

## Advances in Knee Arthritis

**Treatment**  
**State-of-the-Art Care:**  
**Less Pain, Quicker Recovery**

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BoulderCentre for  
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[www.boulderhipandknee.com](http://www.boulderhipandknee.com)  
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 Boulder Community Health

 Boulder Community Health

## About my practice...

- Focus on minimally invasive surgical techniques combined with advanced technology
- 99% of cases done under spinal anesthesia
- Avg LOS: TKA 1.1 days, THA 1.5 days
- 91% of patients discharged to home with outpatient PT

 Boulder Community Health

## 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

 Boulder Community Health

## New Name, New Place



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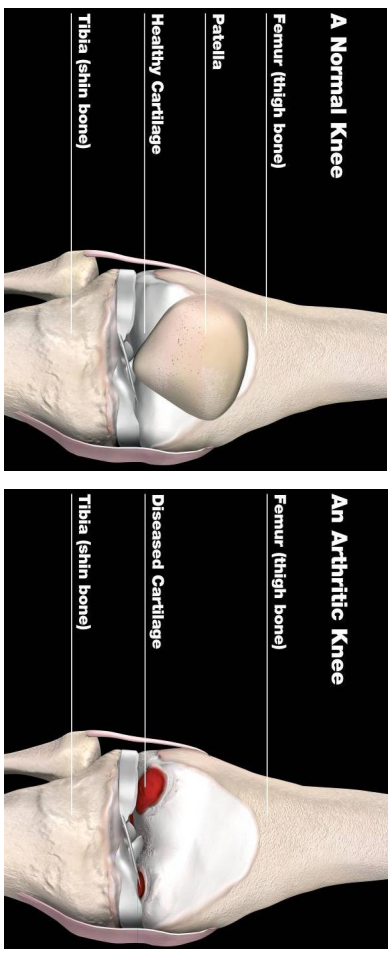


## New Name, New Place

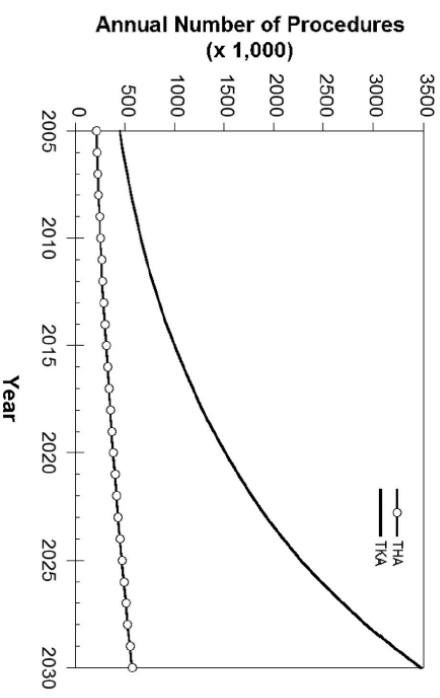


# What is Arthritis?

Osteoarthritis- Worn out articular cartilage  
 Inflammatory Arthritis- Systemic Process  
 ex: Rheumatoid, Psoriatic, etc.



## 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**

## Treatment Options for Knee Pain

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

## How Can I Avoid a Joint Replacement?

### RICE and NSAIDS

Rest, Ice, Compression,  
Elevation

Ibuprofen, Alleve, 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*



## PRP: Platelet Rich Plasma

Injections of concentrated blood products to enhance healing

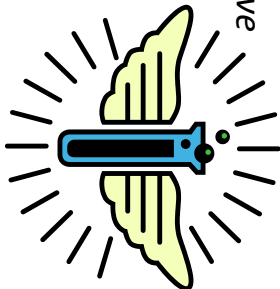
*\*Not covered by insurance, expensive*



# 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*



## Knee Demographics

- Age
  - TKA\* (111) 67.05 y/o
  - BMAC (37) 55.35 y/o
- BMI
  - TKA (53) 31.99
  - BMAC (37) 27.17

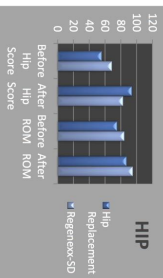
# Stem Cell Results:

### Data Collection

This data was collected by Regenexx network physician Dr. John Strickland, MD, as part of ongoing research. Dr. Strickland has collected data on patients who have had knee and hip arthroscopy on the Regenexx-SD procedure for hip and knee arthroscopy. Regenexx had no involvement in the data collection or the preparation.

#### What does this mean?

The Harris Hip Score and its range of motion improved in both hip replacement and Regenexx-SD patients. While hip replacement patients demonstrated a statistically significant improvement in the Harris Hip Score, Regenexx-SD patients demonstrated a statistically significant improvement in the Harris Hip Score.



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



The Regenexx-SD procedure is a minimally-invasive hip procedure that involves the injection of bone marrow that has been processed.

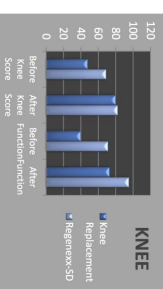


How does a major surgery compare to an injection of stem cells?

**Caution!** This is a comparison trial, which is not the same as a double-blind, randomized, controlled trial.

#### What does this mean?

Both Knee Society Assessment Score and Function Score improved in both hip replacement and Regenexx-SD patients. Regenexx-SD knee patients demonstrated a statistically significant improvement in the Knee Society Assessment Score and Function Score. Hip replacement patients demonstrated a statistically significant improvement in the Knee Society Assessment Score and Function Score.

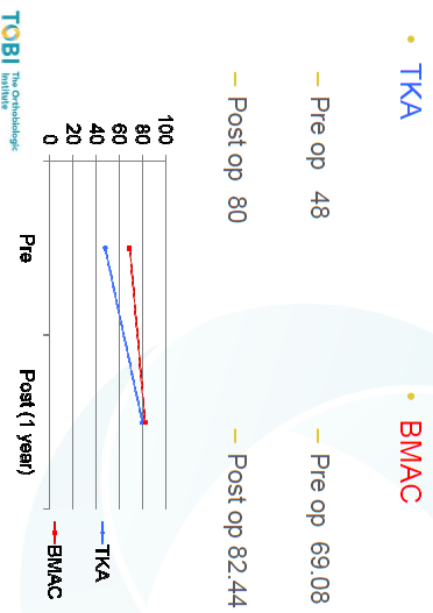


**Caution!** Hip and TKA arthroscopy performed in 2007, mean age of 63 years, mean BMI of 28. 28 Regenexx-SD procedures performed in 2012, mean age of 51 and BMI of 26. 24 TKA patients were available for follow-up at one year and 18 Regenexx-SD patients were available for follow-up at one year. **Knee-111:** Knee-111 knee TKA knee arthroscopy performed in 2007, mean age of 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. 37 Regenexx-SD patients were available for follow-up at one year. **Knee Society Assessment Score:** Knee Society Assessment Score and Function Score were administered to both groups by the same technician and doctor.

Available for follow-up at one year

- TKA (N=71) 43 Males/28 Females
- BMAC at Knee (N=26) 15 Males/11 Females

## Knee Society Assessment Score



## Knee Range of Motion



## Stem Cells = Snake Oil?

## Limitations with Treatment Options

- Oral drug therapy may not provide significant and lasting relief for chronic pain and may have serious adverse effects<sup>1</sup>
- Cortisone injections can weaken bone and cartilage and should not be given continuously<sup>2</sup>
- Arthroscopy, physical therapy, and bracing do not address progressive and degenerative process of OA
- Ease of movement with intra-articular hyaluronic acid viscosupplementation may be limited to 6 months and efficacy is in question for severe arthritis.
- PRP and Stem Cells are still experimental and not proven.

1. <http://www.webmd.com/osteoarthritis/live-better-10/pain-relief>, accessed: Dec. 15, 2010.  
2. [http://www.xlist.com/cortisone\\_injection/page3.htm](http://www.xlist.com/cortisone_injection/page3.htm), accessed: Dec. 14, 2010.  
3. <http://www.webmd.com/osteoarthritis/features/injections-for-osteoarthritis-pain>, accessed: Dec. 15, 2010.

## 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<sup>1</sup>
- At 2 years post-operation, patients who chose surgery earlier in disease process vs. those who waited<sup>1</sup>
  - Had improved function
  - Had reduced pain

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

## Alternatives to TKA

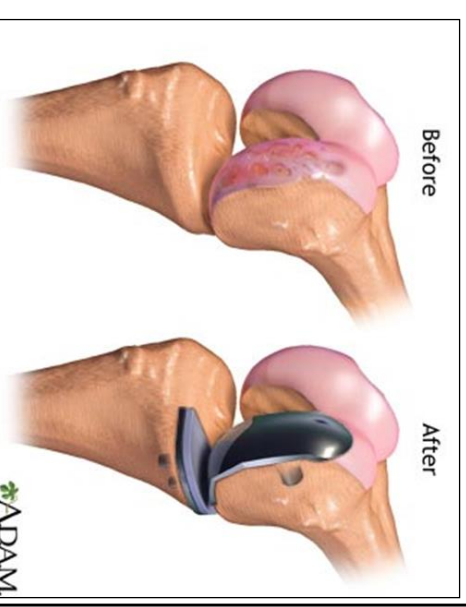
## New Opportunities in Arthroplasty

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

<sup>1</sup>. 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](http://www.niams.nih.gov/Health_Info/Hip_Replacement/default.asp#8).

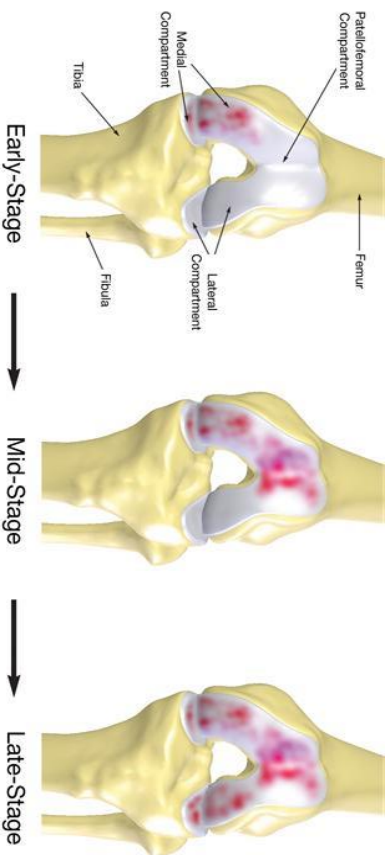
## Partial Knee Replacement

- Unicompartamental arthroplasty
- Patella Femoral arthroplasty
- Bi-compartmental arthroplasty





## Stages of Arthritis



## What is Makoplasty?

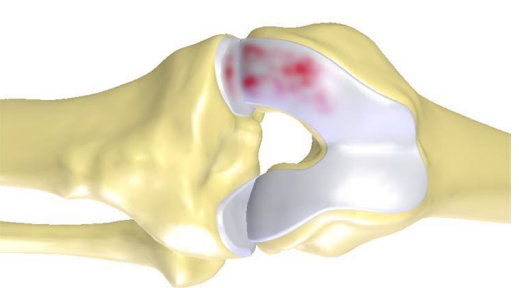


## Computer Navigated, Robotic Assisted



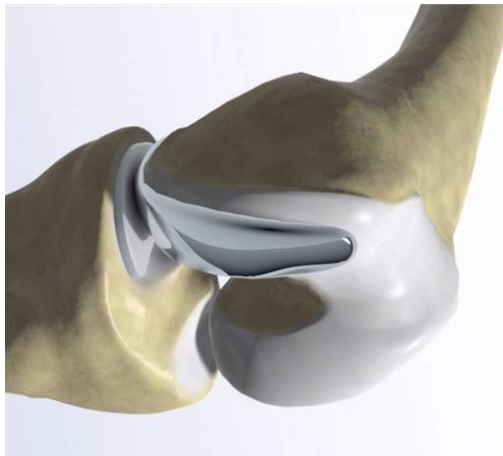
## Early Arthritis

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



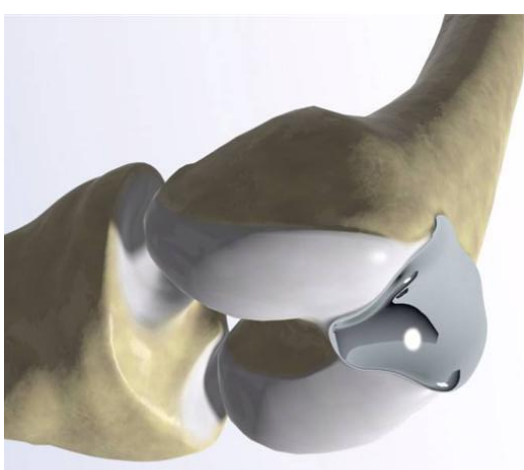
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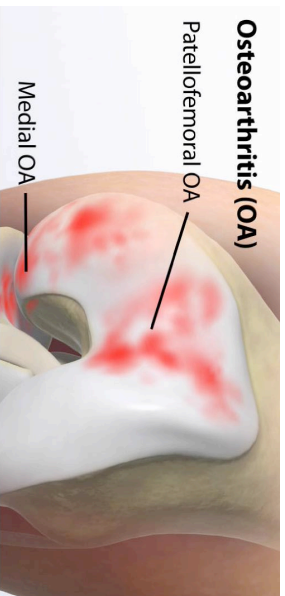
## Early Arthritis

- Can also be isolated to the patella femoral joint.



## Mid-stage Arthritis

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



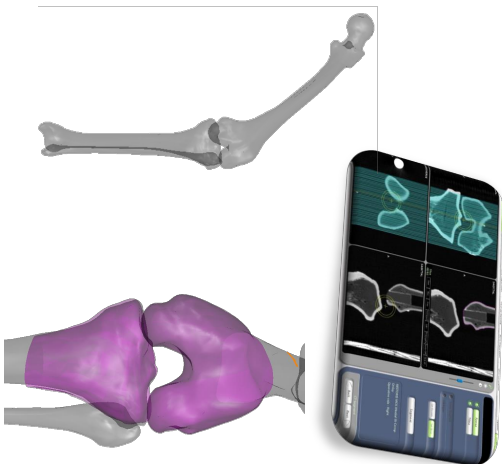
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## Makoplasty Procedure

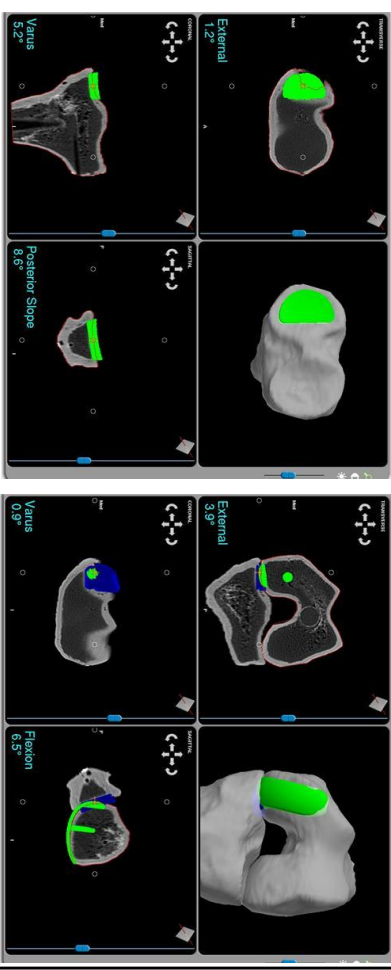
- The patient must have the correct indications for the procedure.
- A CT scan is then performed to make a 3D model of the patients knee.



## 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.



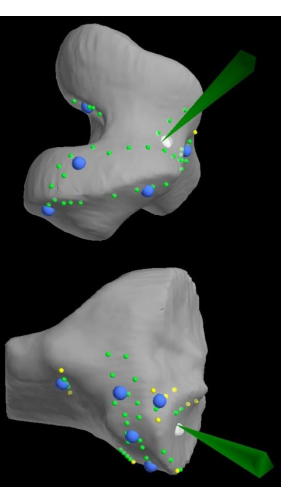
## Robotic process (cont.)

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



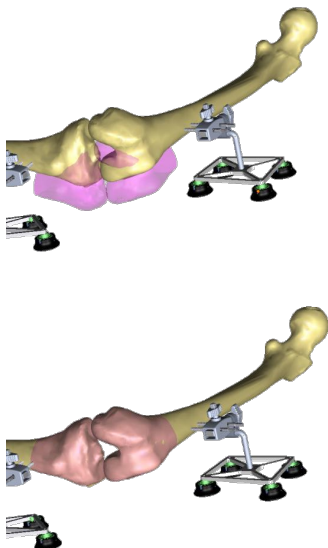
## Surgical Technique

- 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.



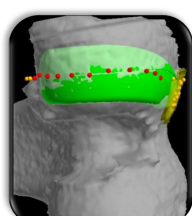
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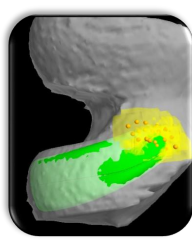


## Surgical Technique (cont.)

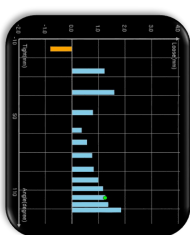
- After obtaining anatomic landmarks, evaluation of coronal and sagittal alignment, flexion and extension laxity and ROM can be measured.
- Infinitely Personalized Process.



Implant Tracking



Cartilage Mapping



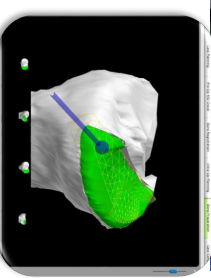
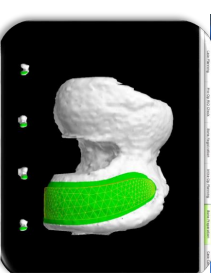
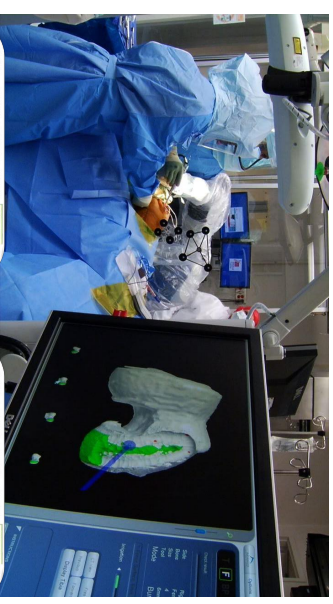
Joint Balancing

## Bone Preparation

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

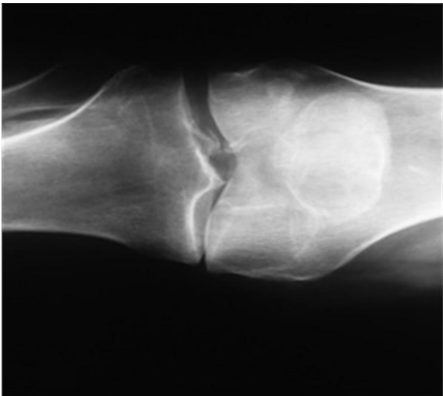
## Surgical Technique (cont.)

- 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.

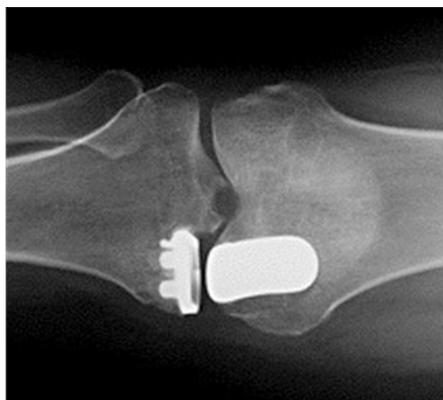


## Clinical benefits

Pre-op



Post-op



## Research Results

- 2-3x more accurate
- 3x more reproducible
- Lower pain scores:  
6 days vs 8 wks

## Makoplasty

- Less invasive
- Accurate
- Reproducible
- Bone conserving



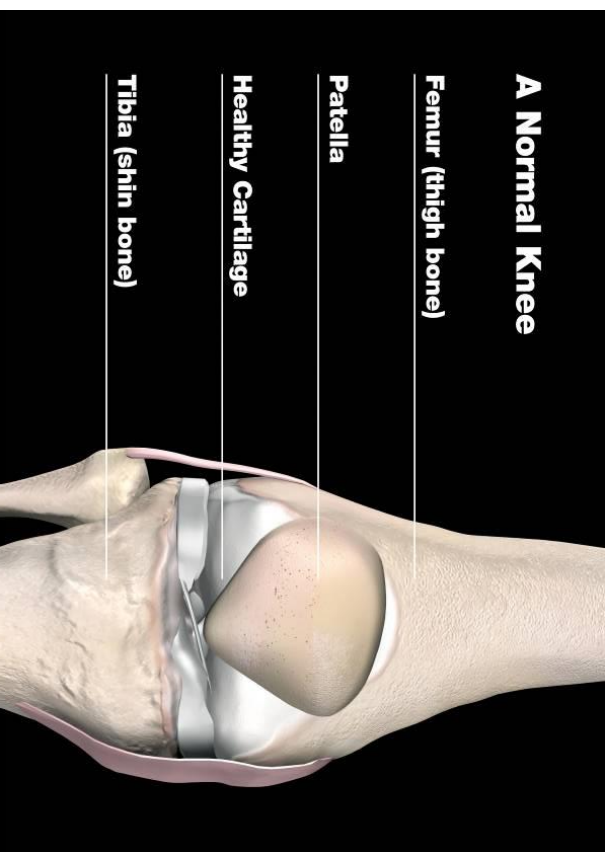
## Total Knee Arthroplasty

Minimally Invasive Knee Replacement

## Total Knee Replacement

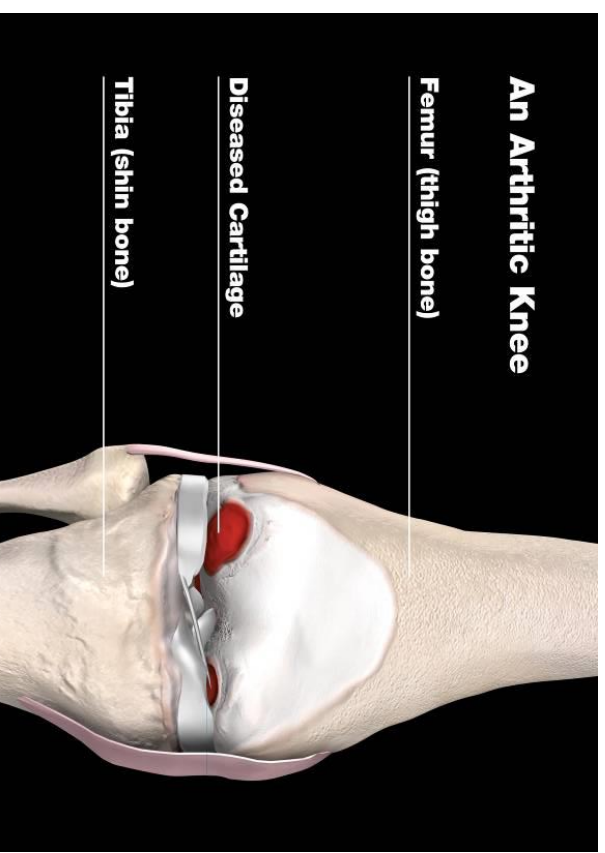
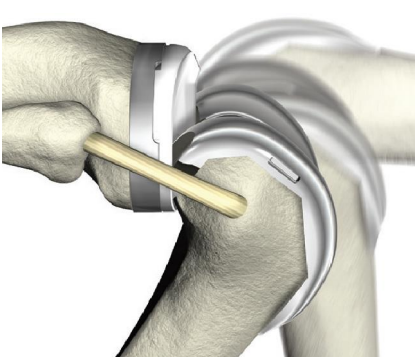
Goals of total knee replacement are to help:

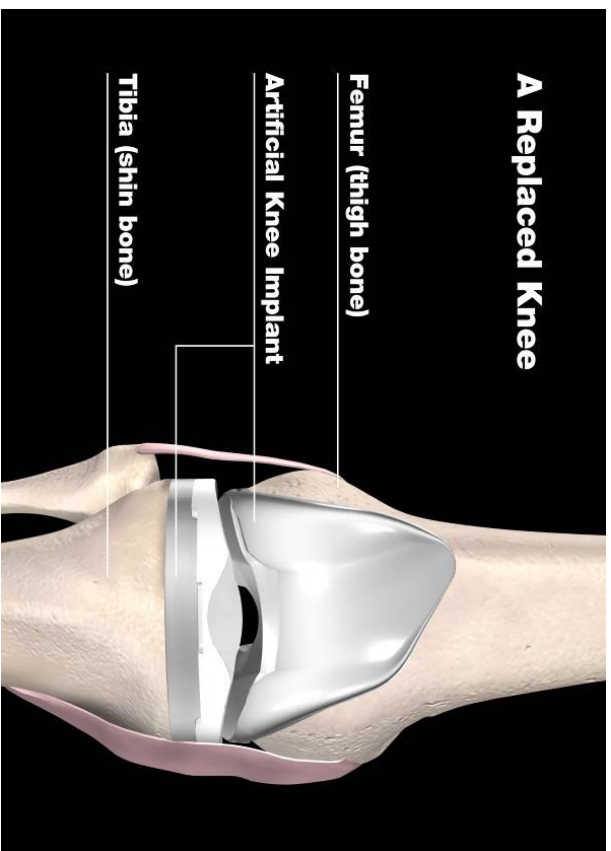
- Relieve pain
- Restore motion



## 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 Replaced Knee

Femur (thigh bone)

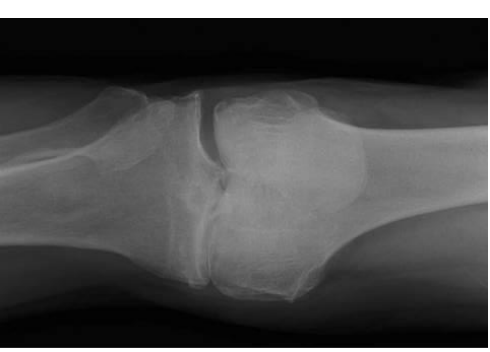
Artificial Knee Implant

Tibia (shin bone)

## Normal Knee X-ray

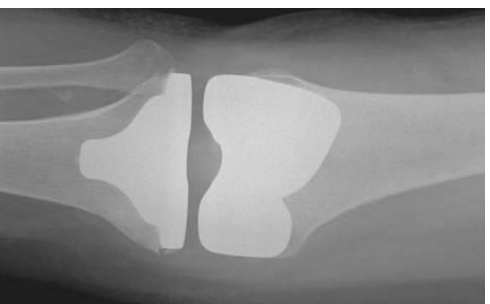


## Arthritic Knee X-ray



## Replaced Knee X-ray

Anterior View



Lateral View



## 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

## Streamlined Procedures

Tourniquet Time '02	89 min ave
Tourniquet Time '06	38 min ave
Tourniquet Time '10	28 min ave

- Reduced variability
- Fewer complications
- Improved quality control

## New Study Results

- Followed 159 pts
- Avg LOS 1.1 days
- 140/159 only oral pain medication, usually Norco
- 98.1% d/c to home
- 5/159 needed IV pain medication
- 1.9% d/c to SNF
- 14/159 took no pain medication in the hospital



# Return to the Top of the Mountain



# New Technology Advancements...

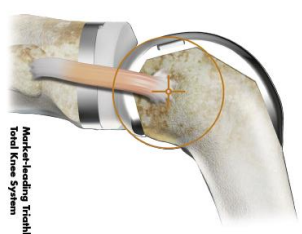
## Robotic Assisted TKA



## Mako™ Total Knee with Triathlon Total Knee System

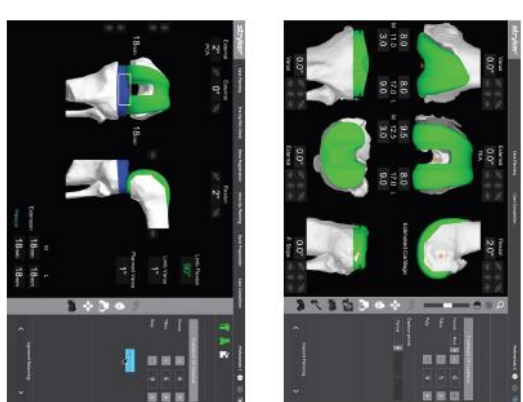


Mako™  
Robotic Arm  
Assisted Surgery

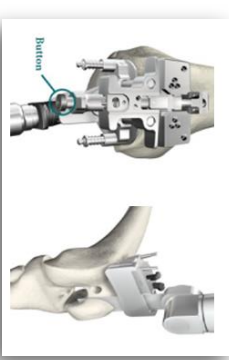


Mako™-Assisted  
Triathlon  
Total Knee System

First in Colorado, one of the first in the World.



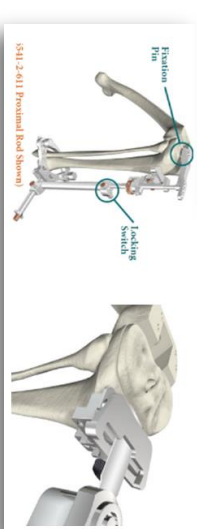
## Variability of manual instrumentation



Placement of the IM rod

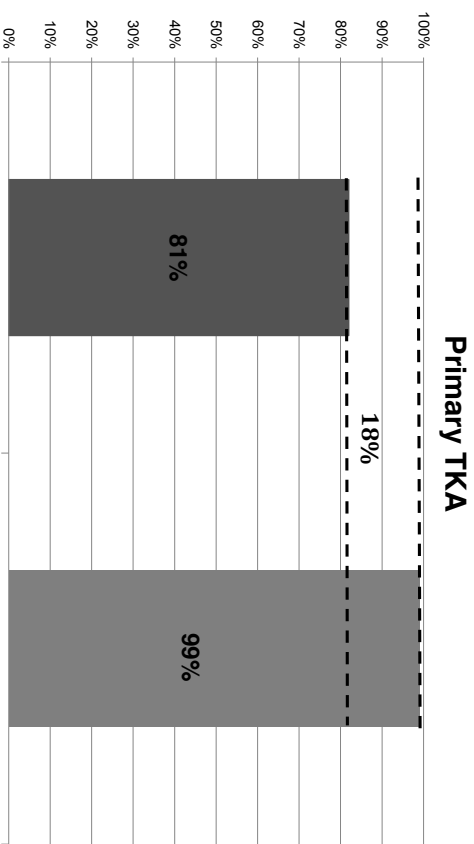


Alignment of cutting guides



Placement of extramedullary guides sawblade excursion and toggle

(S411-24611 Postoral Rod System)

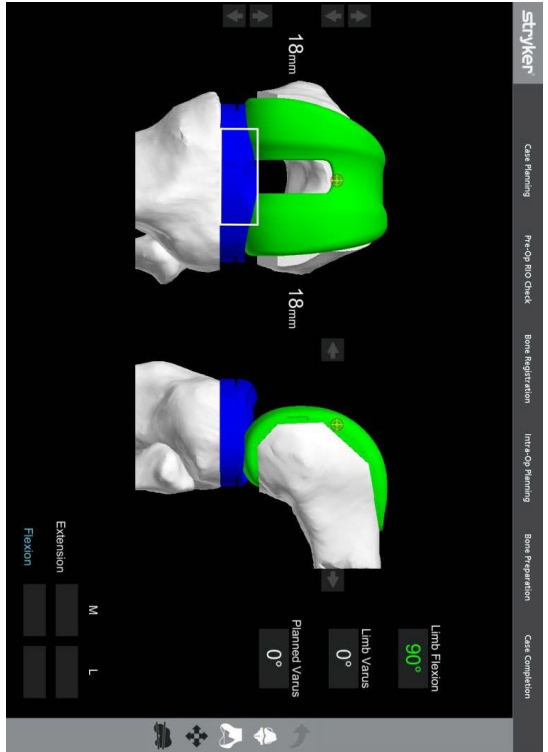


### Primary TKA

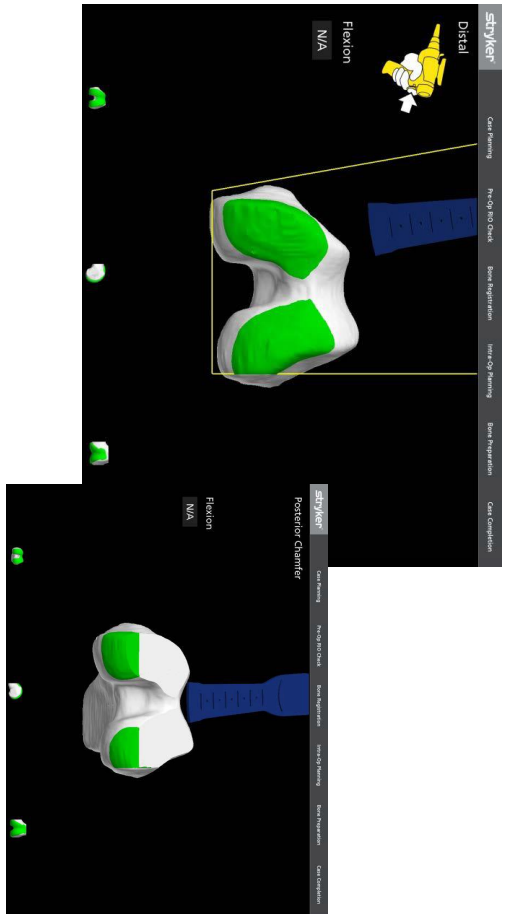
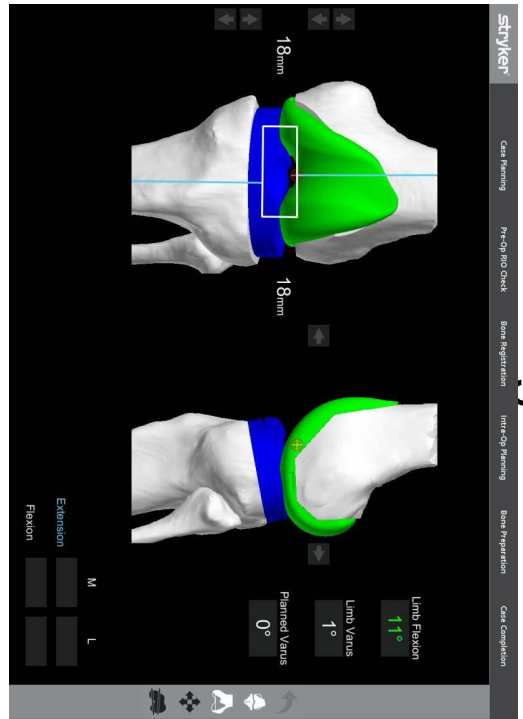
Overall patient satisfaction "satisfied" or "very satisfied" WOMAC score

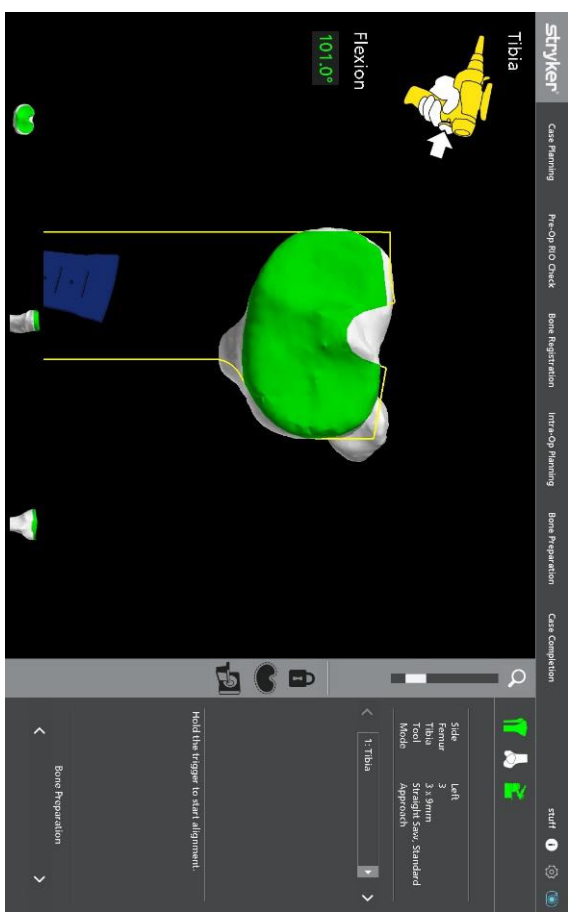
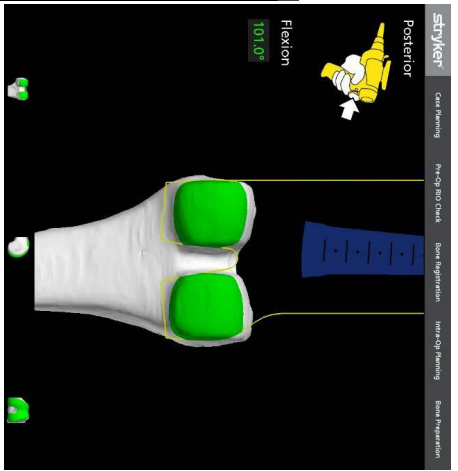
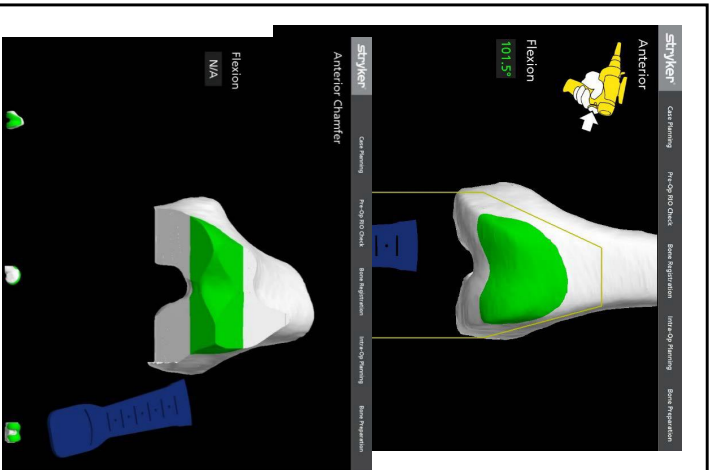
Survivorship

## Joint Balancing



## Dynamic pre-resection balancing





# “Custom Knee”?

# “CUSTOM”-Doesn't Improve Outcomes 20% reoperation rate at 6 wks for stiffness



## “Custom Knee”

- Participation Trophy for Baby Boomers



## Experience:

- Over 2,000 cases including my time in California
- Over 1,000 TKA
- Nearly 1,000 THA (Most experienced DA THA in Northern CO)
- Over 1,000 robotic knee and hip (Most experienced in CO)
- Clinical Educator for Stryker/Mako Surgical



## Questions?

[www.boulderhipandknee.com](http://www.boulderhipandknee.com)

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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

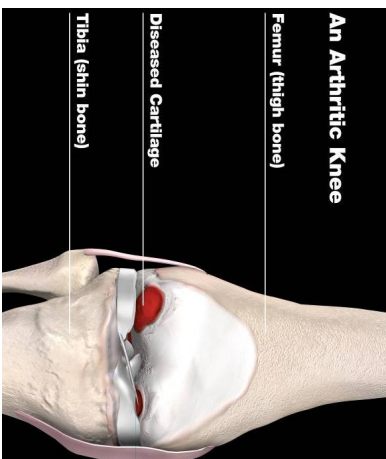
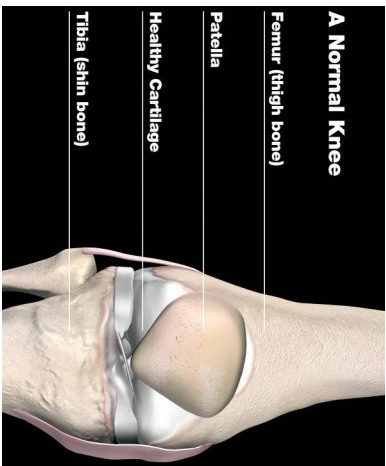
## New Name New Place



## About my practice...

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- 99% of cases done under spinal anesthesia
- AVGLOS: TKA 1.1 days, THA 1.5 days
- 91% of patients discharged to home with outpatient PT

## What is Arthritis?

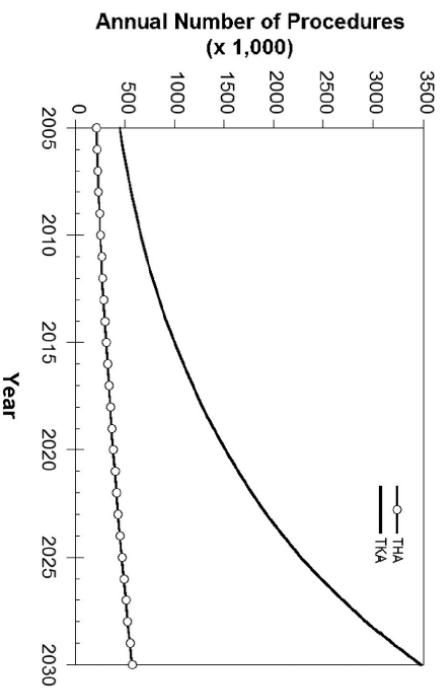


Osteoarthritis - Worn out articular cartilage

Inflammatory Arthritis S systemic Process  
ex: Rheumatoid, Psoriatic, etc.

## Primary Hip and Knee Replacement

Projection 2005-2030



## 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**

## How Can I Avoid a Joint Replacement?

### RICE and NSAIDS

Rest, Ice, Compression,  
Elevation

Ibuprofen, Alleve, Tylenol,  
Celebrex

Topical compounds

Glucosamine

## Treatment Options for Knee Pain

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

## Activity Modification and Weight Loss

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

Weight Loss: Goal BMI < 40



## Joint Injections

Cortisone

Viscosupplementation

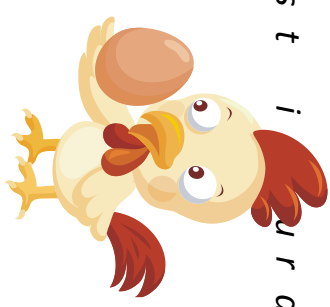
Platelet rich plasma (PRP)

Stem Cells

## Viscosupplementation

“Chicken Shots” - Hyaluronic acid injections

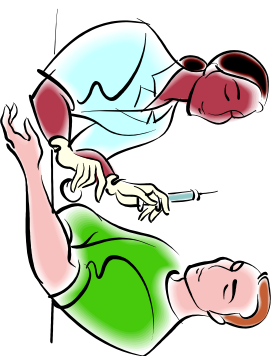
*\* Covered by most insurance*



## PRP: Platelet Rich Plasma

Injections of concentrated blood products to enhance healing

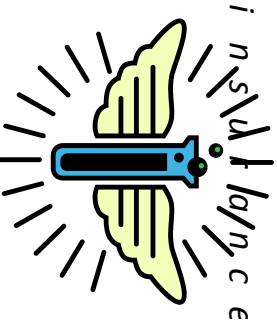
*\* Not covered by insurance*



## 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*



## Stem Cells = Snake Oil?

## New Opportunities in Arthroplasty

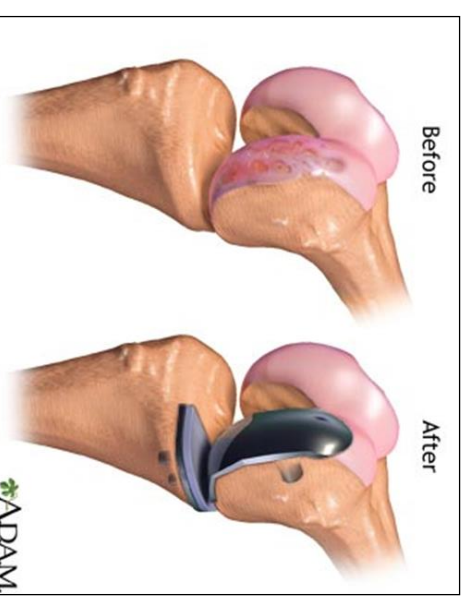
- Improvements in hip and knee replacement materials
  - Success rates >90%
- Partial vs. total knee replacements
- Minimally invasive procedure techniques
- New designs

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\\_R\\_eplacement/default.asp#8](http://www.niams.nih.gov/Health_Info/Hip_R_eplacement/default.asp#8).

## Alternatives to TKA

## Partial Knee Replacement

- Unicompartamental arthroplasty
- Patella Femoral arthroplasty
- Bi-compartmental arthroplasty



## What is Makoplasty?

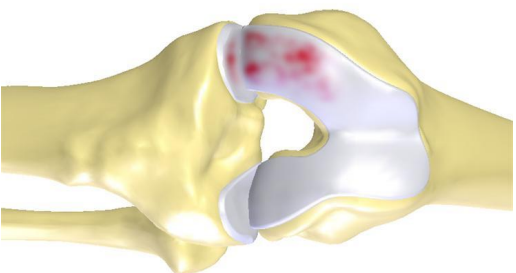


## Computer Navigated, Robotic Assisted



## Early Arthritis

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



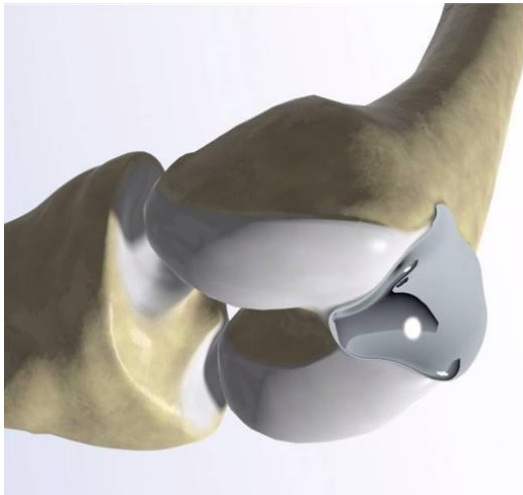
## Early Arthritis

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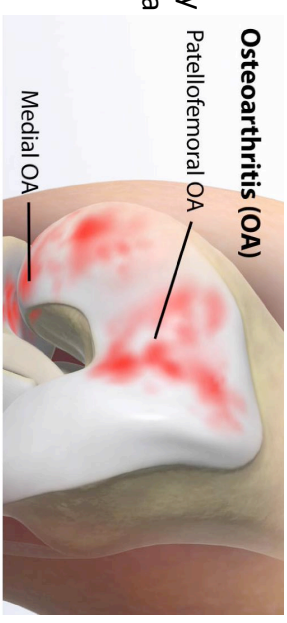
## Early Arthritis

- 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.



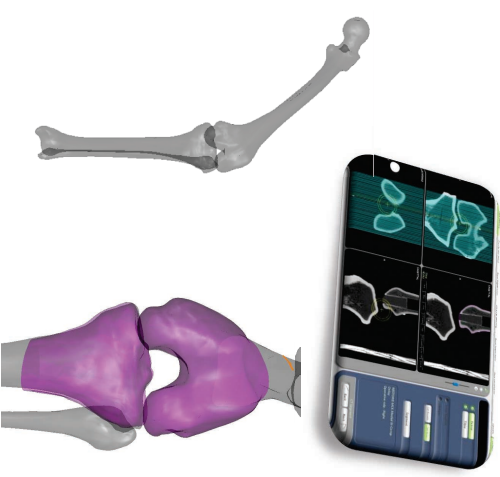
## Mid-stage Arthritis

- 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.



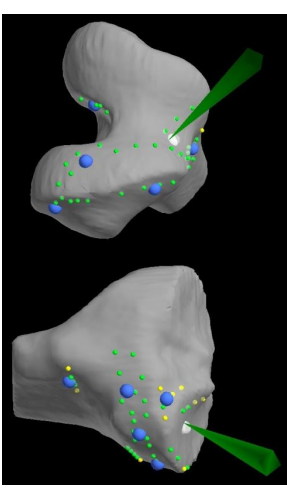
## Robotic process (cont.)

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



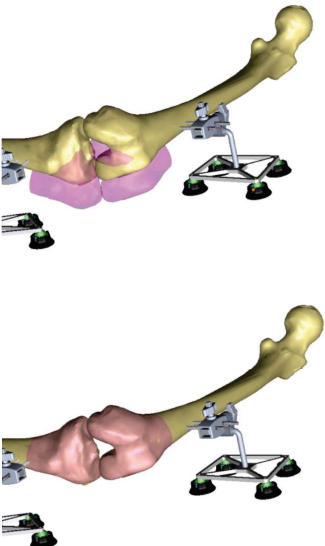
## Surgical Technique

- 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.

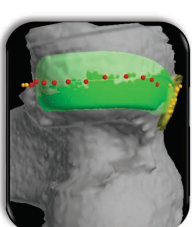


## Surgical Technique (cont.)

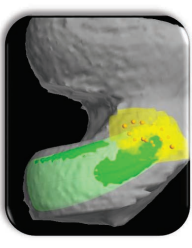
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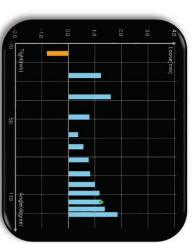
- After obtaining anatomic landmarks, evaluation of coronal and sagittal alignment, flexion and extension laxity and ROM can be measured.
- Infinitely Personalized P process.



Implant Tracking



Cartilage Mapping



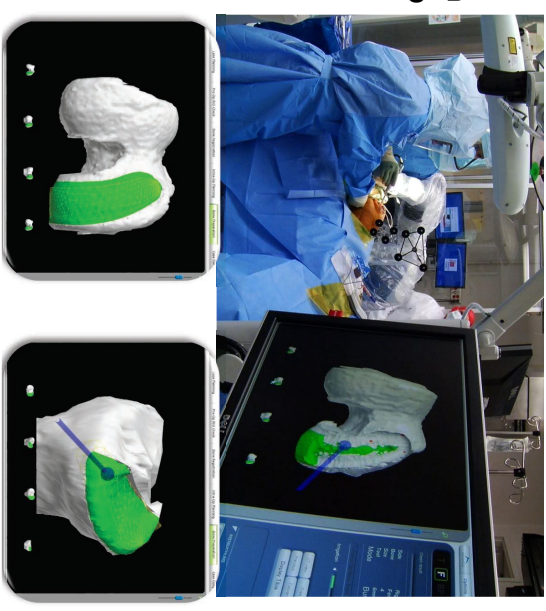
Joint Balancing

## Bone Preparation

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

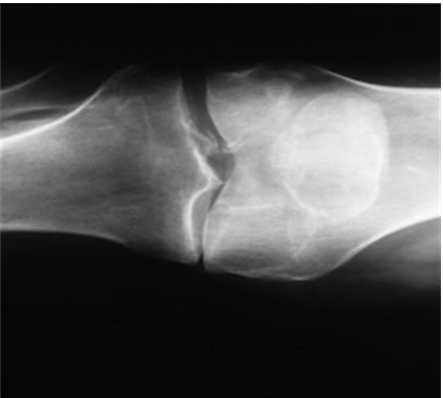
## Surgical Technique (cont.)

- 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.



## Clinical benefits

Pre-op

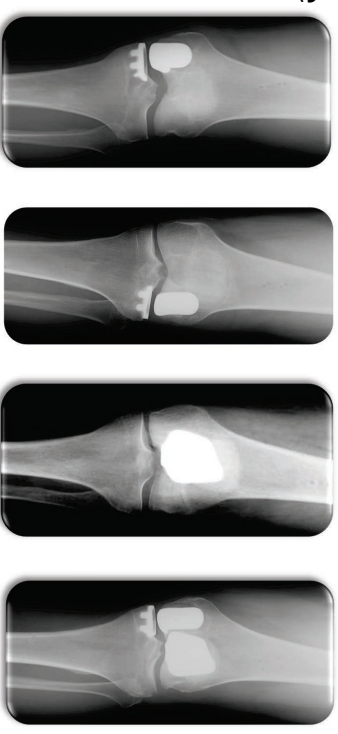


Postop



## Makoplasty

- Less invasive
- Accurate
- Reproducible
- Bone conserving



## Research Results

- 2-3x more accurate
- 3x more reproducible
- Lower pain scores  
6 days vs 8 wks

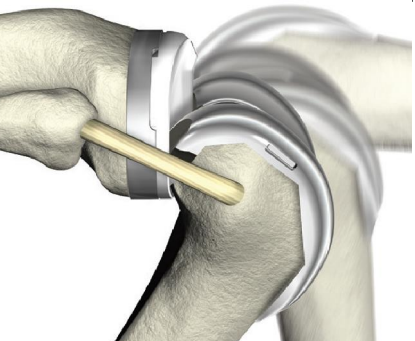
## Total Knee Replacement

Goals of total knee replacement are to help:

- Relieve pain
- Restore motion

## Total Knee Joint Replacement

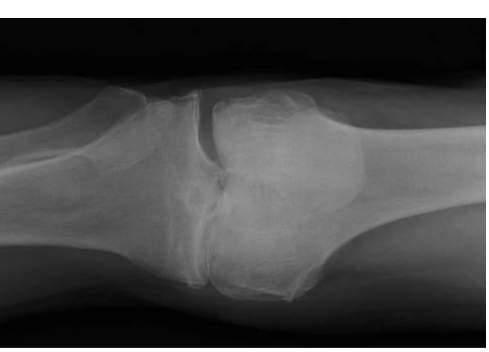
- End surface of femur replaced with metal
- End surface of tibia replaced with metal
- Plastic liner is inserted between femur and tibia
- Patella is resurfaced with plastic



**Normal Knee Xray**

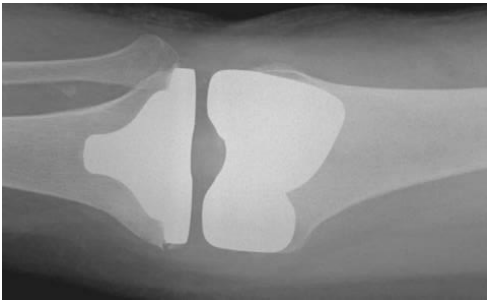


**Arthritic Knee Xray**



## Replaced Knee Xay

Anterior View



Lateral View



## PostOperative Management

- Early ROM with PT
- Ambulation same day

## Operative Management

- SPINAL anesthetic
- IV sedation
- Capsular injection

## PostOperative Management

- Gait training POD1
- S tairs and PT instruction
- P ossible outpatient



## Streamlined Procedures

Tourniquet Time€02	89 minave
Tourniquet Time€06	38 minave
Tourniquet Time€10	28 minave

- Reduced variability
- Fewer complications
- Improved quality control

## Return to the Top of the Mountain



## New Study Results

- Followed 15qpts
- AvgLOS 1.1 days
- 140/159 only oral pain
- 98.1% d/c to home medication, usually Norco
- 1.9% d/c to S NF medication
- 5/159 needed IV pain medication
- 14/159 took no pain medication in the hospital

## New Technology Advancements....

# Robotic Assisted TKA

