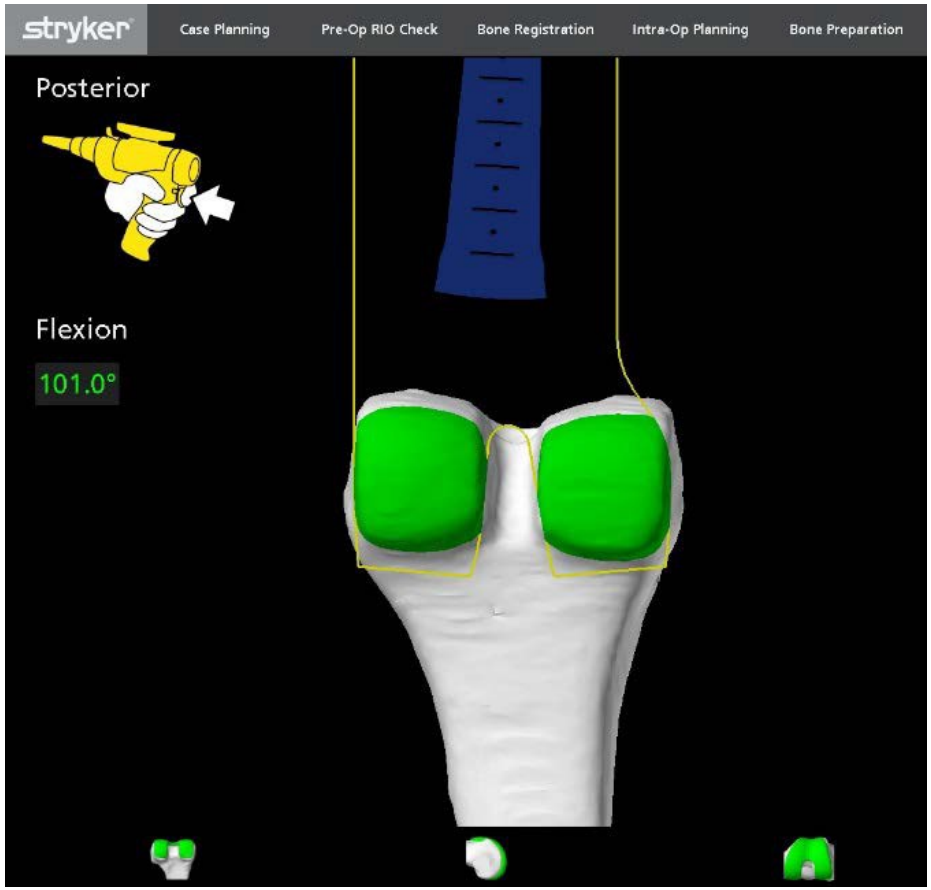
Distal Femur and Posterior Chamfer

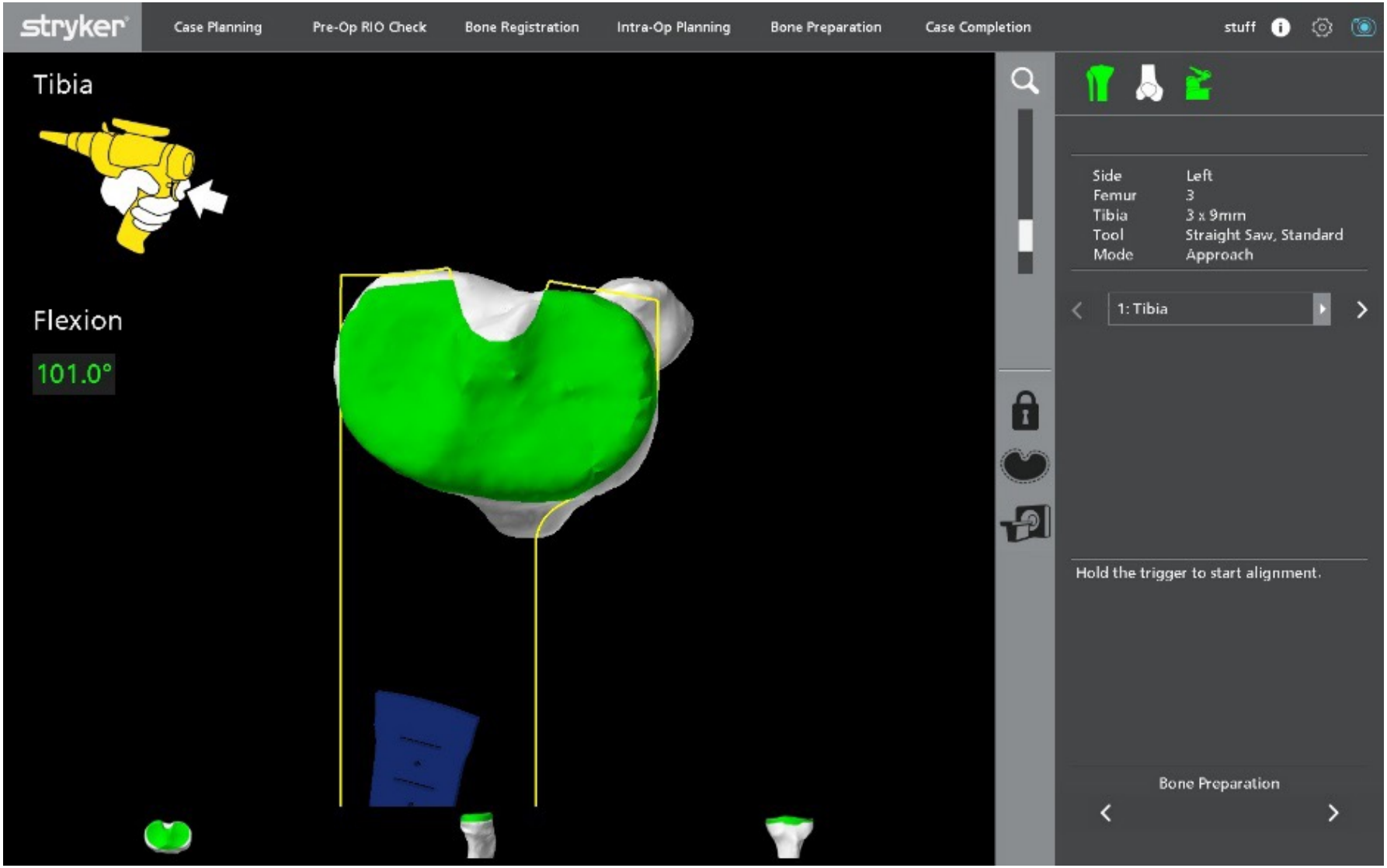











stryker
Case Planning
Pre-Op RIO Check
Bone Registration
Intra-Op Planning
Bone Preparation
Case Completion
stuff
Tibia
Flexion
101.0°
Side Left
Femur 3
Tibia 3 x 9mm
Tool Straight Saw, Standard
Mode Approach
1: Tibia
Hold the trigger to start alignment.
Bone Preparation

Early Clinical results

The Bone & Joint Journal
70 years of orthopaedic excellence

Knee

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*

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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

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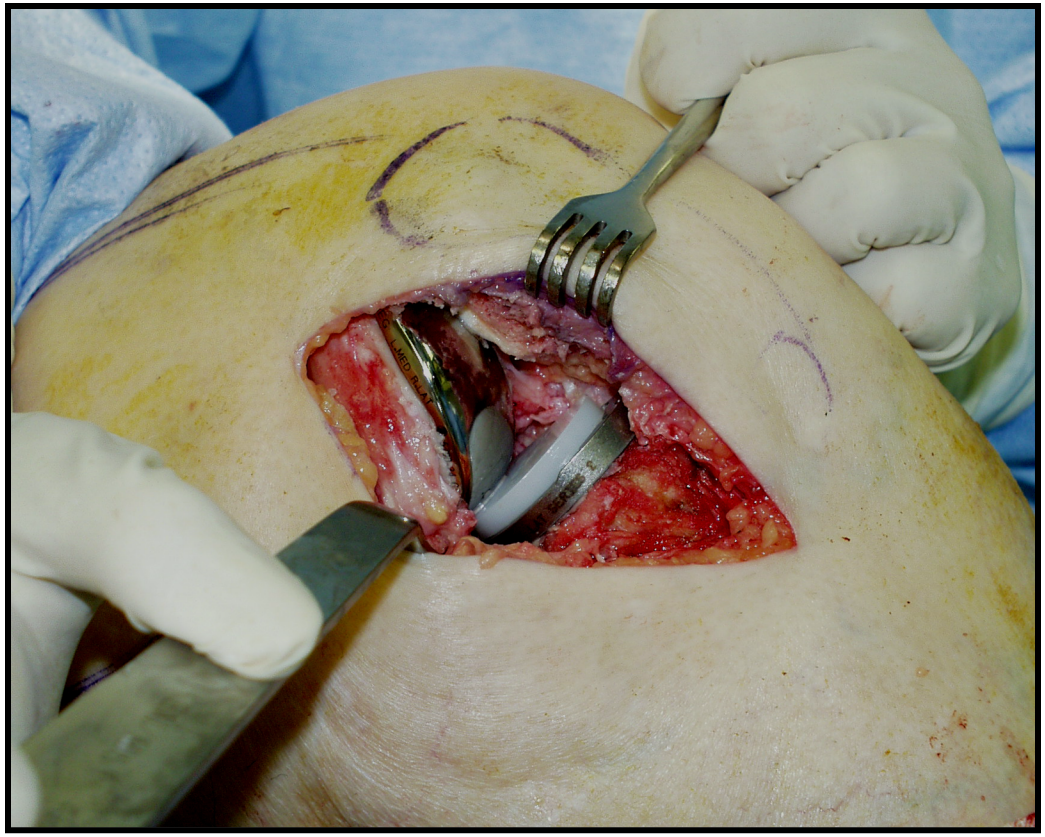
Operative Management



- SPINAL anesthetic
- IV sedation
- Capsular injection

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Post-Operative Management

- Early ROM with PT
- Ambulation same day

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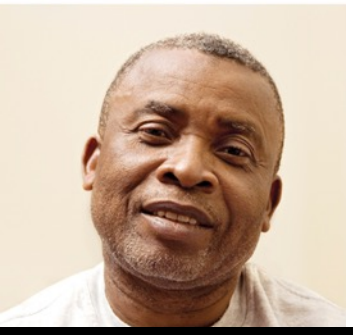
Post-Operative Management

- 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

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

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

Femoral head and acetabular insert in hips

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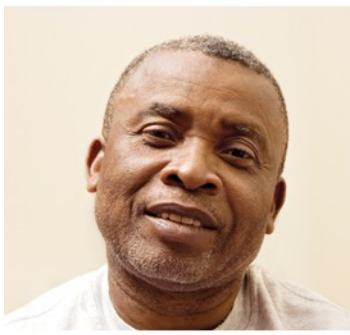
MIS Hip Replacement
Direct Anterior Approach

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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.

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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

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Why I Do The Direct Anterior Approach?

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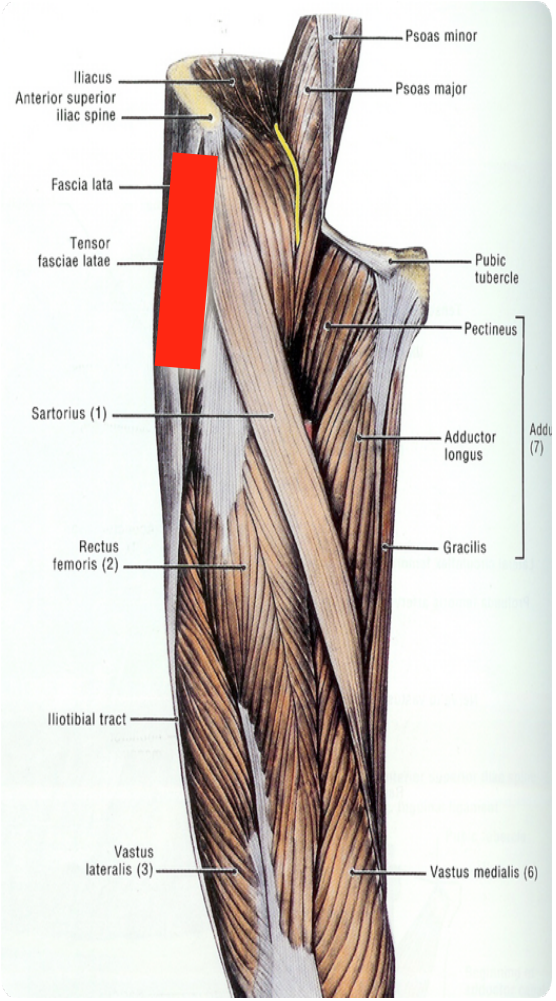
Why Direct Anterior?



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

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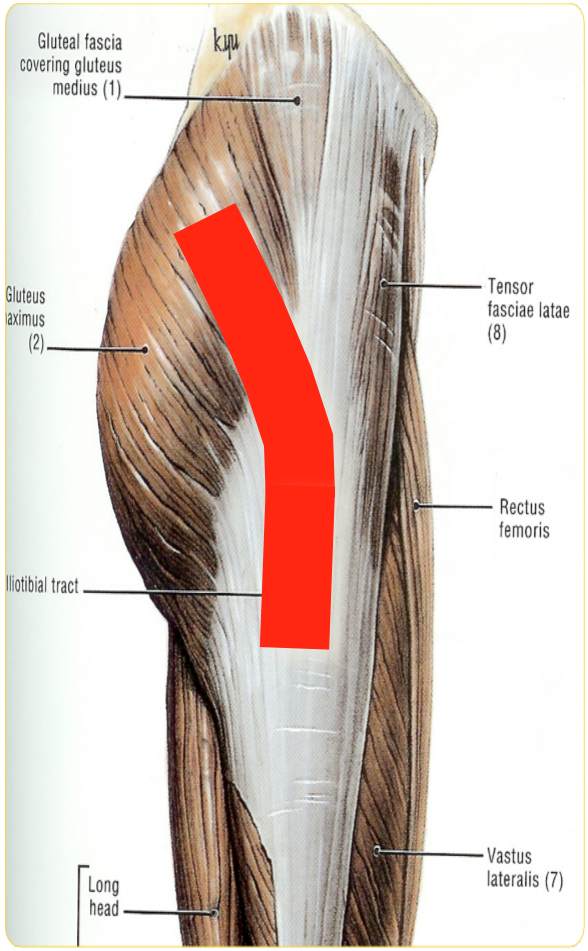
Why Direct Anterior?



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

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Direct Anterior Hip Replacement

Why?

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

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Direct Anterior Hip Replacement

Why Not?

- Unfamiliar territory
- Femoral exposure is difficult
- Specialized equipment

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How it’s done

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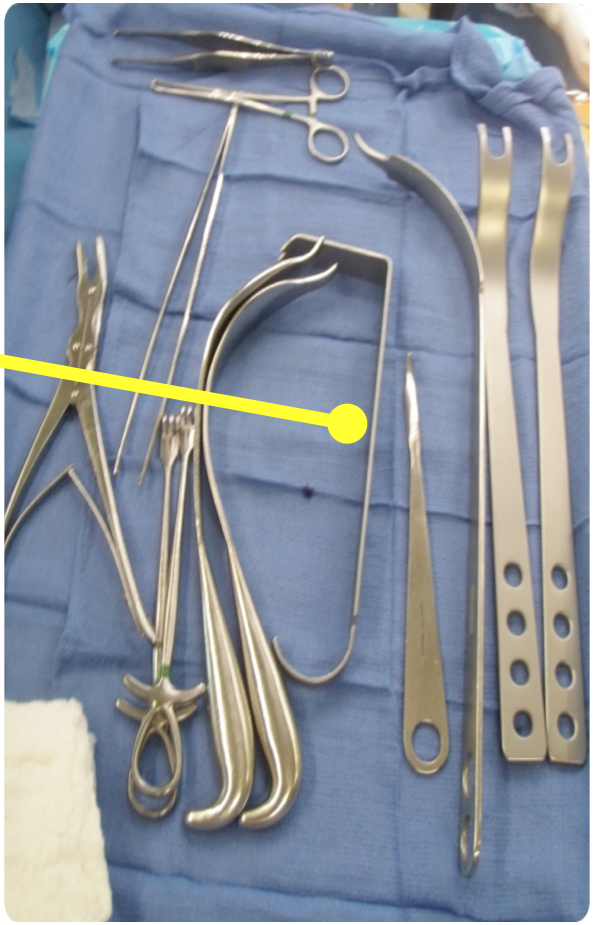
Special Instruments

Retractors



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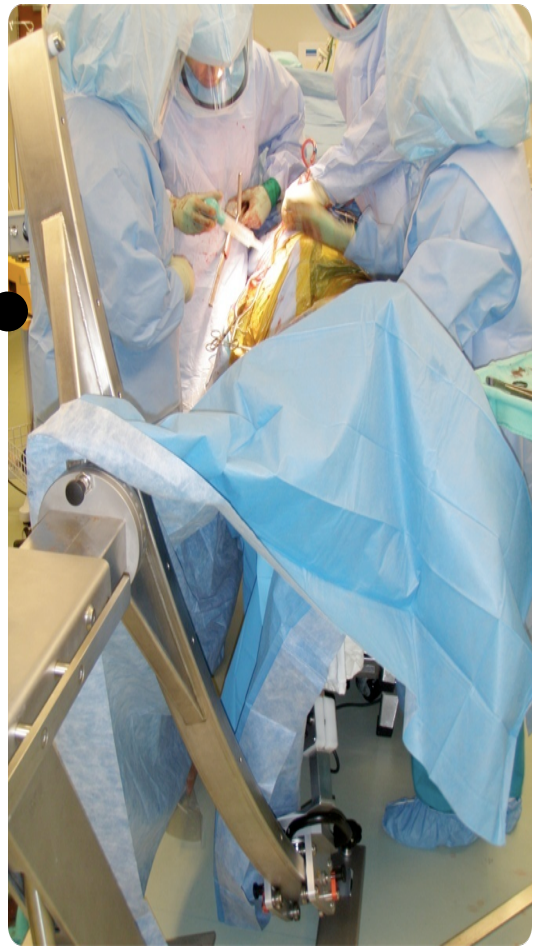
Special Equipment

Lighting

Arch table



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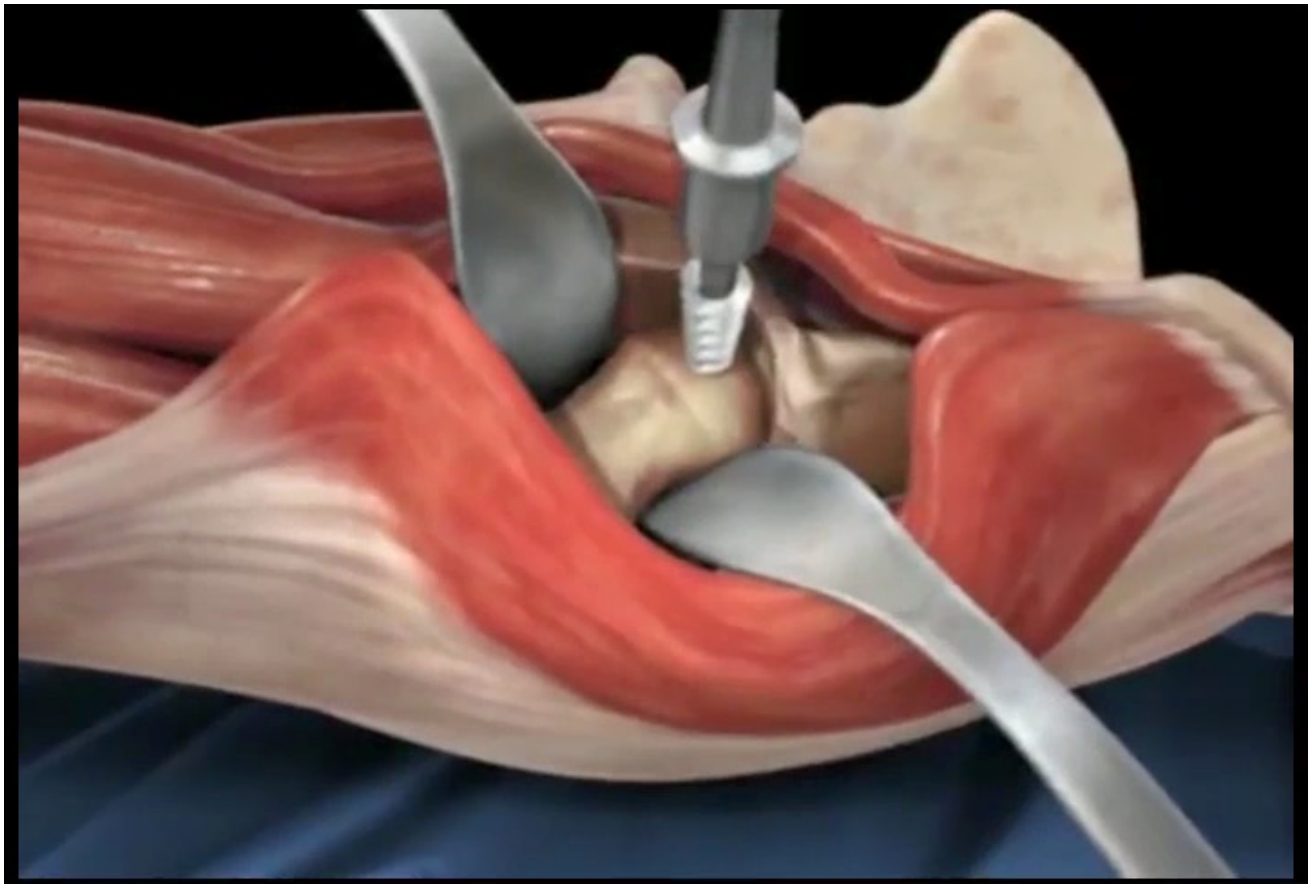

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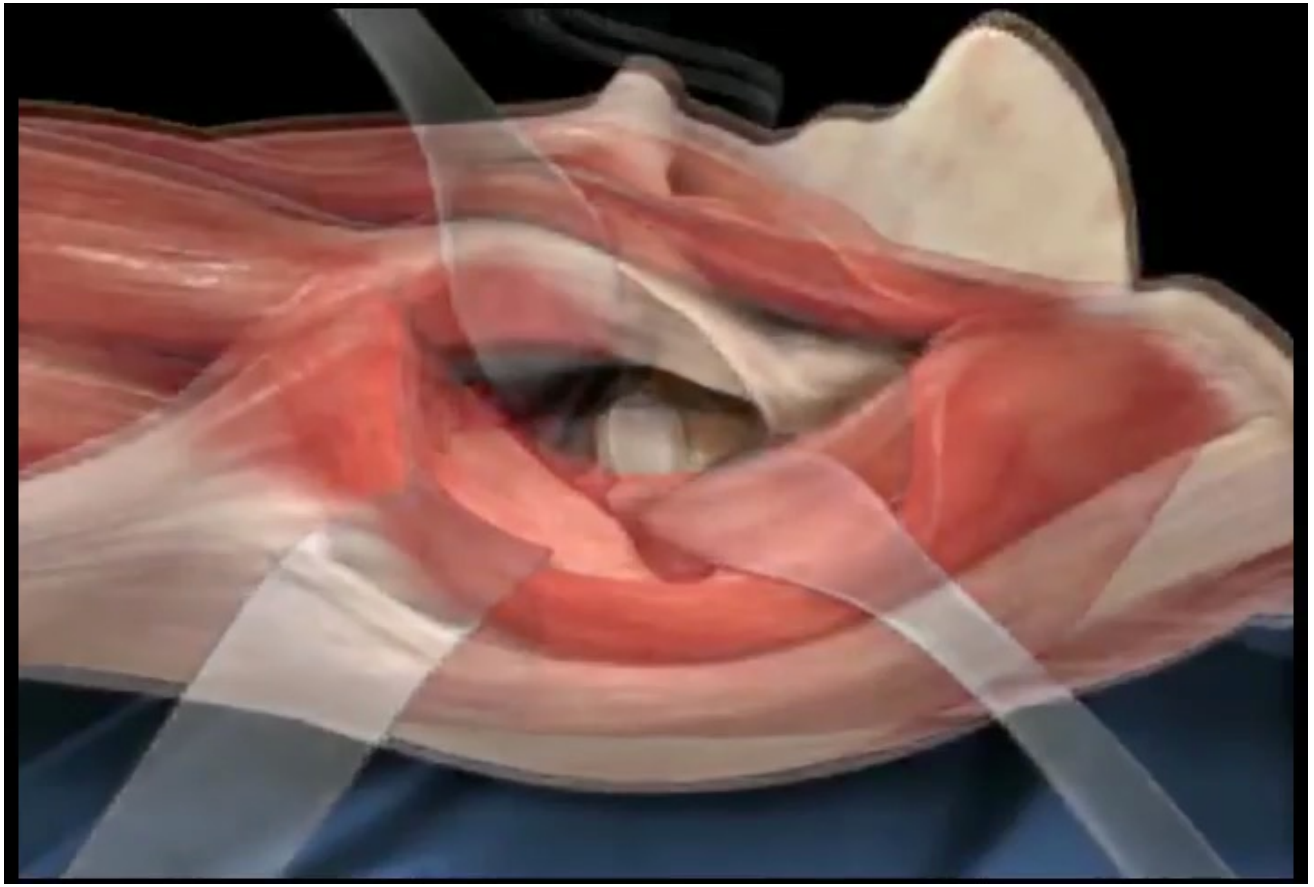

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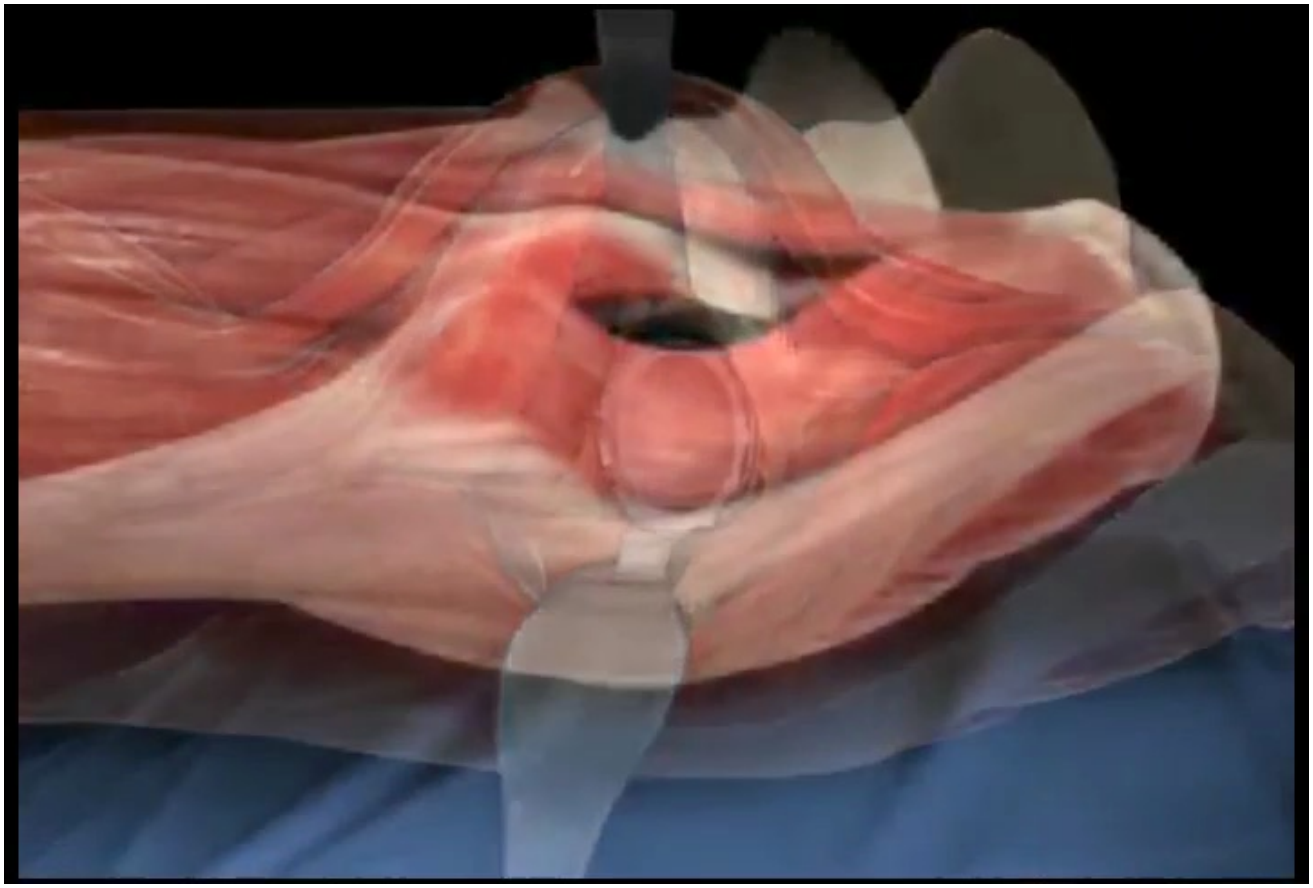

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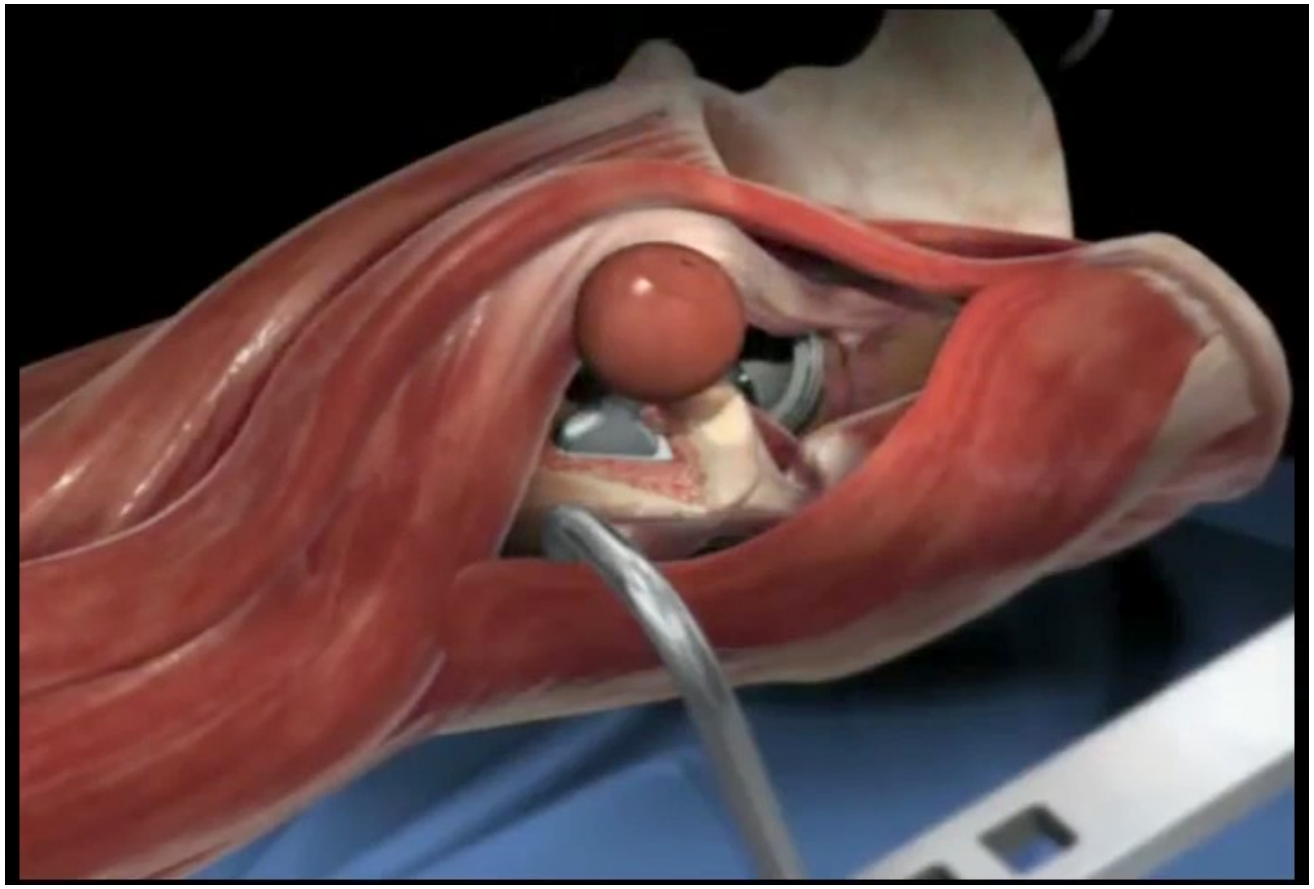

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Typical Precautions: Traditional vs. Direct Anterior

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.

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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.

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Advantages of Direct Anterior

- MIS approach is better for patients
- No Hip Precautions
- Improved Control over Component Position

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The Use of Technology in Hip Replacement

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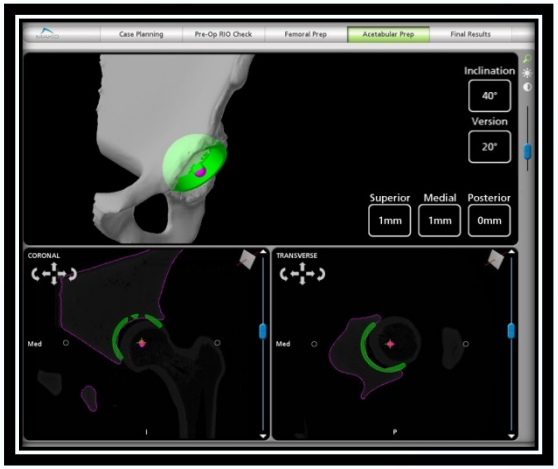
Why Navigation?

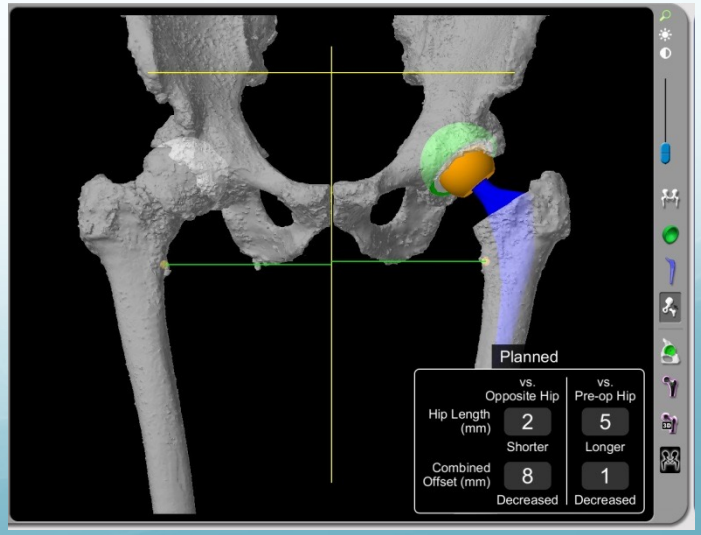
- Increased level of precision
- Confidence in component position
- Recovery room film is too late for changes
- Optimize surgical results

rTHA- Better Plan

mTHA- Plain x-ray

rTHA- 3D CT



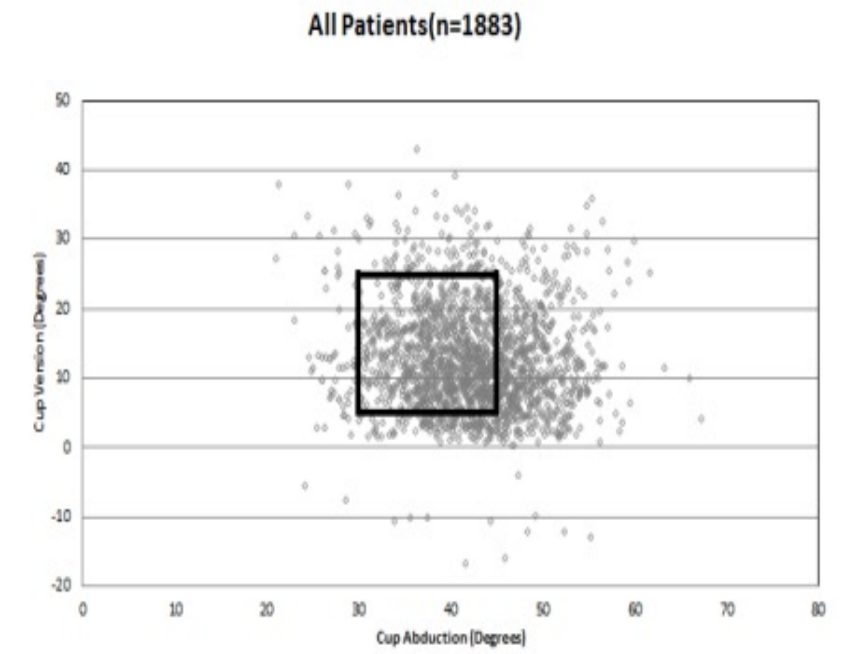


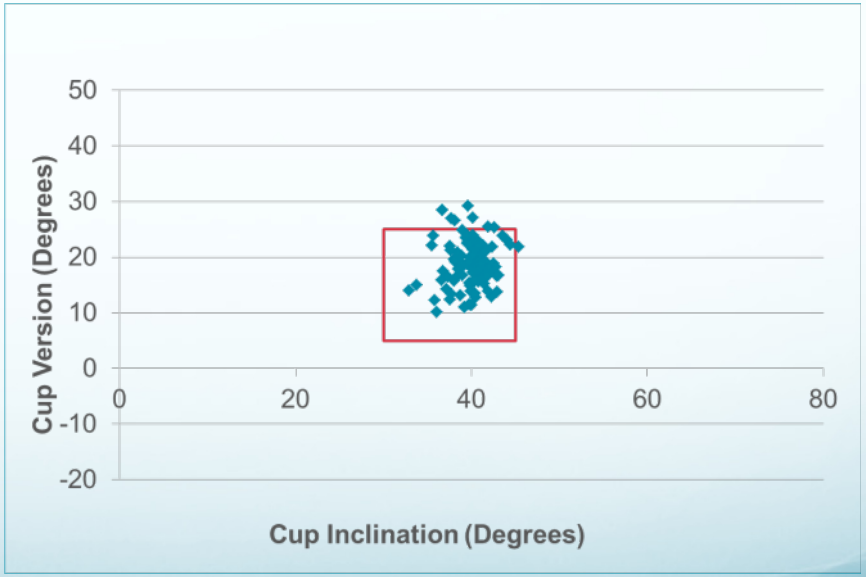
rTHA vs. mTHA: Multicenter study

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





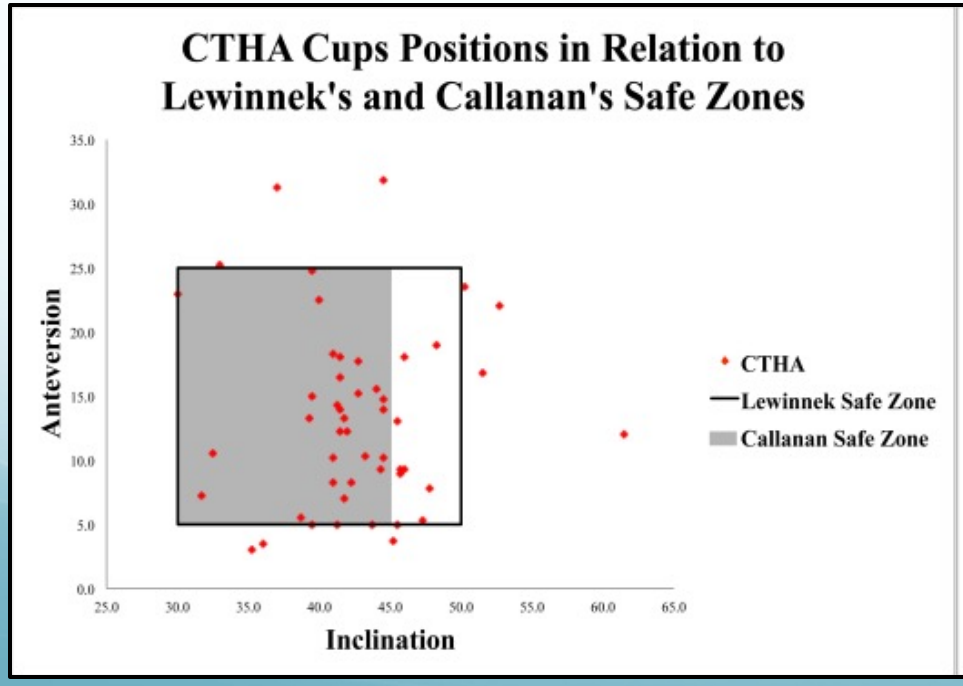
1. The John Charnley Award: Risk factors for cup malpositioning: Quality improvement through a joint registry at a tertiary hospital. *Clin Orthop Relat Res*. 2011 Feb;469(2):319-29.

rTHA vs mTHA: Single Surgeon Data

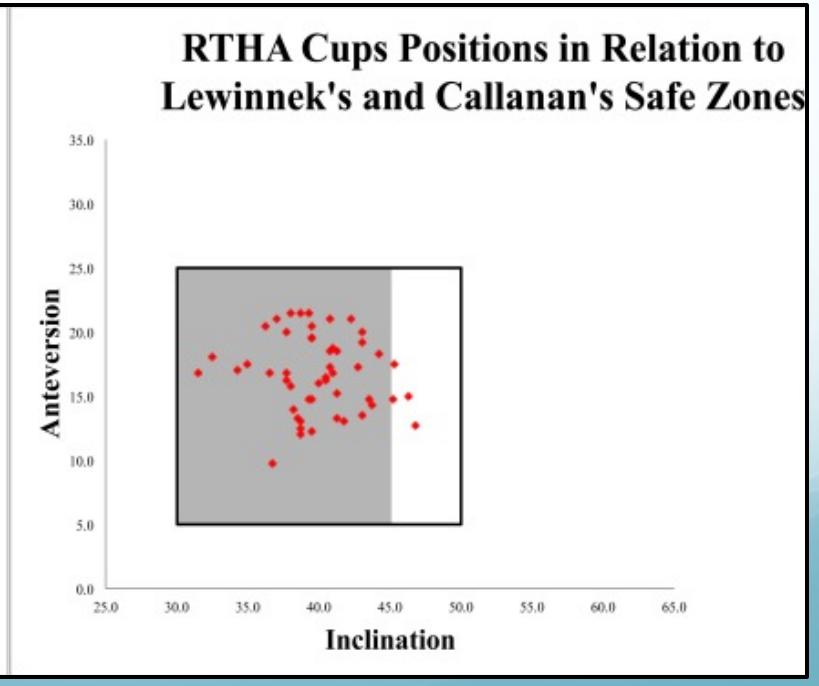
A Matched-Pair Study- Dr. Domb – Hinsdale, IL CORR 2013

- 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



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Technique with Technology

Surgical goals of hip replacement

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

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DA THA

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

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Prevent the Bad Effects

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

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Operative Management

- IV sedation
- Capsular injection

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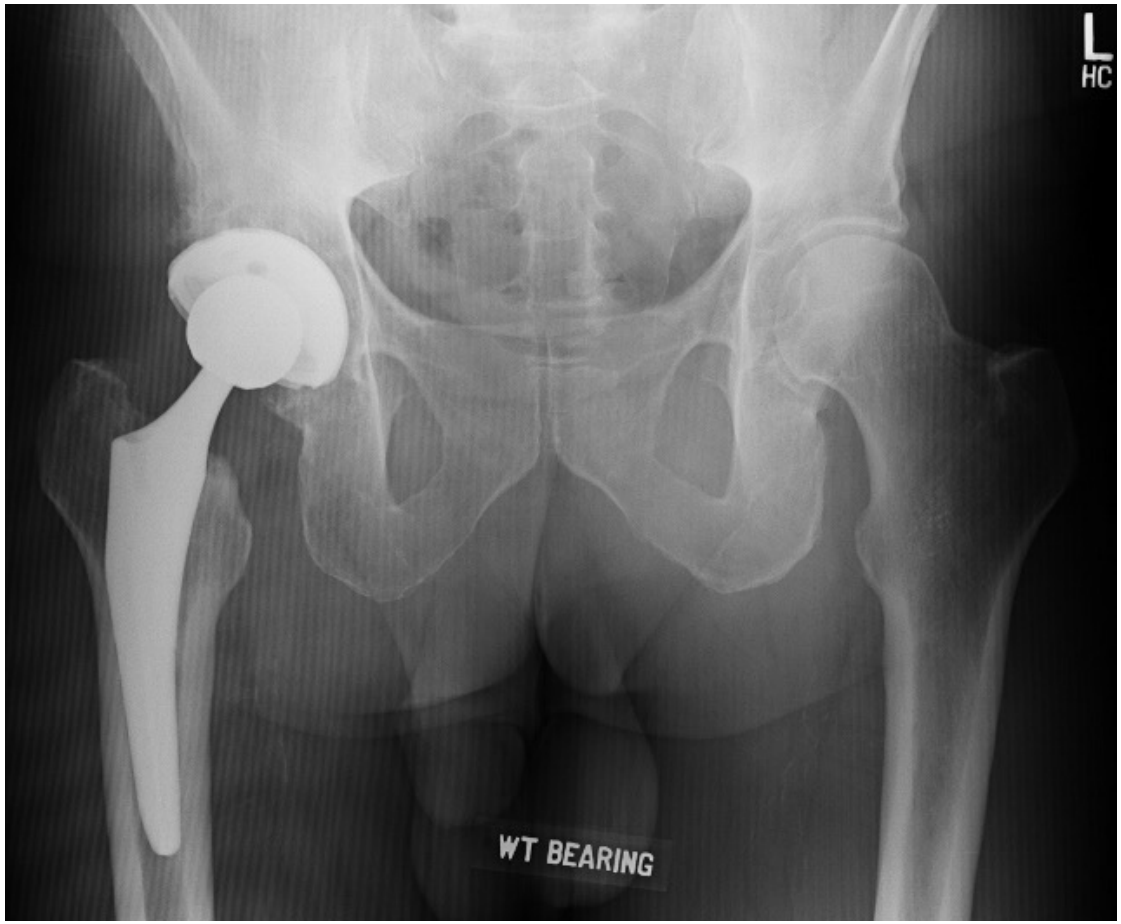
Post-Operative Management



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

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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

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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 and

Death

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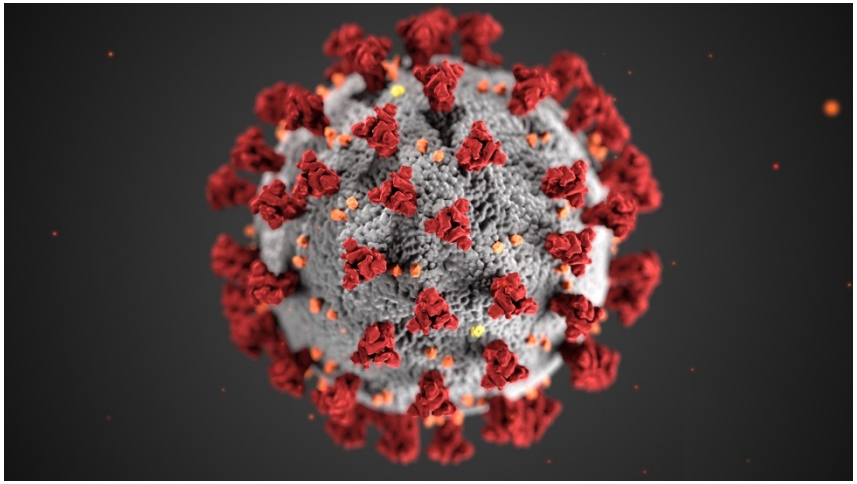
COVID Protocol

- 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.



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stryker

Questions?