

# Custom and Patient-Matched Joint Resurfacing – Emerging Technologies - Arthrosurface

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# Disclosures

## Research Support:

- AOSSM Young Investigator Grants (YIG) 2005
- AANA Research Grants 2008; 2006
- OREF Grants 2002;2004

## Editorial Boards/Reviewer

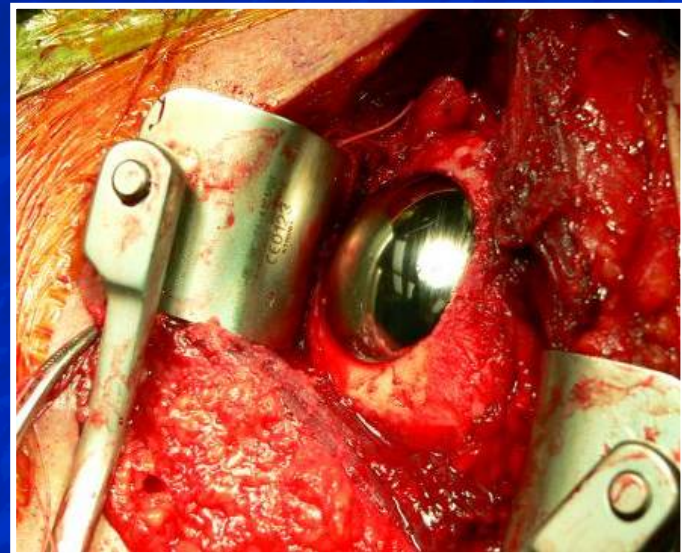
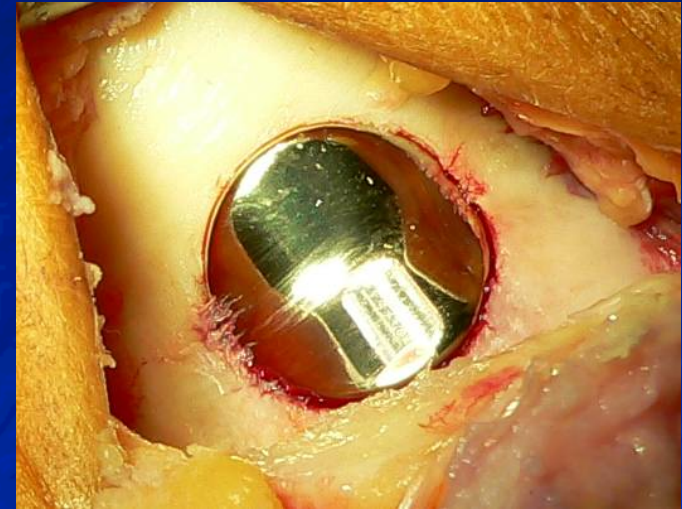
- Elsevier (Arthroscopy; Associate Editor)
- SLACK (Orthopaedics; JKS)
- Sage Publications (AJSM)
  - JBJS Reviewer
  - JSES Reviewer

-No other Conflicts



# Patient-Matched Resurfacing *Outline*

- Cartilage Options - Overview
- Patellofemoral Resurfacing
  - Arthrosurface PF Classic
  - Arthrosurface *WAVE*
- Knee Condyle and Plateau Resurfacing
- Shoulder Resurfacing
  - Arthrosurface *HemiCap*



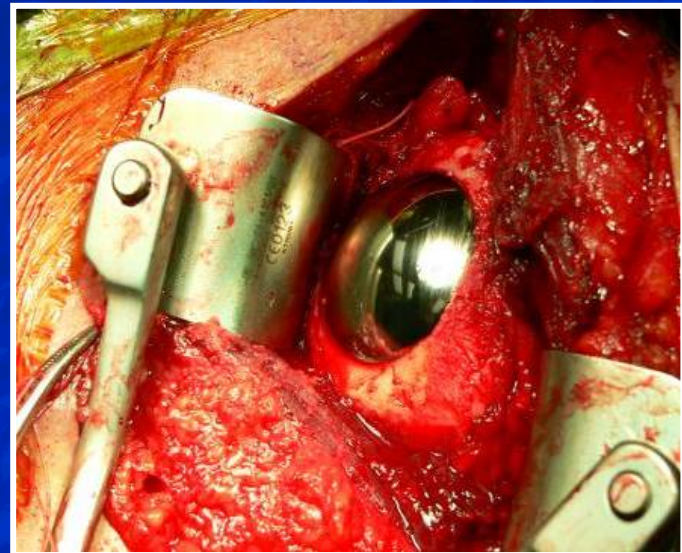
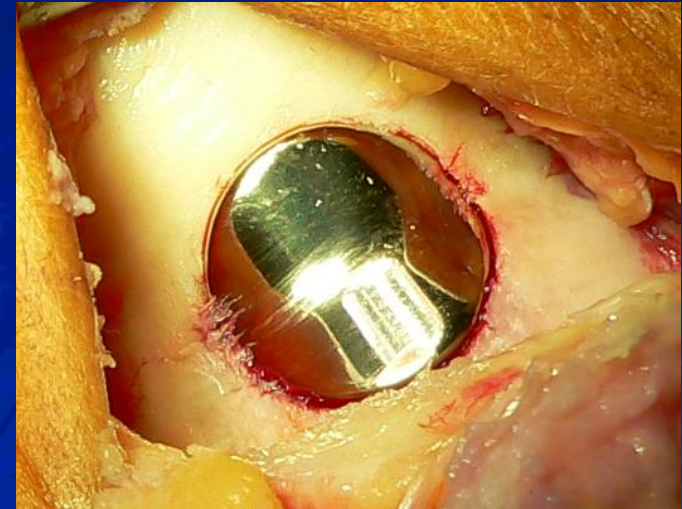
# Young – Moderately Young Active Duty Military Population

- Common diagnosis
- Young, active population
- Demanding
- Return to duty
  - Similar to WC
- Large number of patients 35-55 years of age with early OA

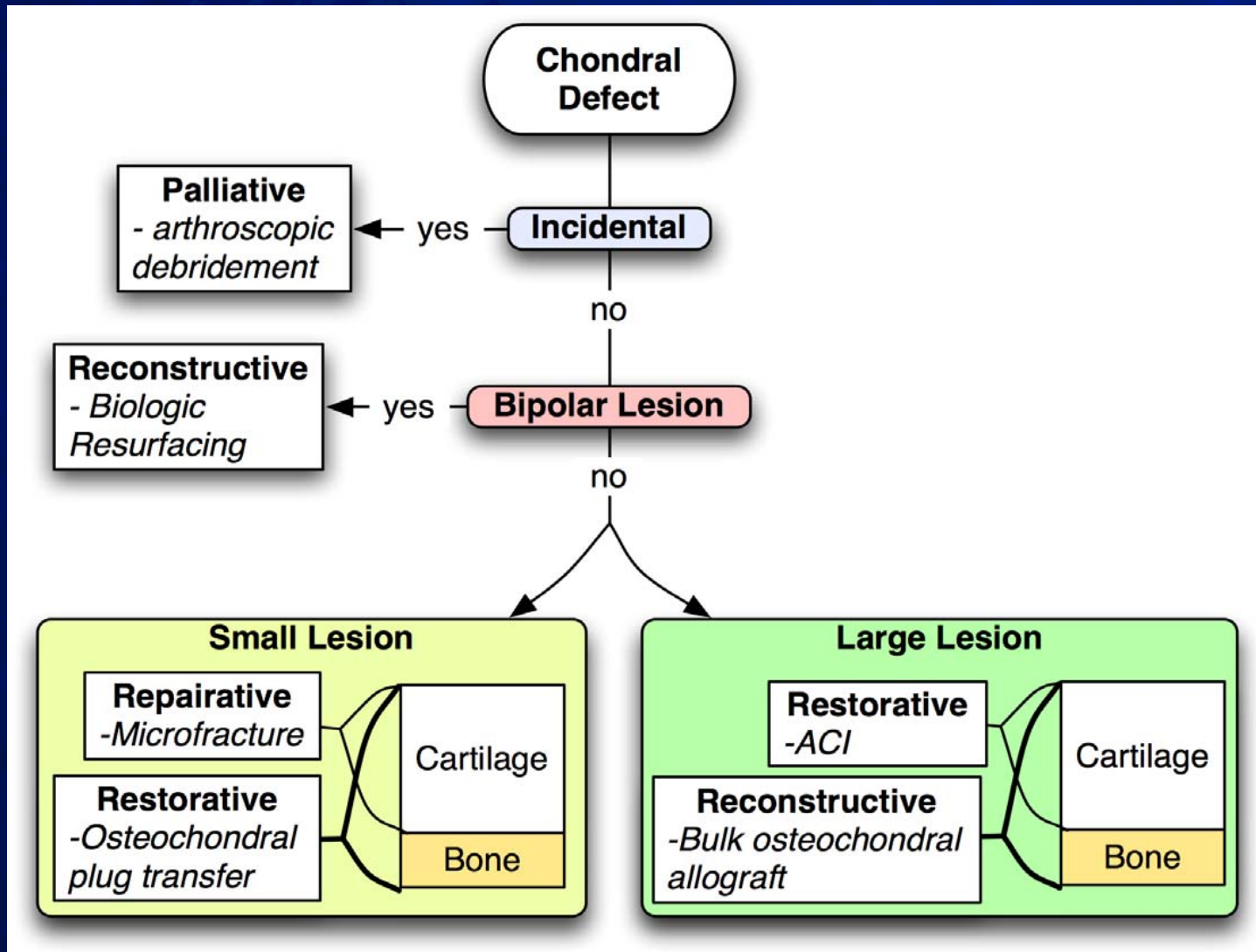


# Patient-Matched Resurfacing *Outline*

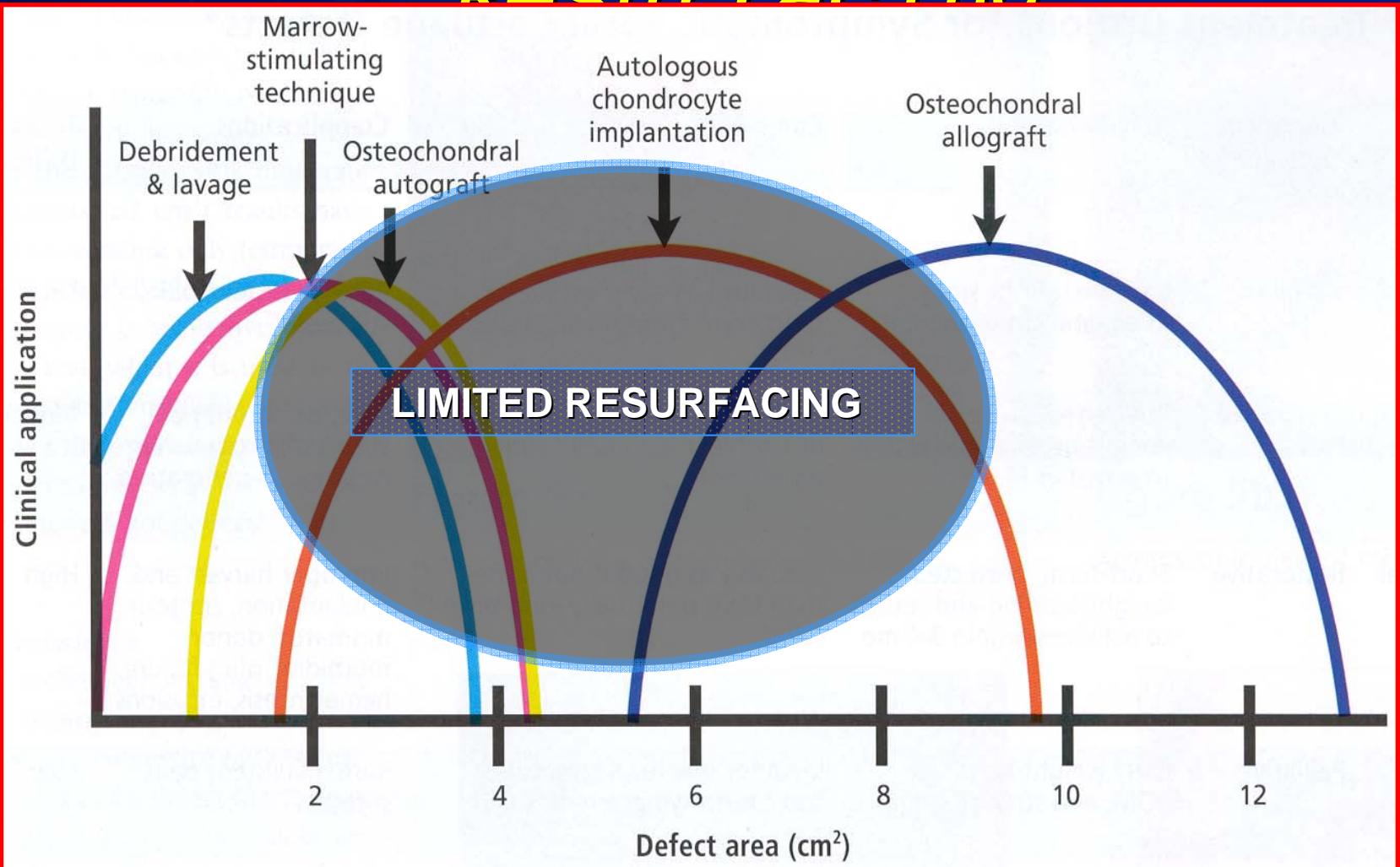
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# Cartilage Options *Non-Arthroplasty*

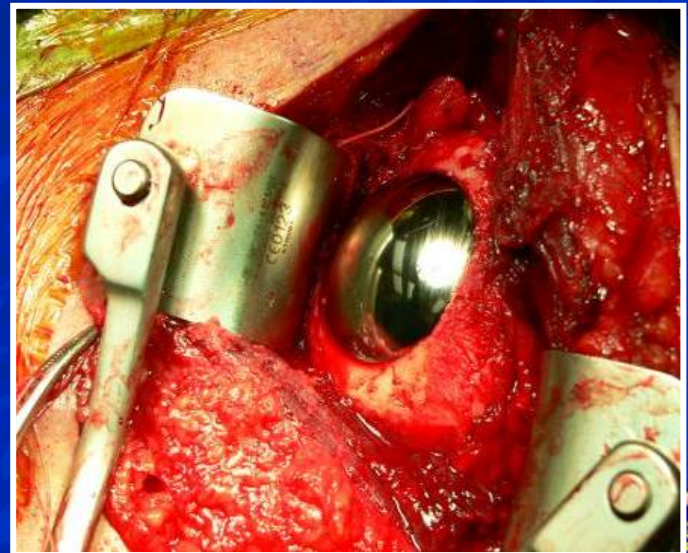
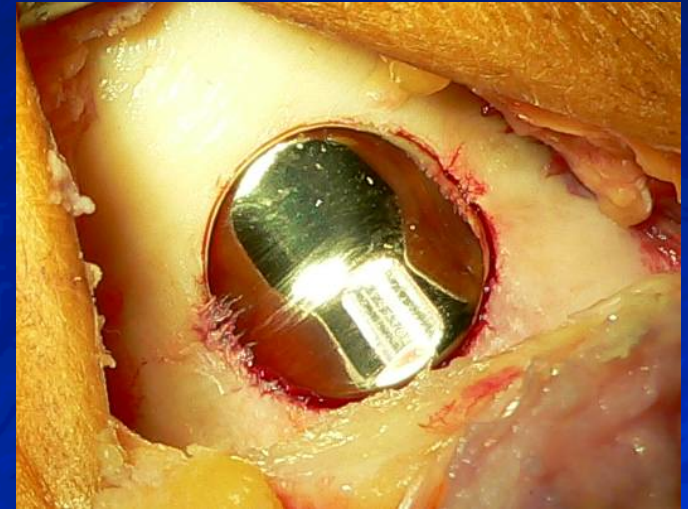


# Emerging Algorithm *Anatomic - Limited Resurfacing*



# Patient-Matched Resurfacing *Outline*

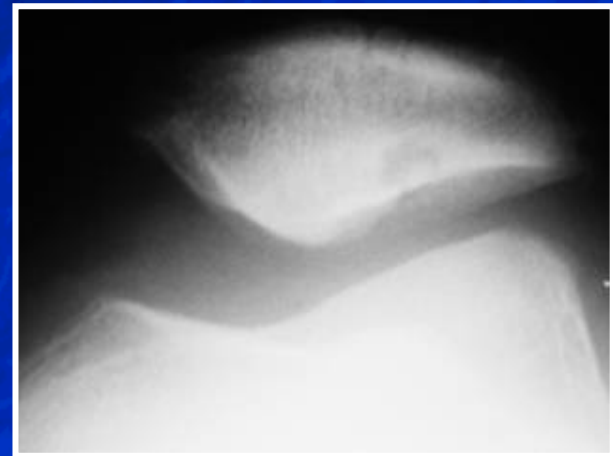
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# Patellofemoral Arthritis...

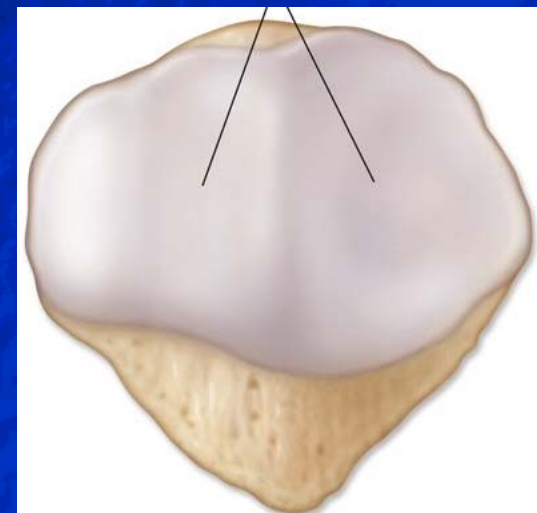
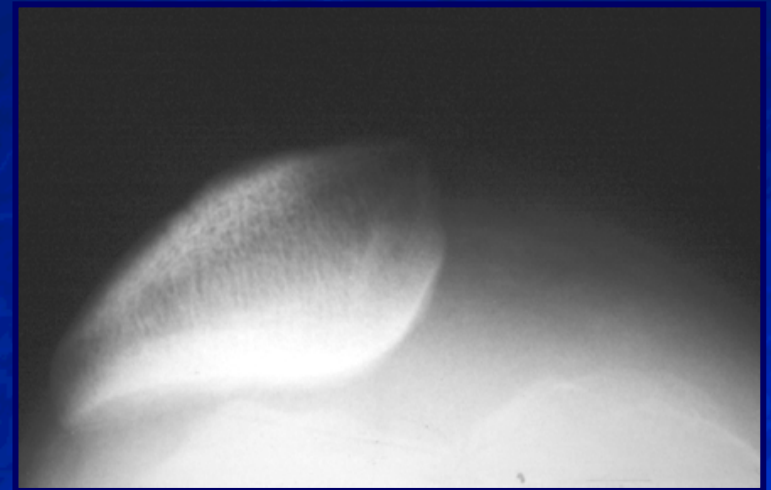
- At age 35:
- 11-35% incidence of full thickness lesions (age 35)
  - Aroen A, et al. AJSM. 2004; 32: 211-15
  - Davies et al. Clin Orthop. 2002
- Isolated PF chondral injuries remain a problem
- Not all lesions symptomatic



# Challenges of PF Anatomy

## *Highly Variable*

- Complex anatomy
- 2 main facets - medial and lateral
- 7 total facets
- Cartilage surface = 2.5 to 6 mm depth
- PF joint is one of the most challenging to



# PF Pathology

## *Complex Decision-Making*

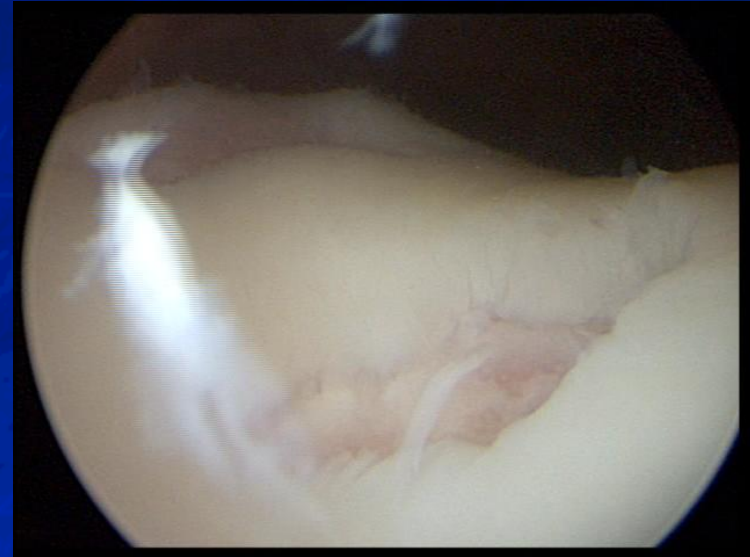
- Etiology of defects
  - ◆ Traumatic
  - ◆ Degenerative
- What else is going on?
  - ◆ Soft tissue injuries
  - ◆ Malalignment
    - Femoral
    - Tibia
    - Extensor mechanism
- Size of defects
- Location of defect



# Patellofemoral Arthritis

## *Resurfacing*

- Surgical indications
  - Young, active pts
  - Isolated patellofemoral or two compartment disease
  - Age < 55-65?
- Treatment remains a challenge
  - high pressures across the knee joint
    - 3-5 x body weight
  - difficulties in achieving a congruent resurfacing procedure



# Arthrosurface HemiCAP *P-F Inlay Prosthesis*



# Trochlea PF Anatomic Implant *Variety of Geometry*



# Patellar Implants

*Variety of Sizes/Shapes,  
Cemented*



# Patellofemoral Kinematics After Limited Resurfacing of the Trochlea

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Stephanie Zaire, BS  
Elizabeth Shewman, MS  
Bernard R. Bach, Jr, MD

JKS 2009\*

To determine patellofemoral kinematics after limited resurfacing with a trochlear anatomic-specific implant

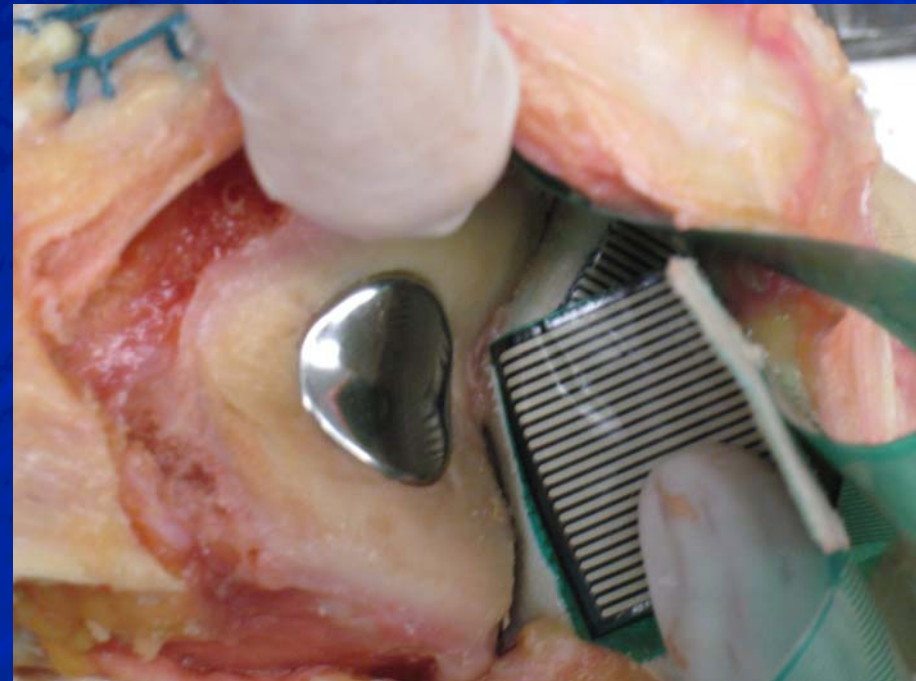
\*No funding was received for this study





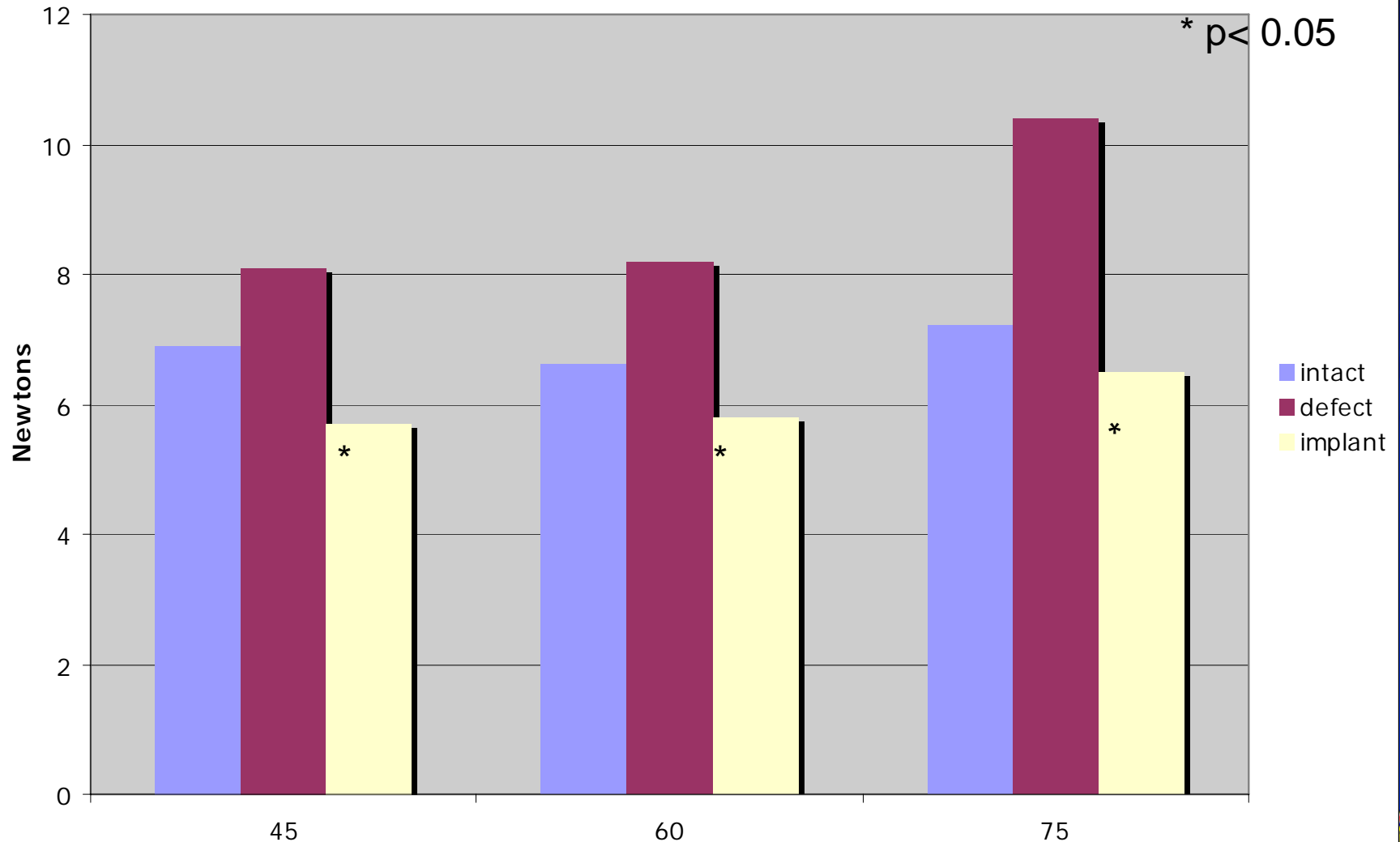
# Methods

- Eight fresh frozen cadaveric knee specimens
  - Mean age = 62.0
- Custom patellofemoral testing apparatus
- Mini lateral arthrotomy centered proximal to the patella
- Real-time pressure sensor pad
  - (Tekscan Inc., South Boston, MA), model K-scan 4000



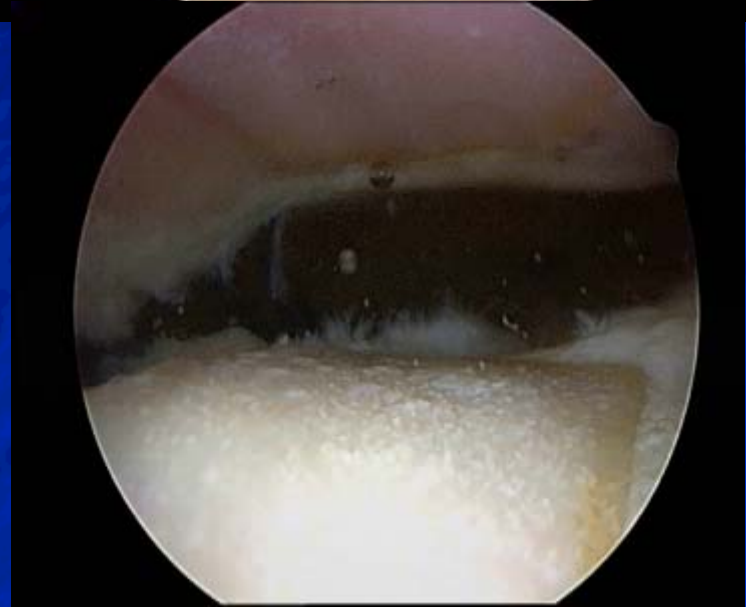
# Results

## *Peak Force at 20 lbs*

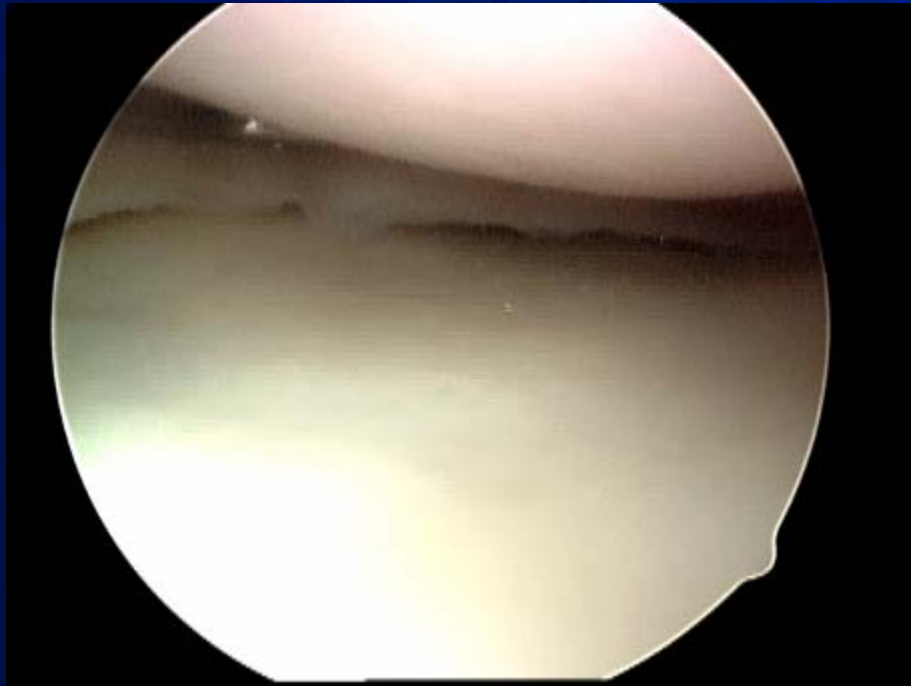


# Case Example #1

- 39 year old male
- 2 prior knee surgeries
- Anterior knee pain
- Former "hard core" athlete
- Could not even walk with kids



# Case Example #1 (healthy medial and lateral )

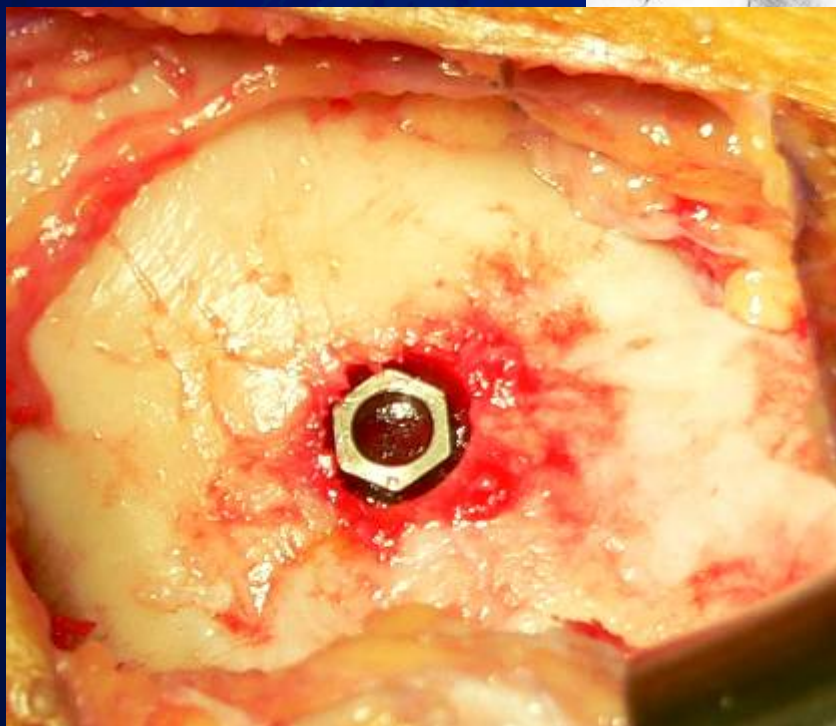
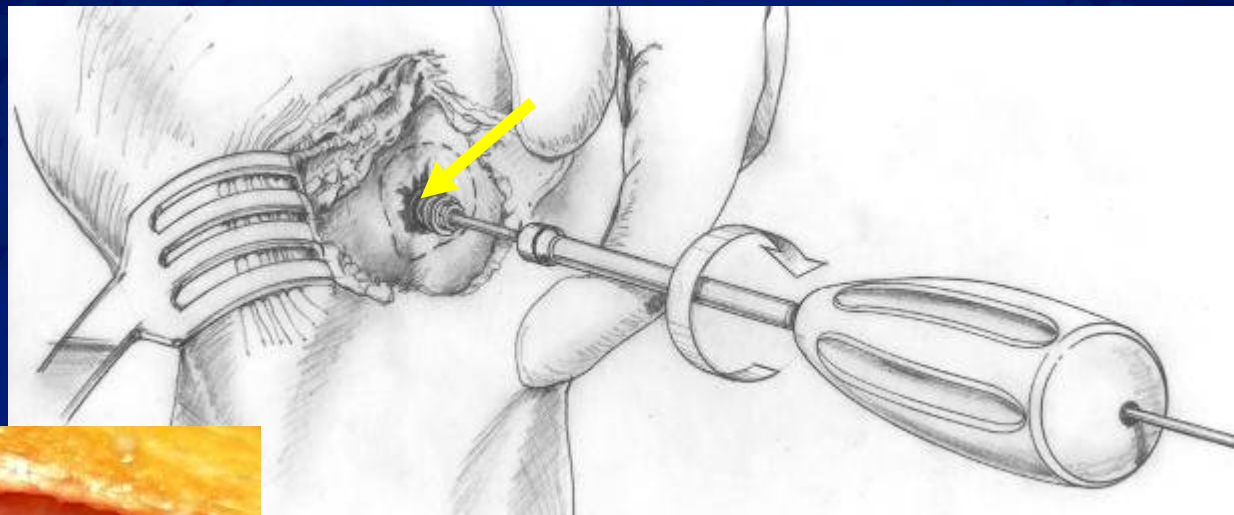


# Surgical Exposure

Either MIS medial incision  
(or midline)

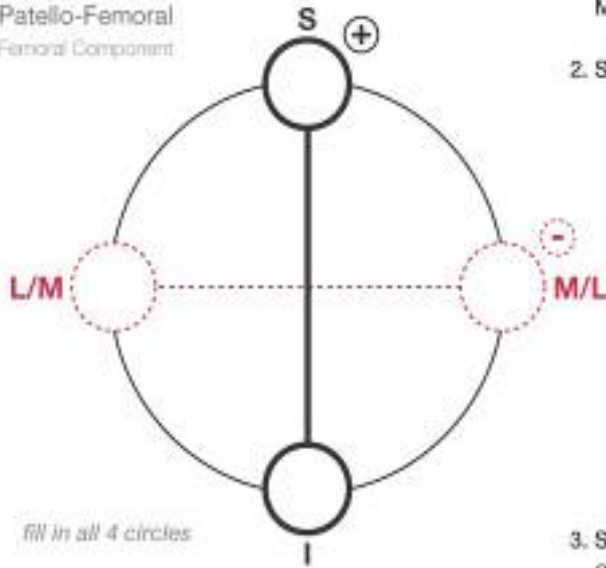


# Insert set screw



# Articular Mapping

arthrosurface®  
Patello-Femoral  
Femoral Component



Sizing Card

1. Maximum SI ———— (+)

Minimum ML ..... (-)

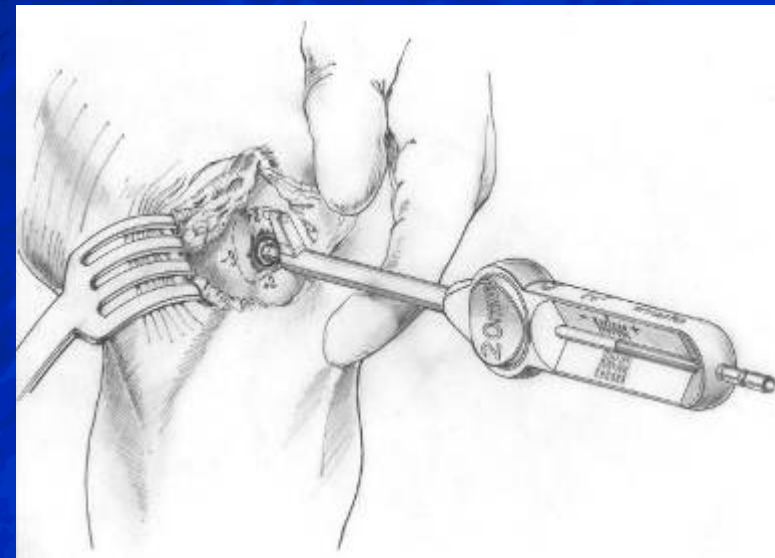
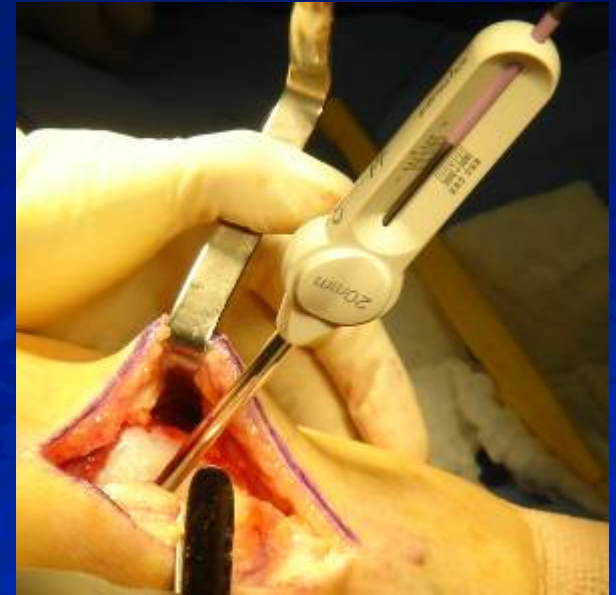
2. Select HemiCAP® offset values

S/I	M/L
2.0 mm x 2.0 mm	+
2.0 mm x 2.5 mm	
2.0 mm x 3.0 mm	
2.5 mm x 2.0 mm	-
2.5 mm x 2.5 mm	
2.5 mm x 3.0 mm	
3.0 mm x 2.0 mm	+
3.0 mm x 2.5 mm	
3.0 mm x 3.0 mm	
3.0 mm x 3.5 mm	-
3.5 mm x 2.0 mm	
3.5 mm x 2.5 mm	
3.5 mm x 3.0 mm	

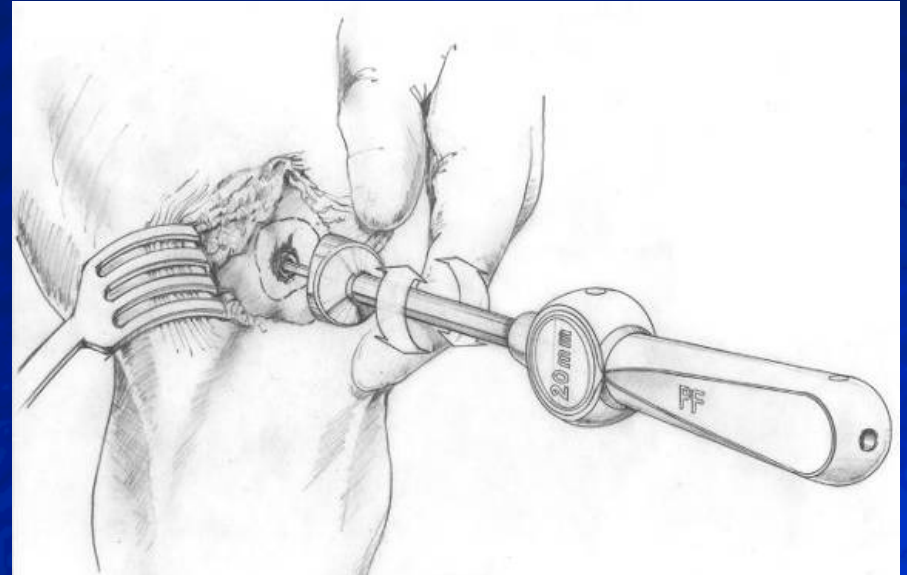
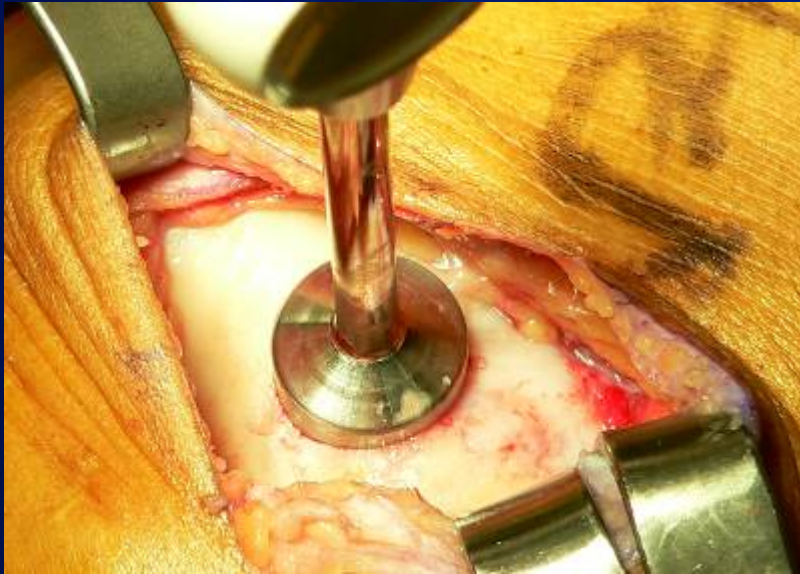
3. Select Surface Reamer size

Choose the Surface Reamer that matches the SI (+) offset value. Confirm with the color code on the HemiCAP® articular component package.

P/W 2001-1120 Rev C



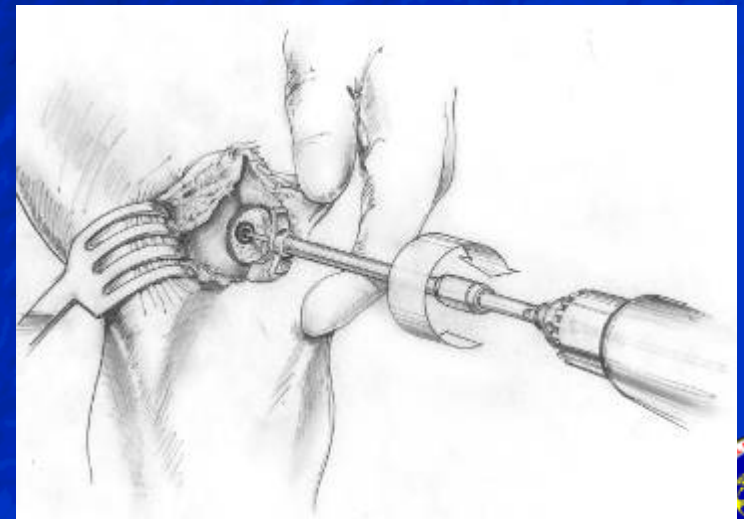
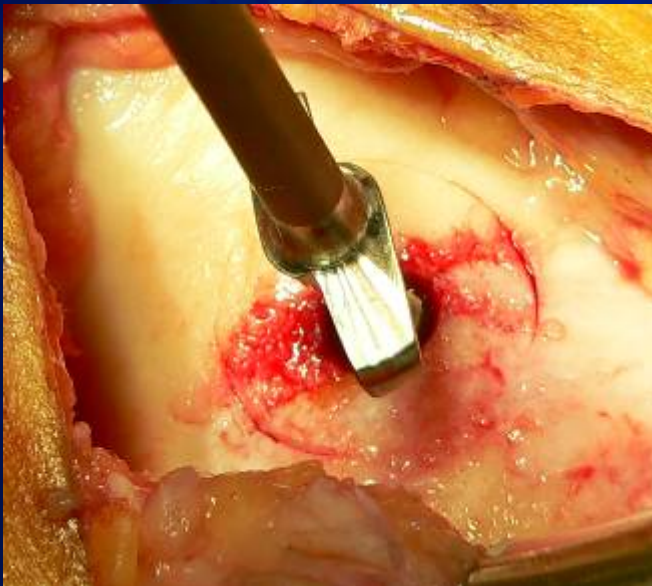
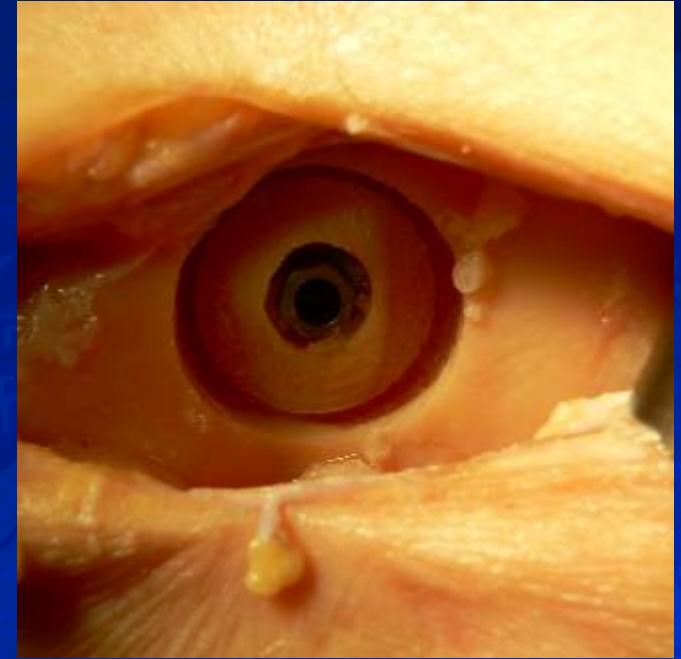
# Peripheral cutting - protect ambient cartilage



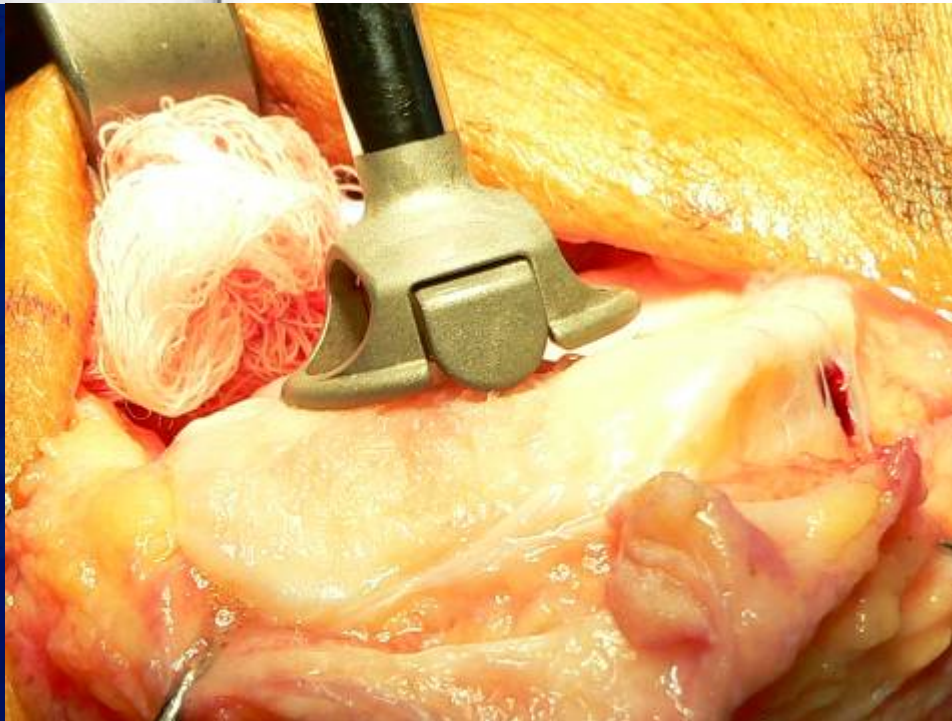
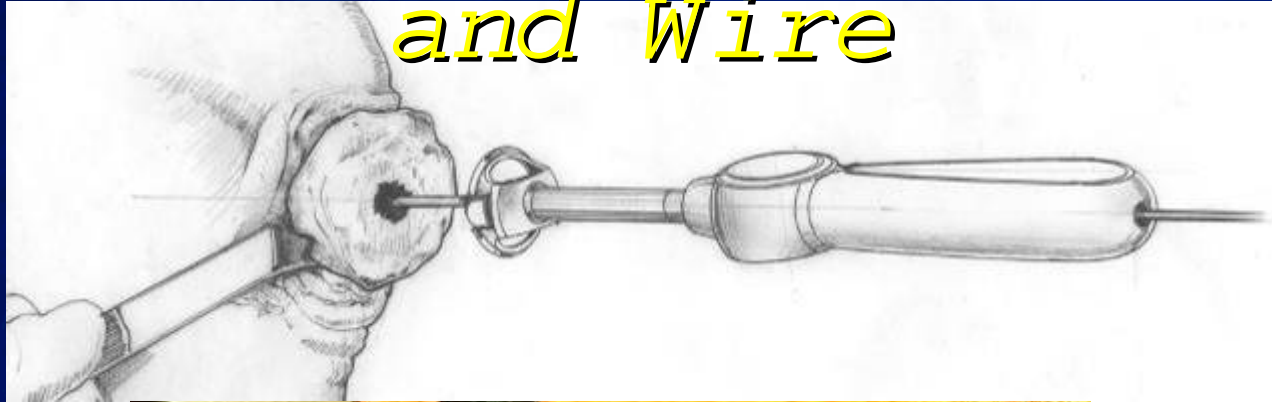


# Drilling for implant

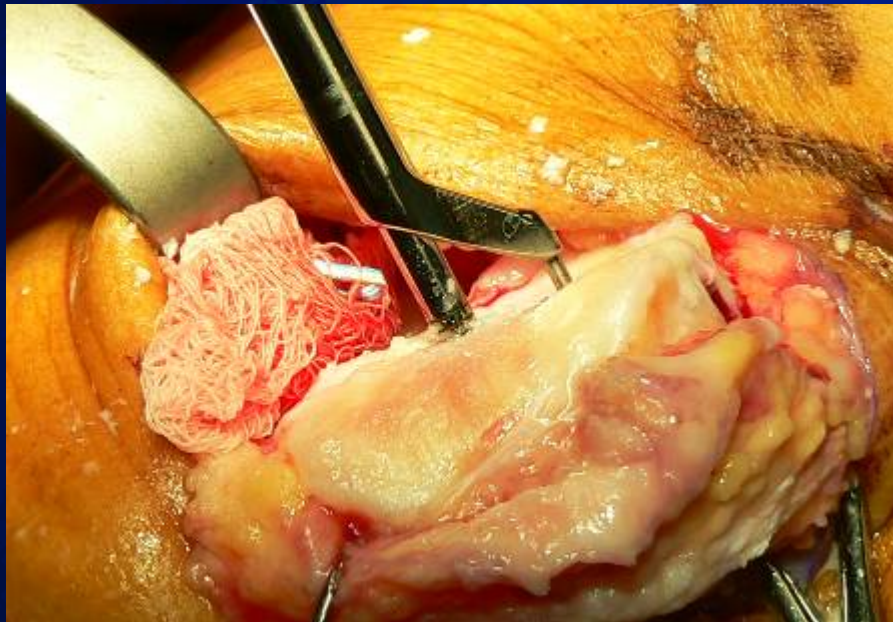
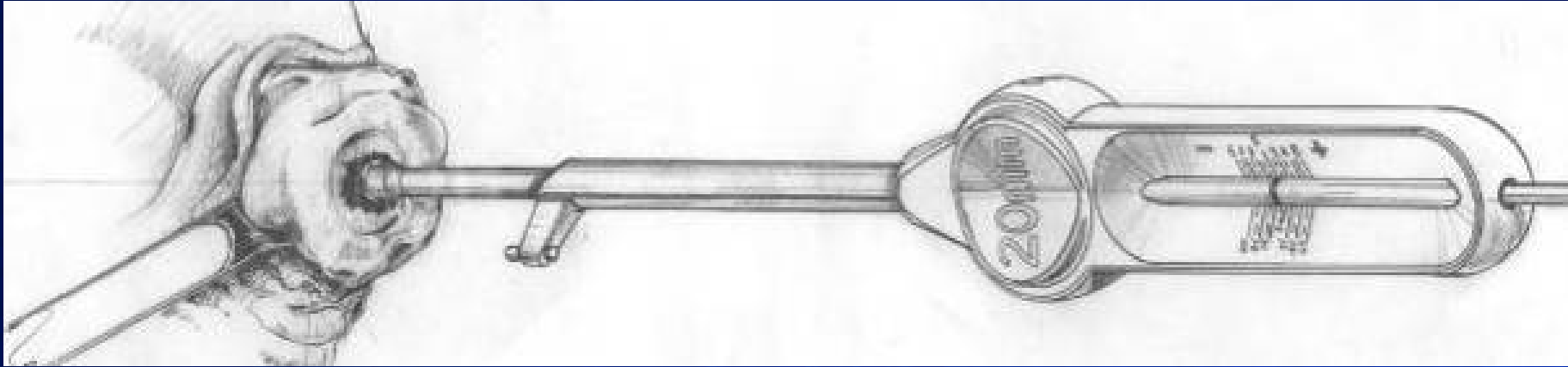
- High speed drill
- Do not use reamer
- Cooling irrigation



# Patella Resurfacing *Guide* *and Wire*



# Contact probe measures depth over centering shaft



arthrosurface®  
Patello-Femoral  
Patella Component

1. Maximum SI \_\_\_\_\_  
Maximum ML \_\_\_\_\_

2. Select HemiCAP® offset values  
*If no match is found, use the next highest offset value*

- 1.0 mm x 2.5 mm
- 1.0 mm x 3.0 mm
- 1.0 mm x 3.5 mm
- 1.0 mm x 4.0 mm
- 1.0 mm x 4.5 mm
- 2.5 mm x 2.5 mm
- 3.0 mm x 3.0 mm
- 3.5 mm x 3.5 mm
- 4.0 mm x 4.0 mm
- 4.5 mm x 4.5 mm

3. Select Surface Reamer size  
*Choose the Surface Reamer that matches the highest offset value.*

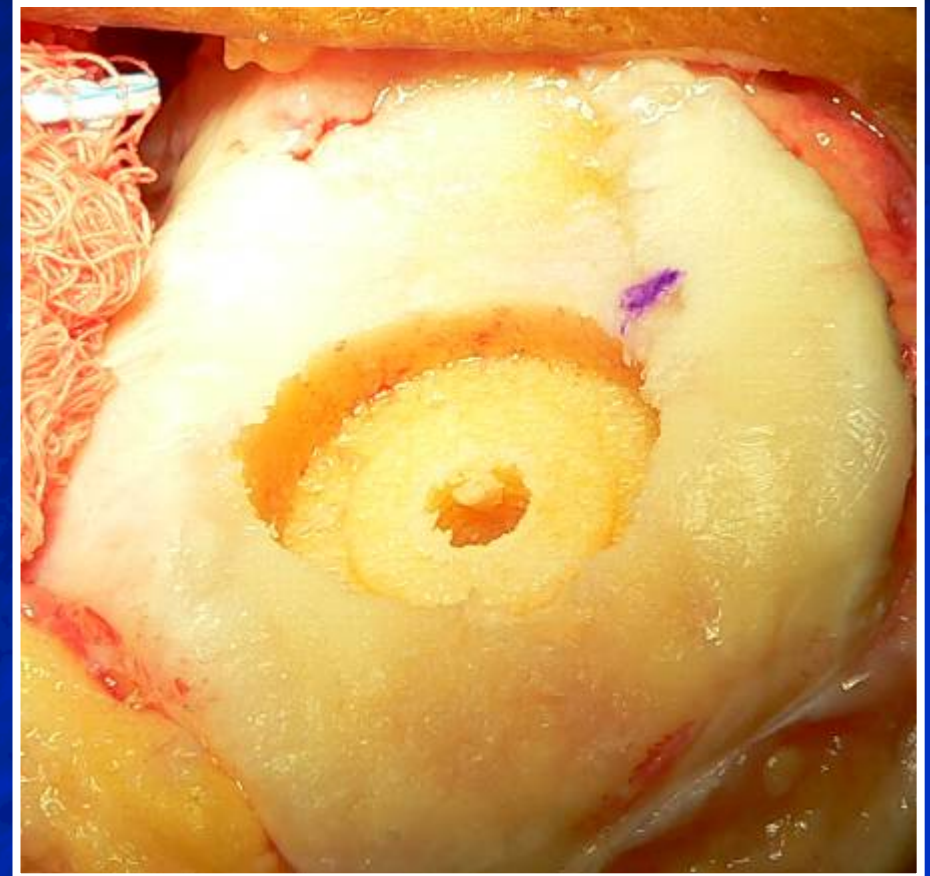
fill in all 4 circles

Sizing Card

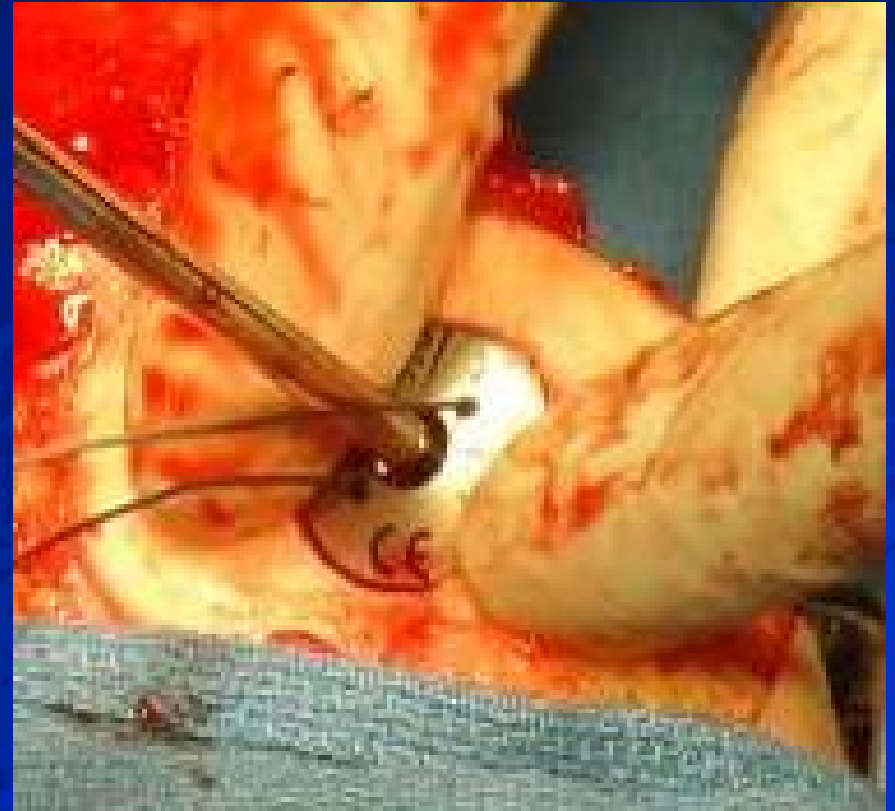
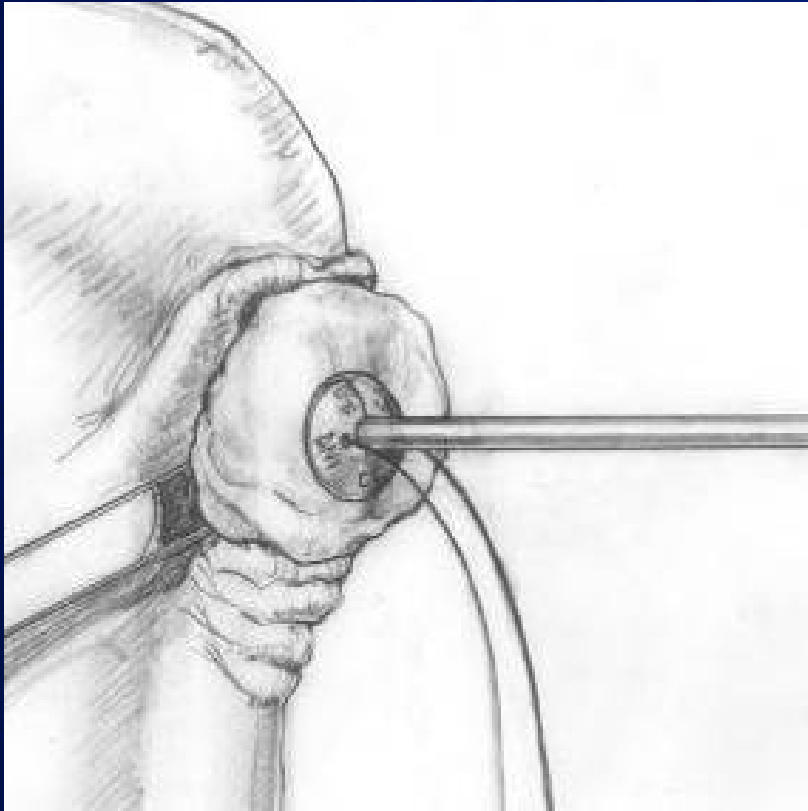
P/W 2007-1220 (Rev.8)

The diagram shows a circular 'Sizing Card' with a vertical line through the center. At the top and bottom of the line are solid circles labeled 'S'. On the left and right sides of the line are dashed circles labeled 'L/M' and 'M/L' respectively. A dashed horizontal line also passes through the center of the card.

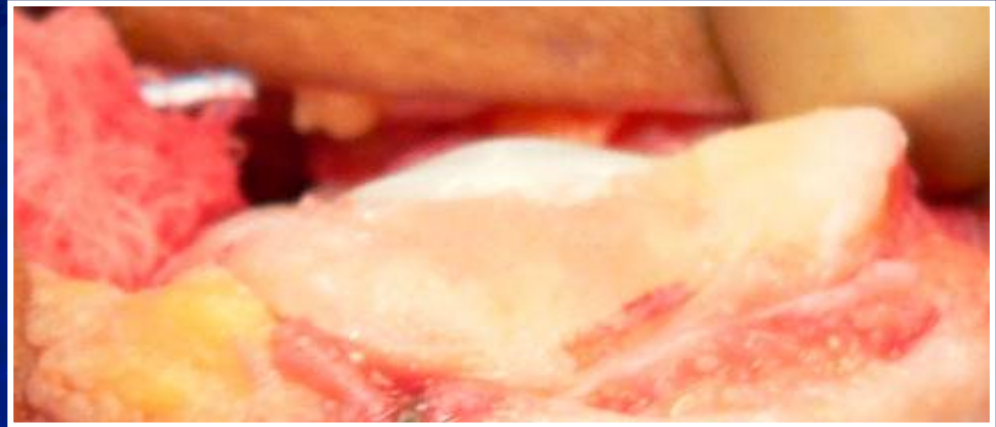
# Drill to depth stop



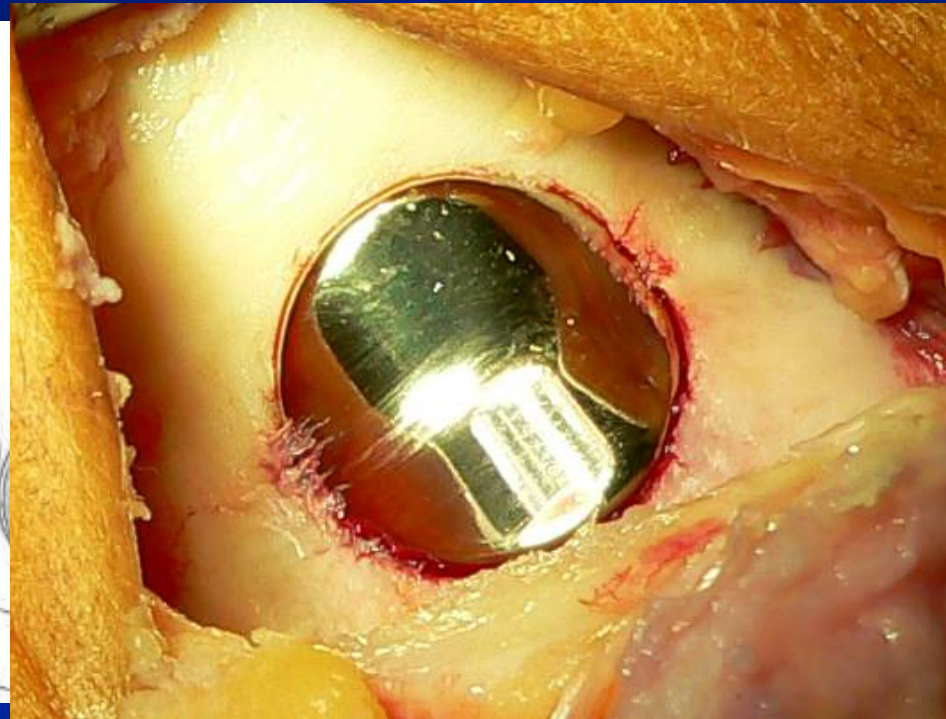
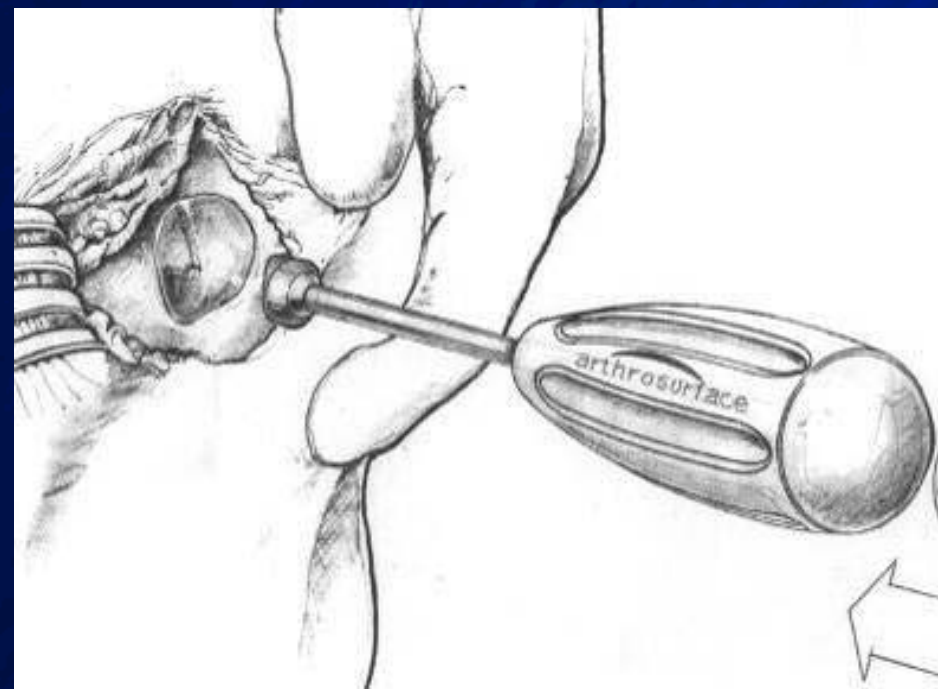
# Patella Trial



Patella  
cemented in  
place



# Final Trochlea Impaction

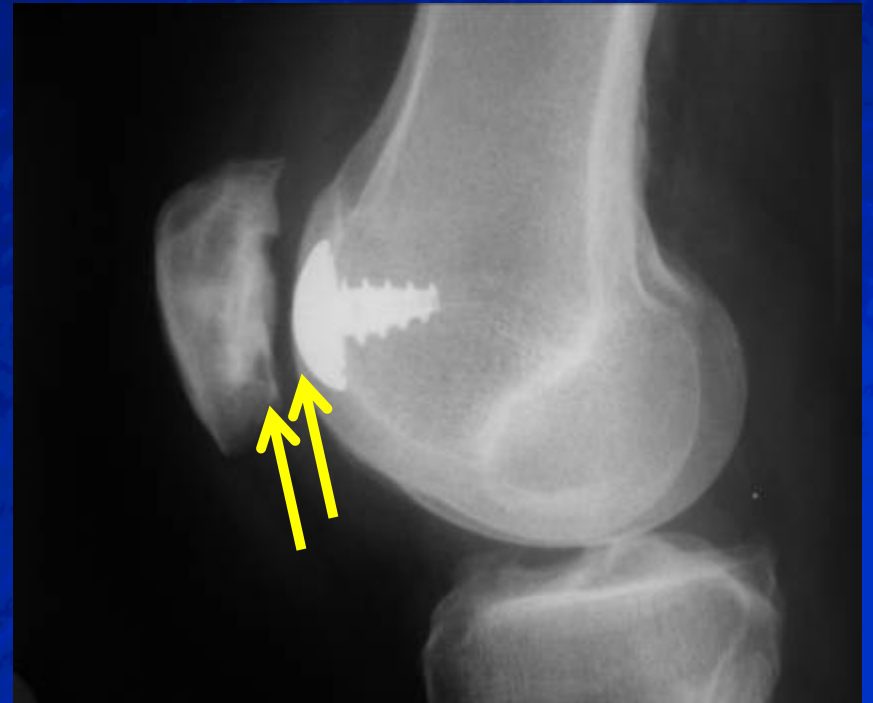


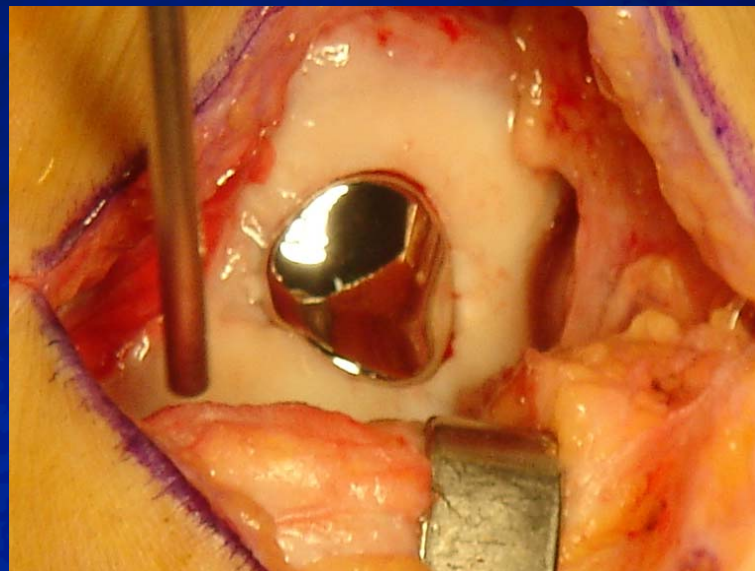
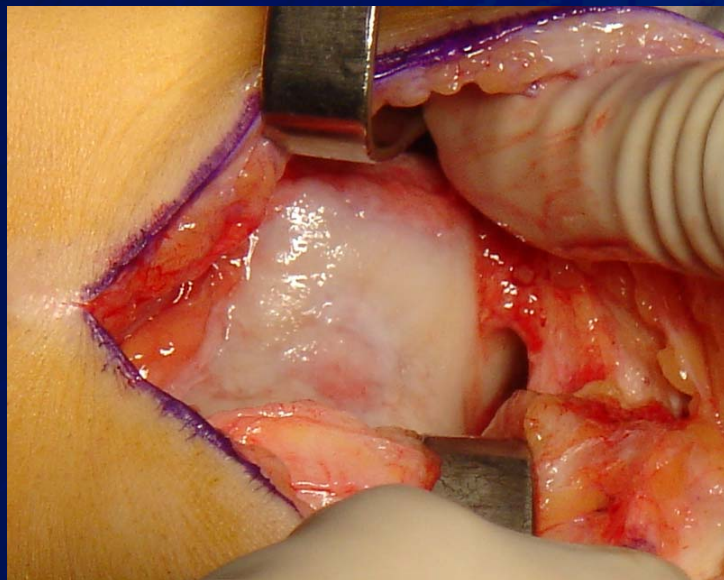
# Radiographs

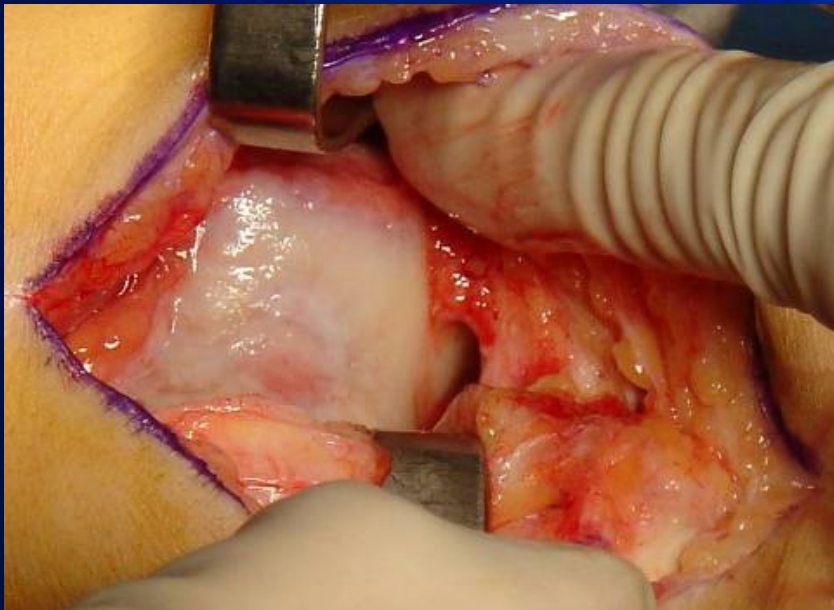
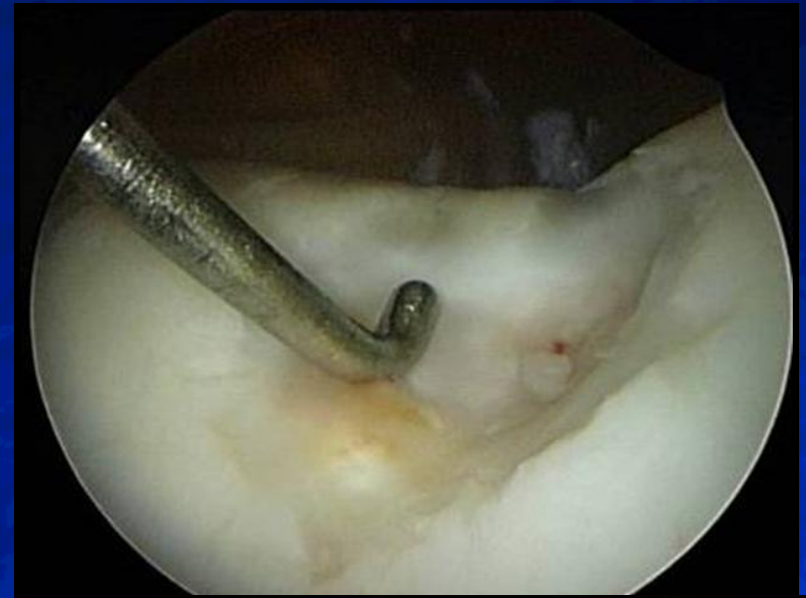
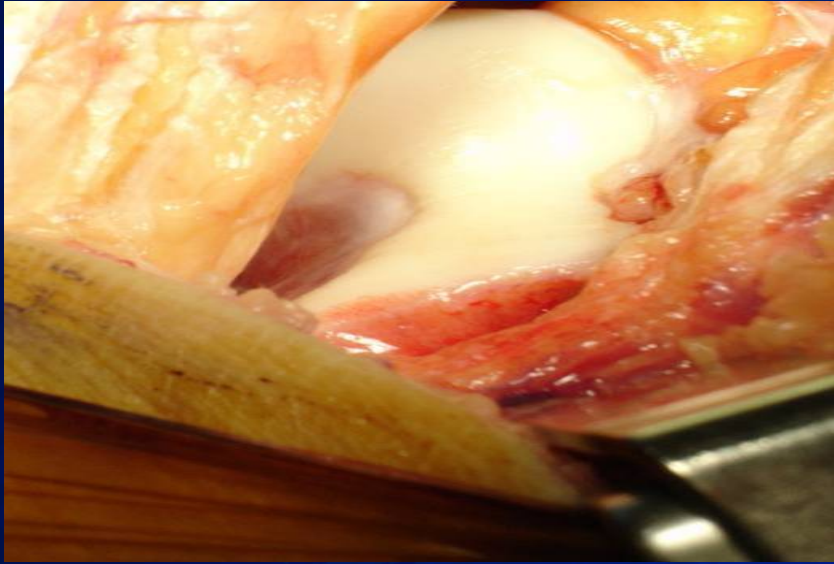




# Radiographs







# Radiographs after unilateral

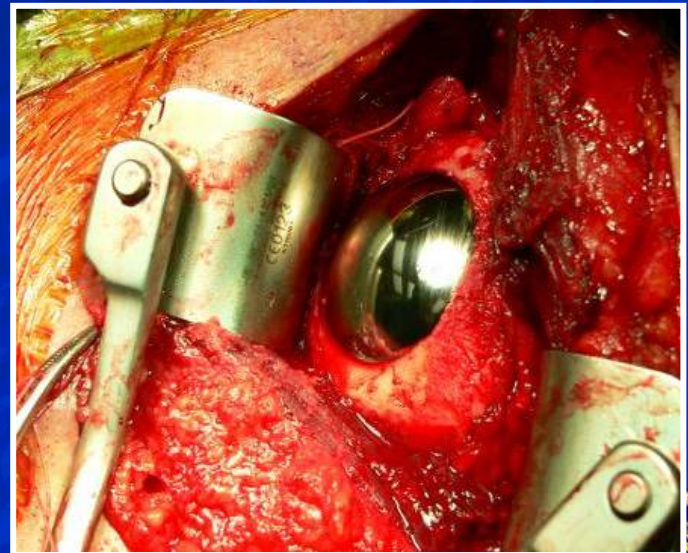
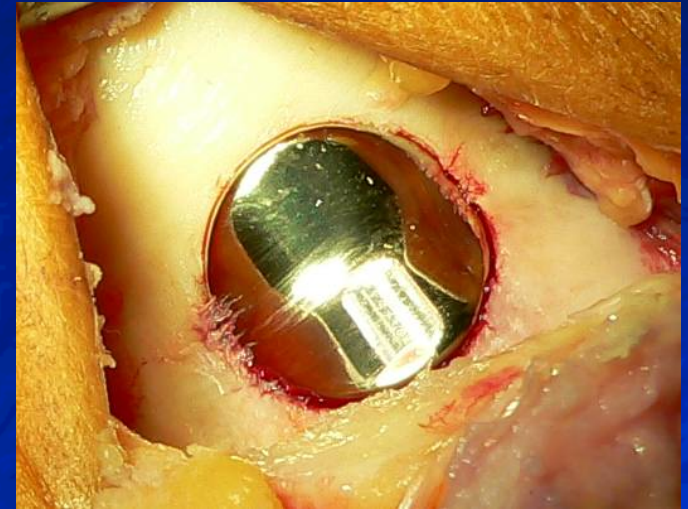
If indicated: Consider distal  
realignment and/or lateral  
release

In addition to resurfacing of the  
joint



# Patient-Matched Resurfacing *Outline*

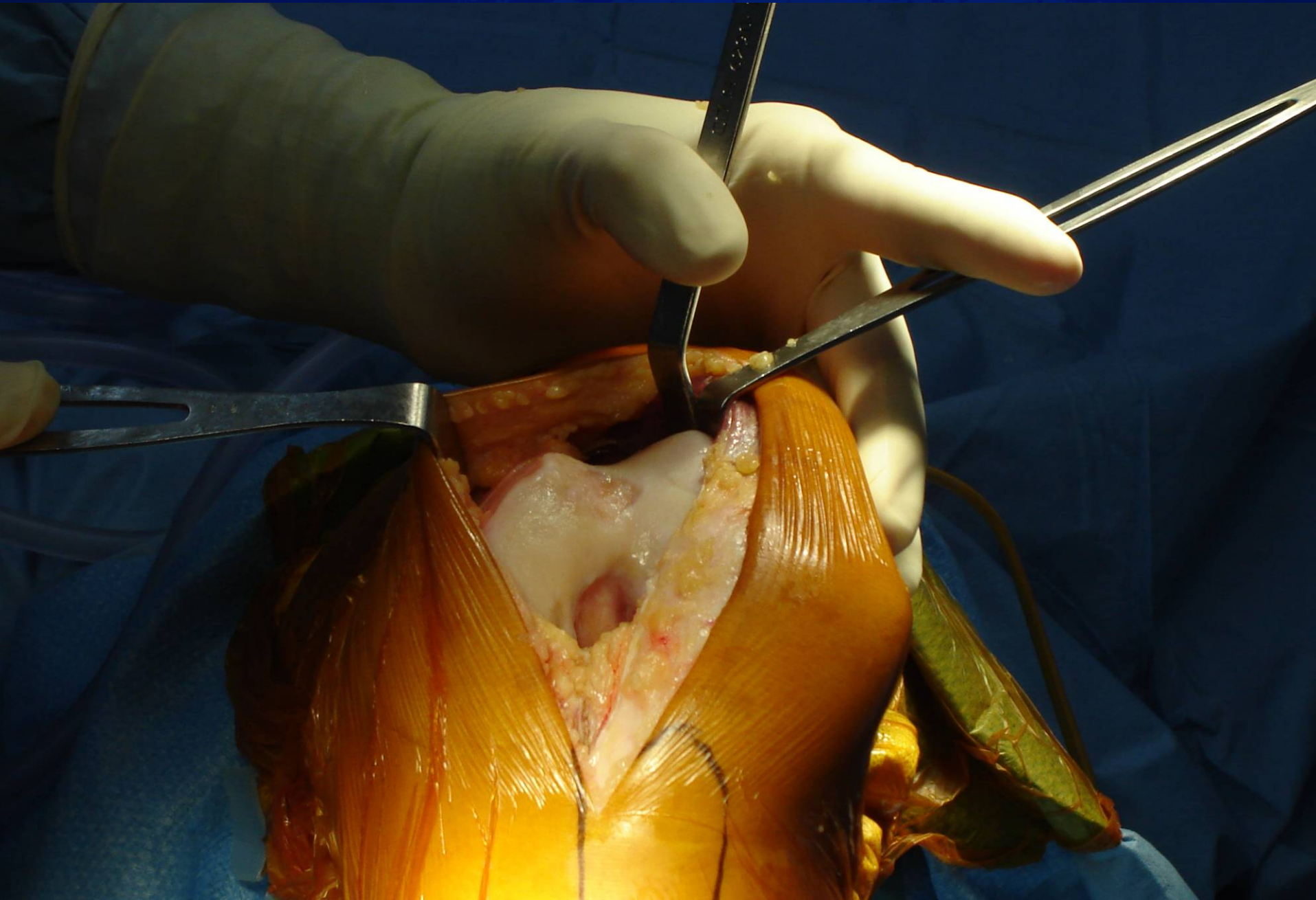
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  - Arthrosurface PF
  - *Arthrosurface WAVE*
- Knee Condyle and Plateau Resurfacing
- Shoulder Resurfacing
  - Arthrosurface *HemiCap*



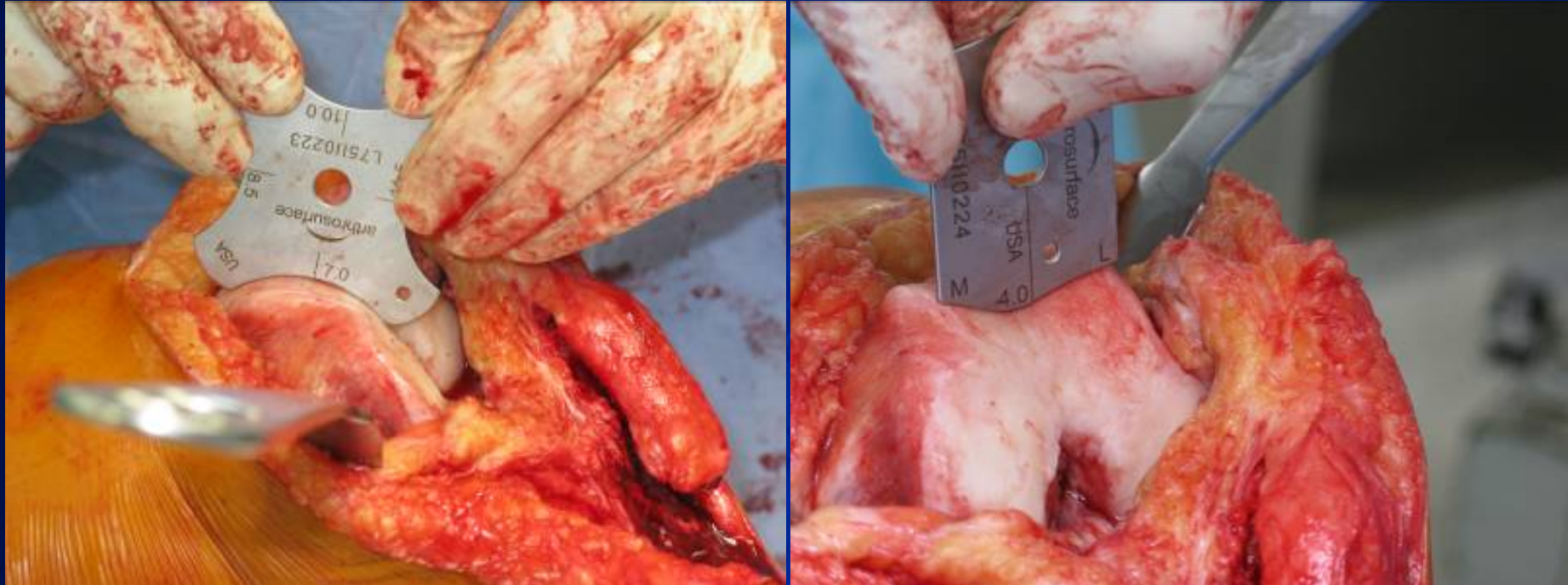
# For Larger PF Defects *Larger diameter prosthesis*

- PF Classic = 20 mm circular device
- *WAVE* = larger
  - ♦ 37 mm medial-lateral
  - ♦ 35 mm superior-inferior
- Prevents overstuffing
- Anatomical fit preserved in design
- Uniquely





# Anatomic Sizing Med-Lat and Sup-Inf



The depth (4 or 5 mm) of the preexisting trochlear groove is determined.

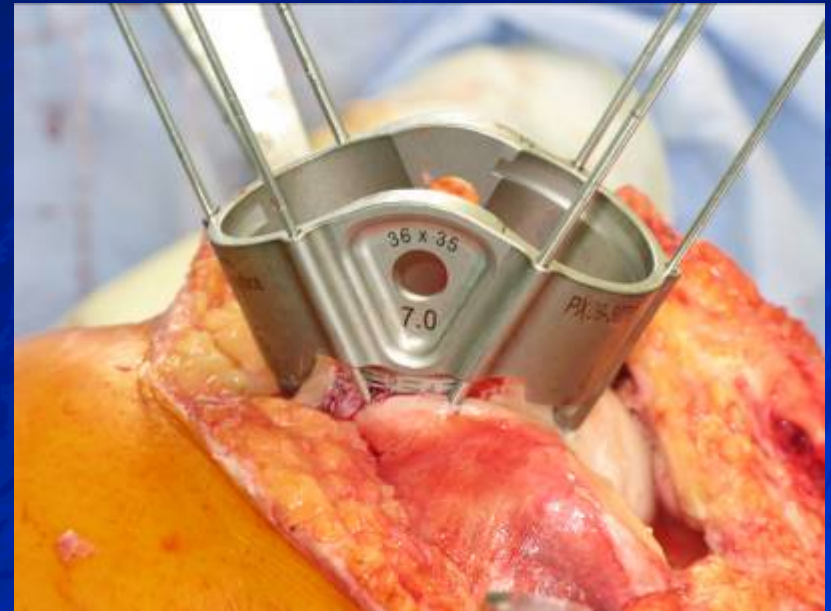


# Mapping Joint S/I



Read **Contact Probe** to obtain positive (+) superior and inferior offsets.  
).

# Fixing the Guide Block

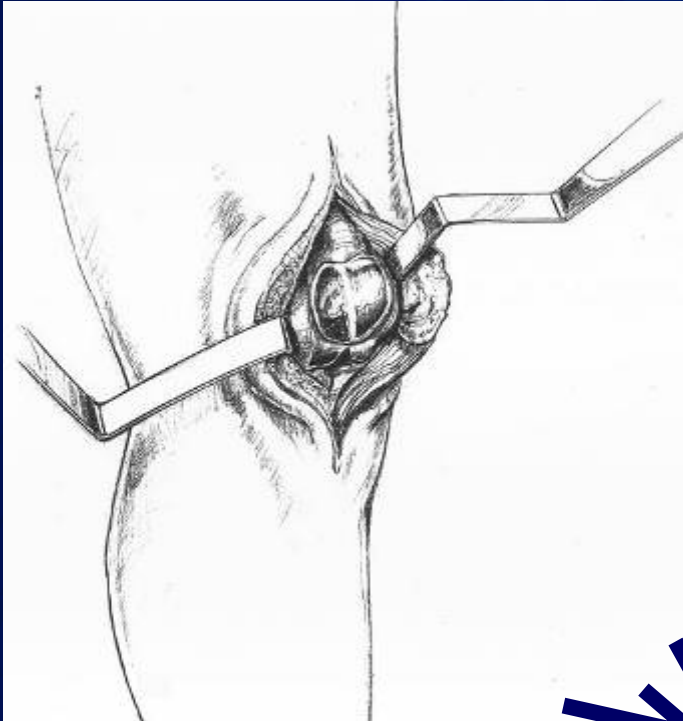


Select the **Guide Block** that corresponds with the offset from the superior/inferior mapping point





# Implant In Situ



Femoral Resurfacing Component: Cobalt-Chromium Alloy (Co-Cr-Mo)

Undersurface Coating: Titanium (CP Ti)

Fixation Stud: Titanium Alloy (Ti-6Al-



# Results of PF Resurfacing

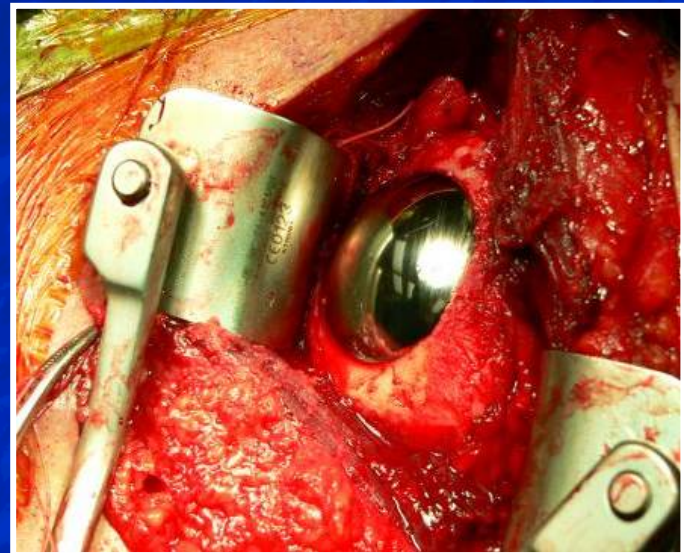
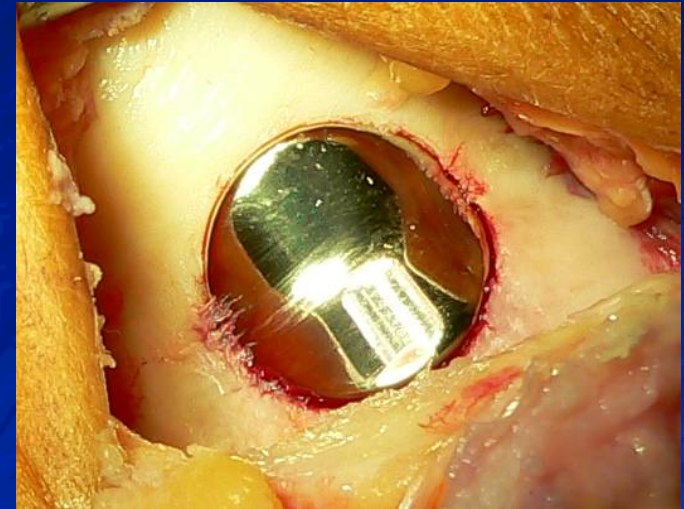
Short-term multicenter results:

- **43 patients**
- **Average follow-up: 9 months**
- **Activity level at last follow-up**
  - 70% of patients (N=30/43) achieved their pre-injury level
  - 21% of patients (N=9/43) improved by 1 level
  - 9% of patients (N=4/43) decreased by 1 level at current follow-up
- **Functional status at last follow-up**
  - Unrestricted (Level I): 30% of patients (N=13/43)
  - Nearly Unrestricted (Level II): 56% of patients (N=24/43)
  - Moderately Restricted (Level III): 14% of patients (N=6/43)



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  - Arthrosurface *WAVE*
- Knee Condyle and Plateau Resurfacing
- Shoulder Resurfacing
  - Arthrosurface *HemiCap*

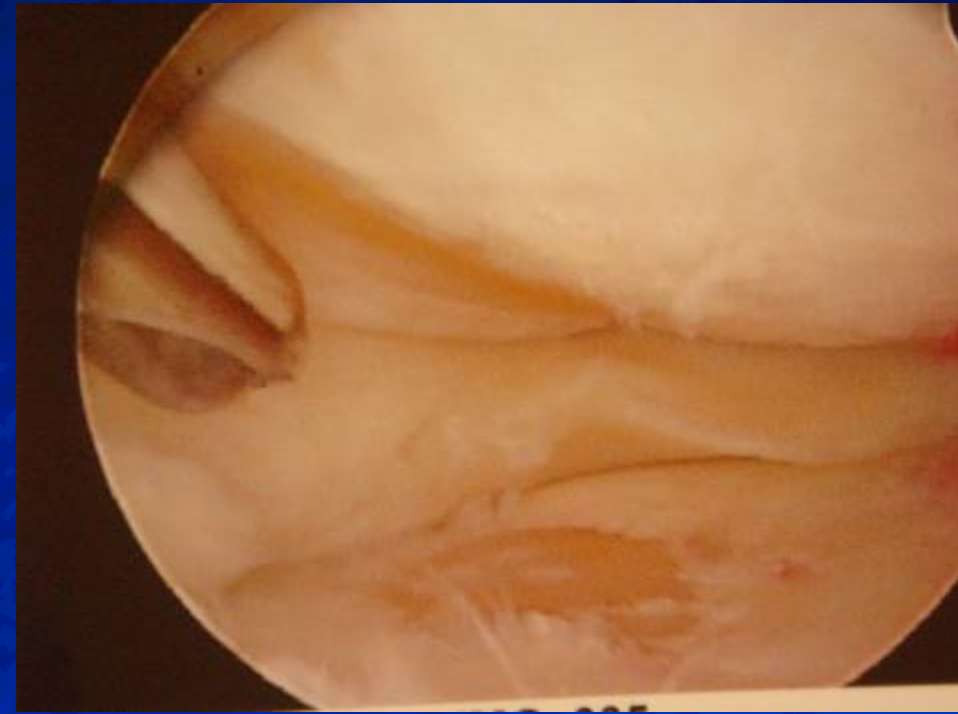


# Unicompartmental Lesions & OA

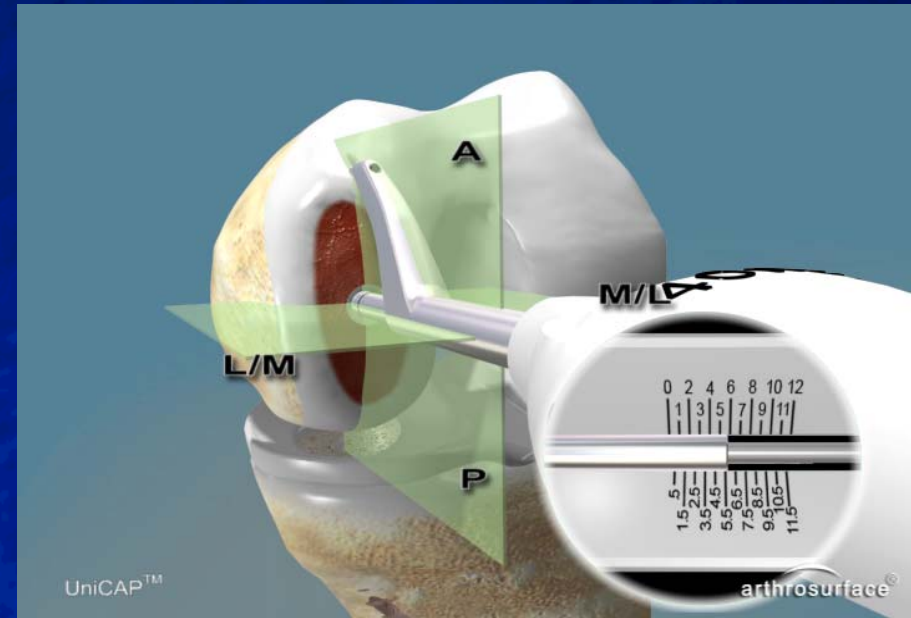
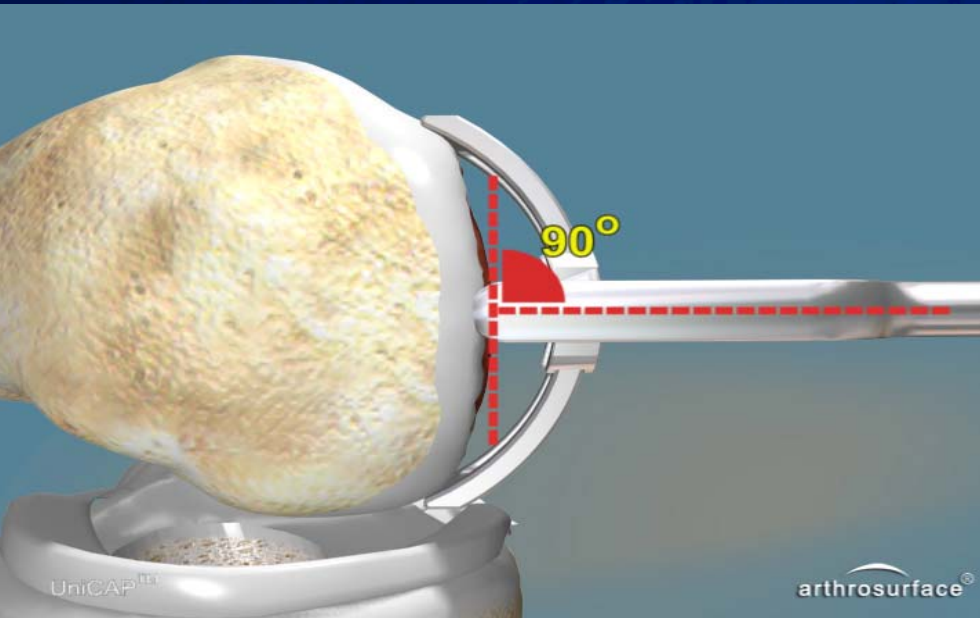
## Medial OR Lateral

23 \*

REC \*







arthrosurface®  
Uni Femoral

fill in all 4 circles

Sizing Card

1. Average AP          **U**  
Average ML         

2. Select Femoral UniCAP™ offset values  
*If no match is found, use the next highest offset value*

- 6.0 mm x 2.0 mm
- 6.0 mm x 3.0 mm
- 7.0 mm x 2.0 mm
- 7.0 mm x 3.0 mm
- 8.0 mm x 2.0 mm
- 8.0 mm x 3.0 mm

3. Select the Surface Reamer size that matches the maximum ML offset value.

4. Select the Surface Reamer size that matches the maximum AP offset value.

UniCAP™

arthrosurface®

arthrosurface®  
Uni Femoral

fill in all 4 circles

Sizing Card

1. Average AP 6.0 **U**  
Average ML 3.0

2. Select Femoral UniCAP™ offset values  
*If no match is found, use the next highest offset value*

- 6.0 mm x 2.0 mm
- 6.0 mm x 3.0 mm
- 7.0 mm x 2.0 mm
- 7.0 mm x 3.0 mm
- 8.0 mm x 2.0 mm
- 8.0 mm x 3.0 mm
- 9.0 mm x 2.0 mm
- 10.0 mm x 3.0 mm

3. Select Femoral Surface Reamer size  
*Choose the Surface Reamer that matches the maximum ML offset value.*

4. Select the Surface Reamer size that matches the maximum AP offset value.

UniCAP™

arthrosurface®

Set Pin Perpendicular & Inline with Cam of Condyle



Map M/L curves



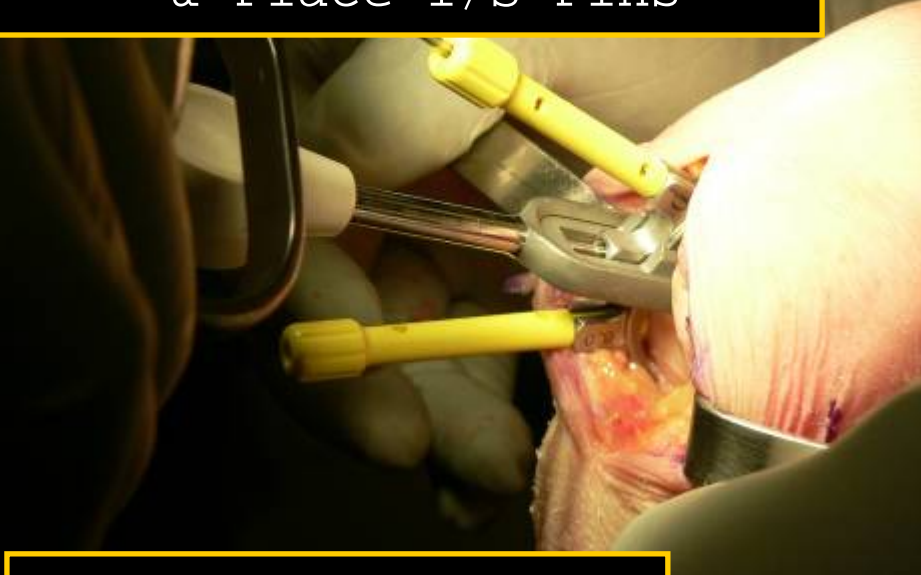
Map Superior/Inferior Curves



Ream Central Circle



Use Femoral Guide Block  
& Place I/S Pins



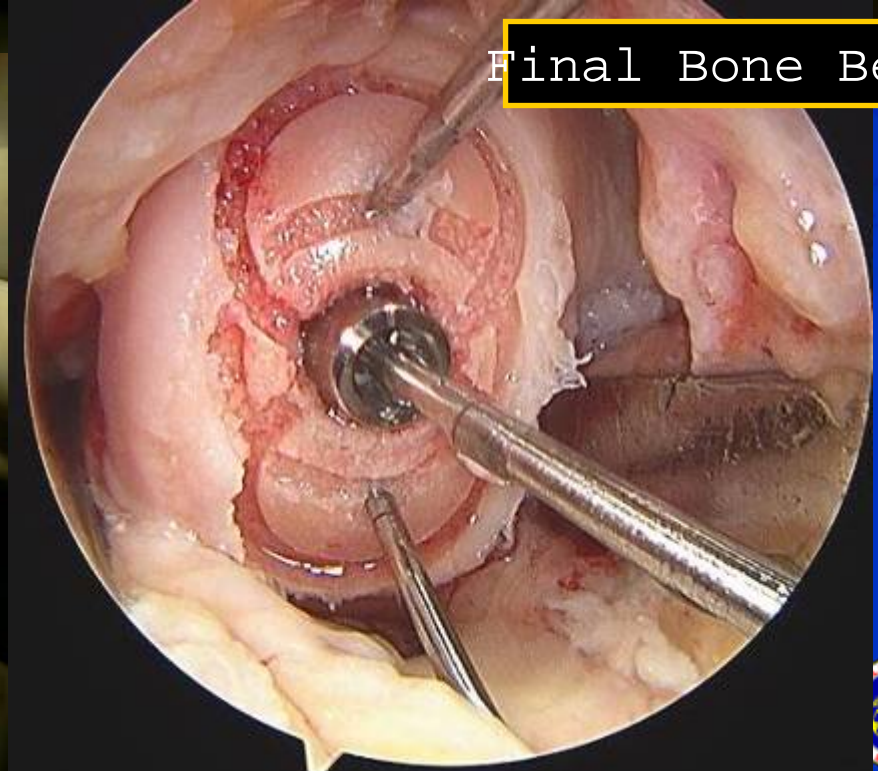
Ream Inferior & Superior Circles

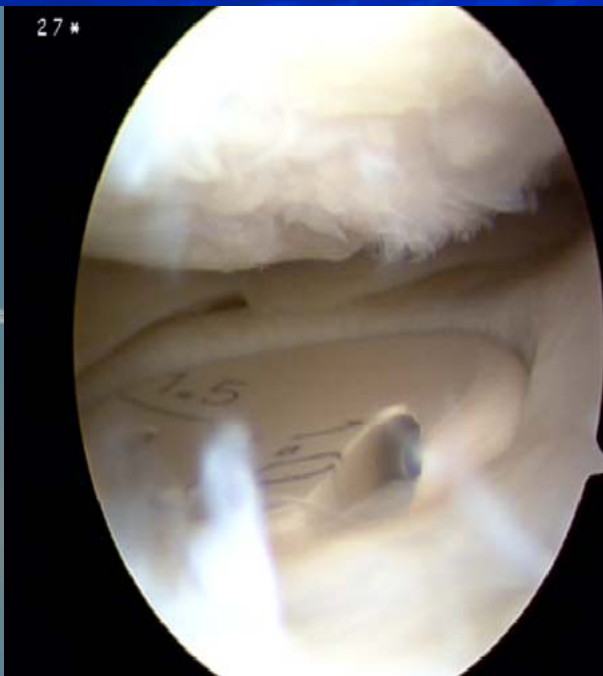
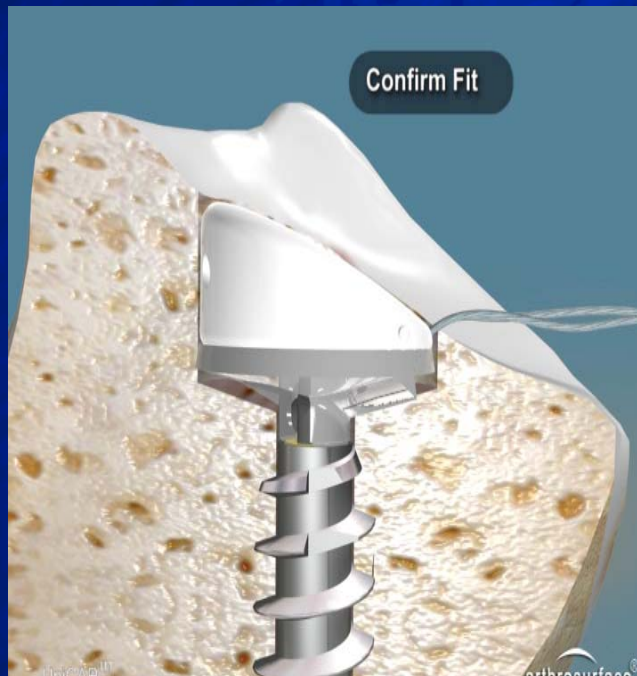
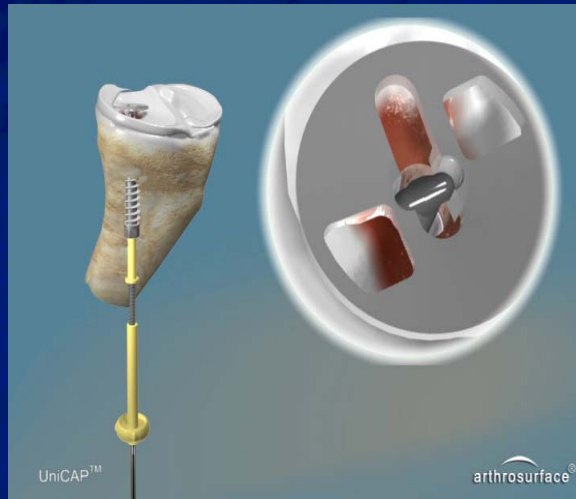


Place Trial & Insert Screw

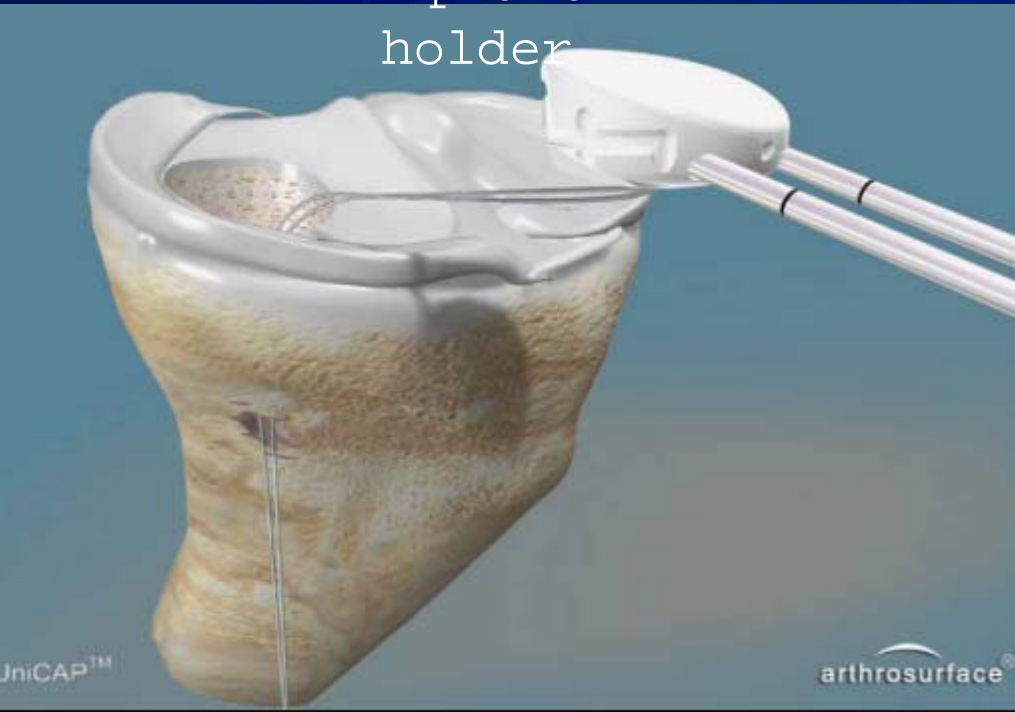


Final Bone Bed

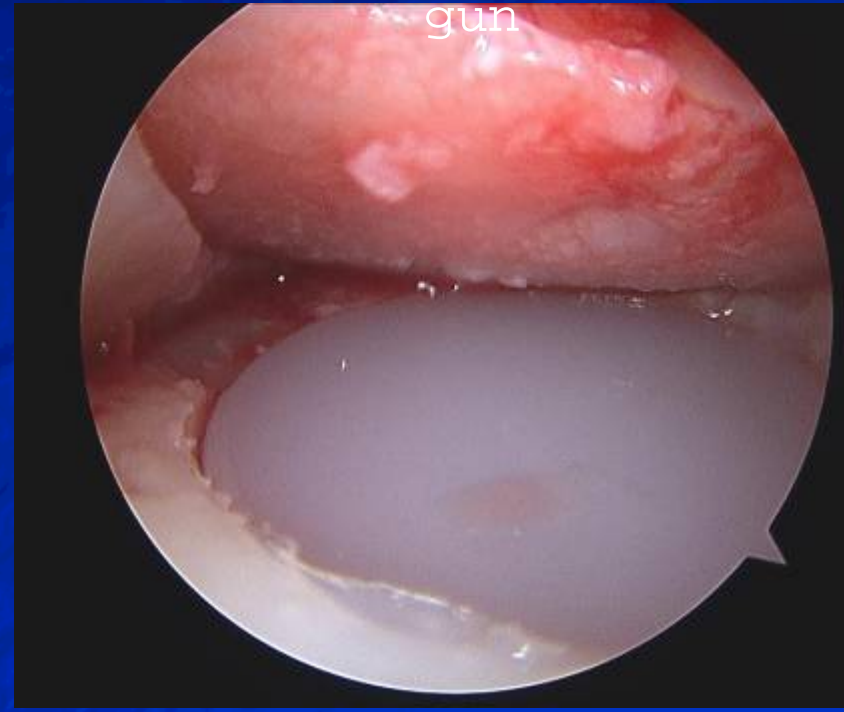




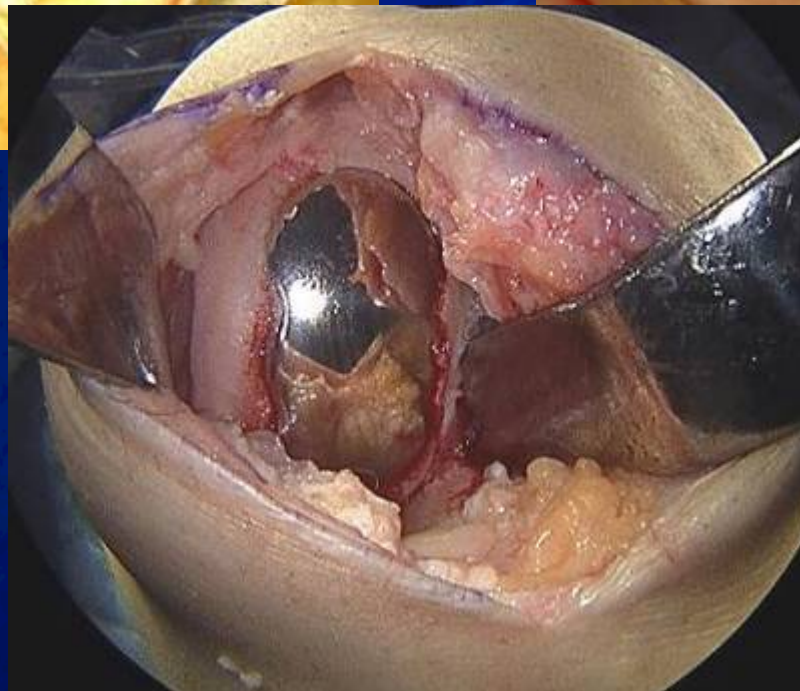
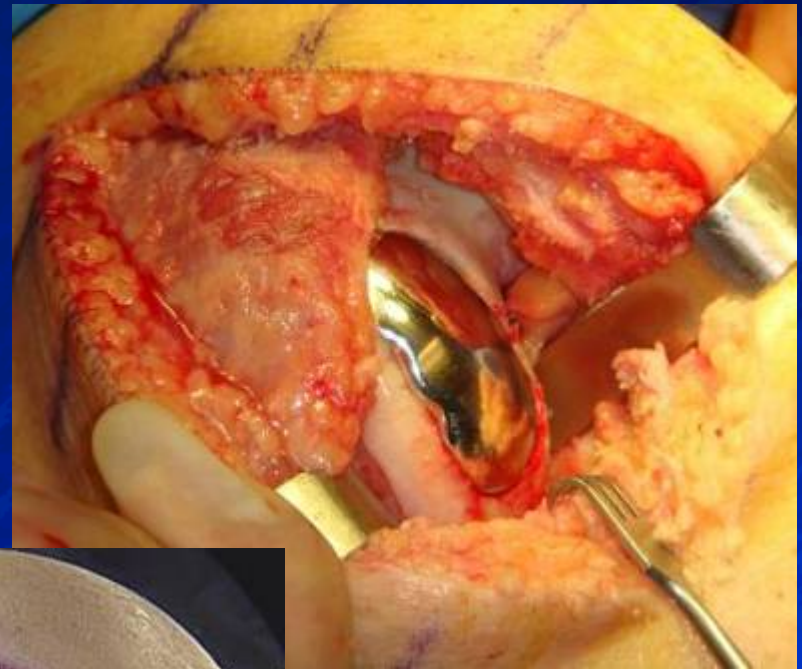
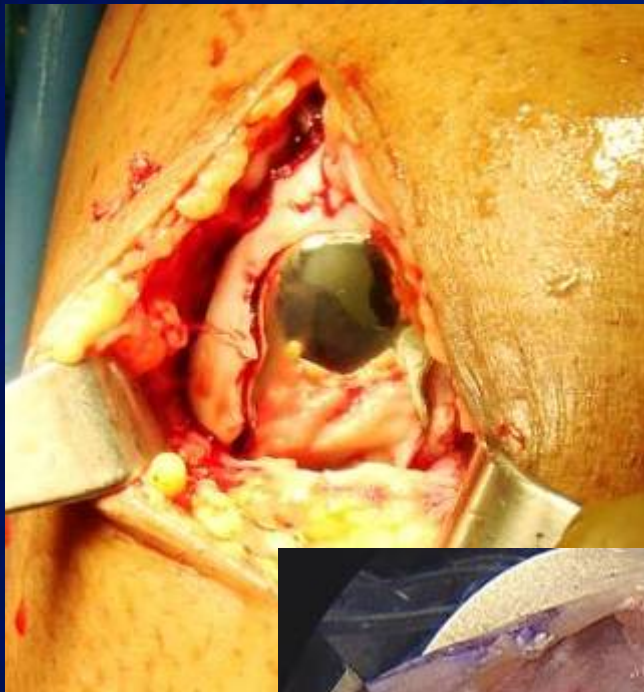
Place Tibial  
Implant  
using wire  
shuttle &  
implant  
holder



Cement  
Implant in  
Place using  
"pressurize  
d" cement  
gun



# Final Implant



FRONCEK ROBERT L D O 01/14/1992

CLEVELAND CLINIC  
STADIUM KNEE APART UNBLIND-RO-AS  
07.28.2008 11:58:58

R  
C

L  
C

CC  
STANDING



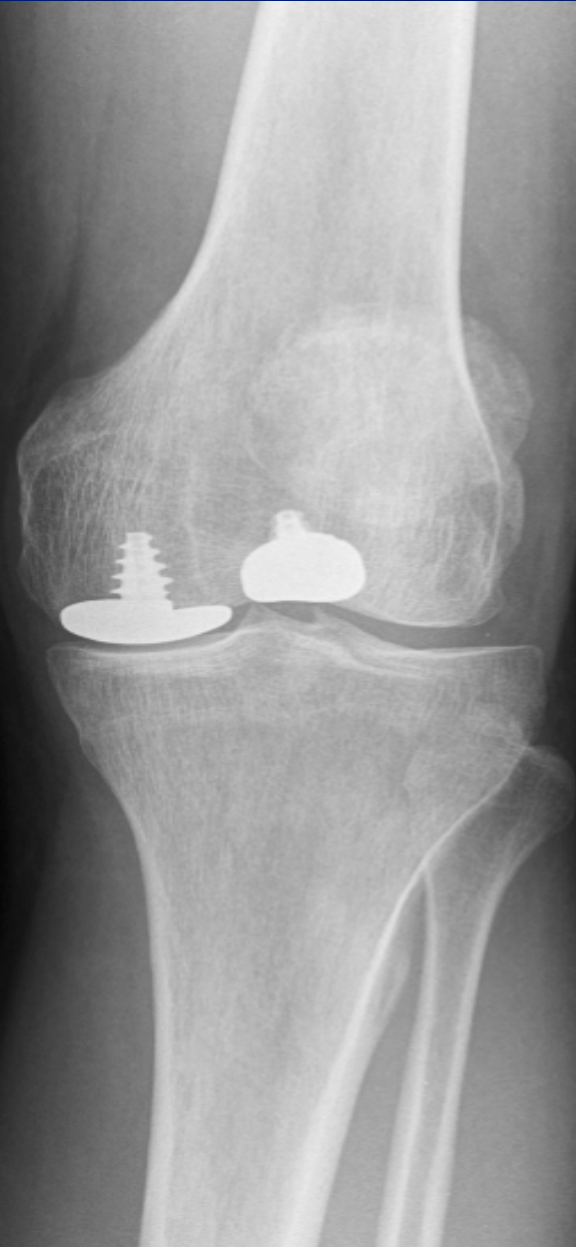




39 y/o Male Navy Flight Doctor 1.5

770

R

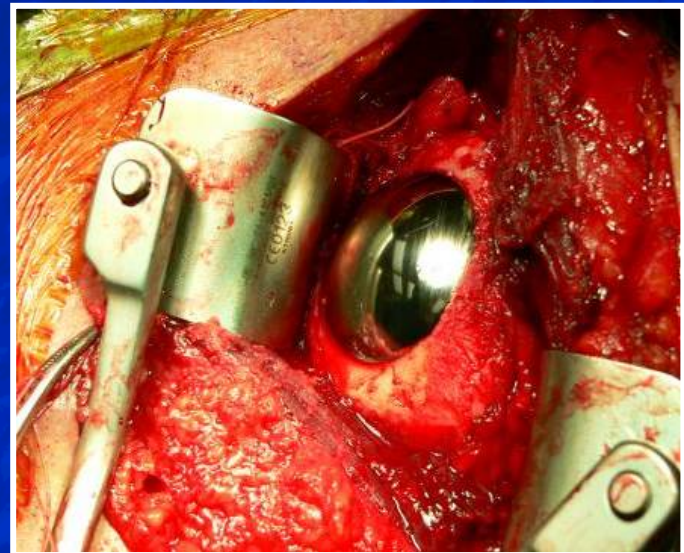
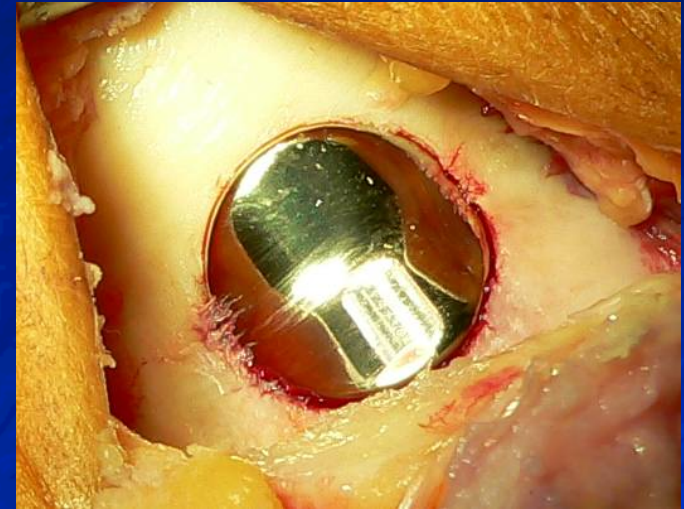


L  
04  
weight bearing

Na

# Patient-Matched Resurfacing *Outline*

- Cartilage Options - Overview
- Patellofemoral Resurfacing
  - Arthrosurface PF Classic
  - Arthrosurface *WAVE*
- Knee Condyle and Plateau Resurfacing
- Shoulder Resurfacing
  - Arthrosurface *HemiCap*



# Where does the HemiCAP<sup>®</sup> fit in?

To provide a new option in the continuum of care after conservative or biological treatments have failed and either before or, **hopefully**, to avoid a traditional joint replacement.



# Treatment Options

## ARTHROSURFACE - HemiCAP

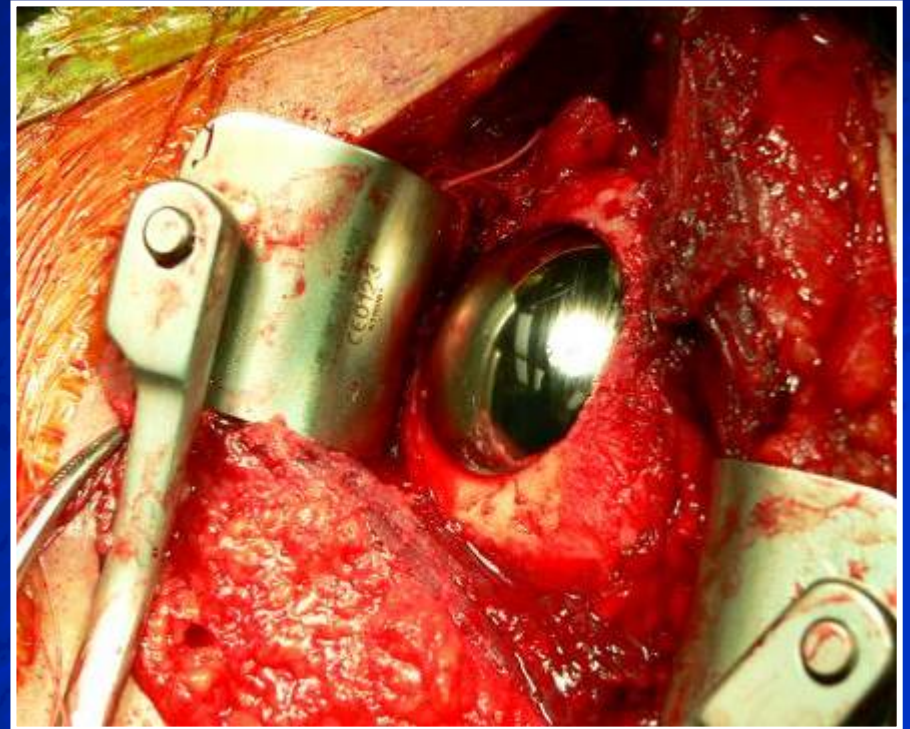
Surface  
hemiarthroplasty

Bone sparing

No compromise  
future TSA

FDA approved  
♦ Jan. '04

Excellent early  
results



How does the HemiCAP<sup>®</sup> implant confer a congruent articular surface in two planes??

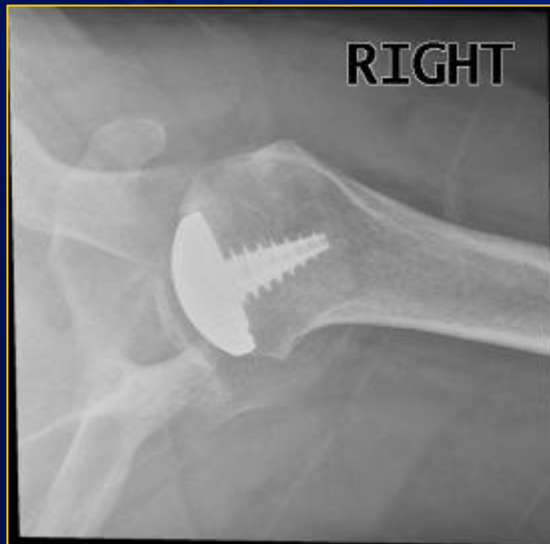
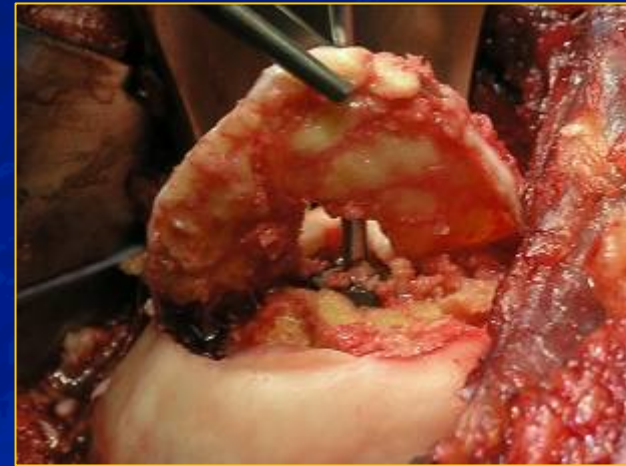




Cartilage "Flow" over the Implant Edge  
Emphasizes anatomic - fit



# AVN-Operative



# Humeral Head Defects

## Reverse Hill Sachs

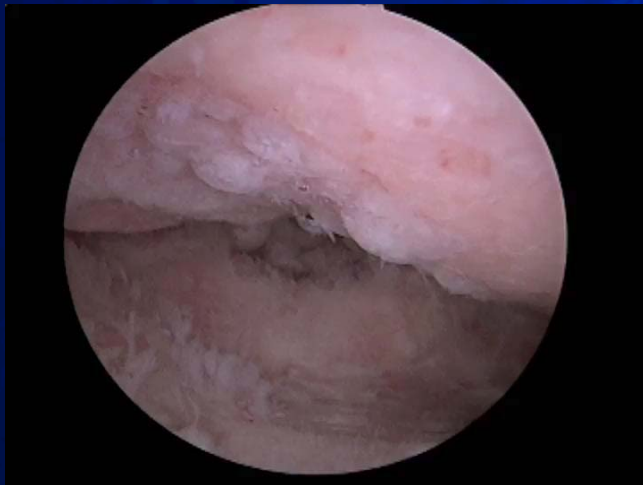
## Locked Posterior

## Dislocation





# Post-Instability Anchor Arthropathy



# Arthrosurface Clinical Outcomes

62 patients

- ◆ 36 male, 26 female
- ◆ Mean age: 60 yrs (range 25- 84)
- ◆ Mean follow-up: 8 mo (range 3 - 23)

## ANATOMIC HUMERAL HEAD RESURFACING

REVIEW OF CLINICAL OUTCOMES AND CASE PRESENTATIONS

By Philip A. Derriben, MD, Lawrence J. Lovati, MD, John W. Uribe, MD, John E. Zayas, MD, Robert B. Laceyfield, MD, Anthony Mivcaci, MD, Joshua A. Sargent, MD

Investigation performed at the Tampa Bay Orthopaedic Specialties, North Park, FL - Alabama Sports Medicine and Orthopaedics Center, Birmingham, AL - UHS Sports Medicine Services, Miami, FL - University of Illinois, Chicago, Illinois, IL - Cleveland Clinic, Cleveland, OH - Arcom Sports Medicine & Orthopaedics, Everett, WA

### ABSTRACT

**Background:** Humeral head resurfacing has recently gained increased interest with clinicians. A novel anatomic resurfacing technology has been introduced to the market that allows for intraoperative mapping of the joint surface geometry. The objective of this investigation is to quantify the effectiveness of the HemiCAP<sup>®</sup> contoured articular shoulder prosthesis in the management of pain and restoration of shoulder function. This review examines short term multicenter clinical results.

**Materials and Methods:** Between March 2004 and January 2005, 62 patients underwent humeral head resurfacing at six participating institutions. Thirty-six patients were male, 26 female. The mean age at the time of surgery was 60 years (range 25-84). The mean follow-up was 8 months (range 3-23). Forty-five patients were treated for glenohumeral osteoarthritis, eight for avascular necrosis, four received treatment for local full thickness chondral defects, four were treated for humero-acromial arthritis, and one for rheumatoid arthritis.

**Results:** Defect sizes were effectively covered with the following diameters: 35mm (32 implants), 30mm (24 implants), and 25mm (6 implants). Mean WOODS (range 1234 to 248), ASES (range 28 to 70), pain VAS (range 24 to 16), SST (range 3.2 to 6.4), and Constant scores (range 65 to 78) demonstrated marked improvement over the follow-up period. The most frequent concomitant procedure was rotator cuff repair in 13 patients. Advanced glenoid wear, found at the time of implantation, lead to one clinical failure due to unimproved shoulder pain. Ninety-five percent of the patients reported a good to excellent result at last follow-up.

**Conclusions:** Intraoperative mapping of the joint surface geometry permits an anatomic restoration of the humeral head. Compared to rotating shoulder arthroplasty procedures, the HemiCAP<sup>®</sup> system is a joint preserving procedure with minimal removal of bone stock and preservation of healthy cartilage. The surgical technique is reproducible, has a short learning curve and causes minimal impact on future surgery. Treatment outcomes provide pain relief and return to activities across a variety of indications.

**Level of Evidence:** Therapeutic study, Level IV (case series).

No significant papers have been made in this journal or elsewhere in support of this study. Special thanks are extended to the Arthroscop<sup>®</sup>, Steegen, Leiden, Netherl. for their excellent press on letters to Arthroscop<sup>®</sup> equity.

### INTRODUCTION

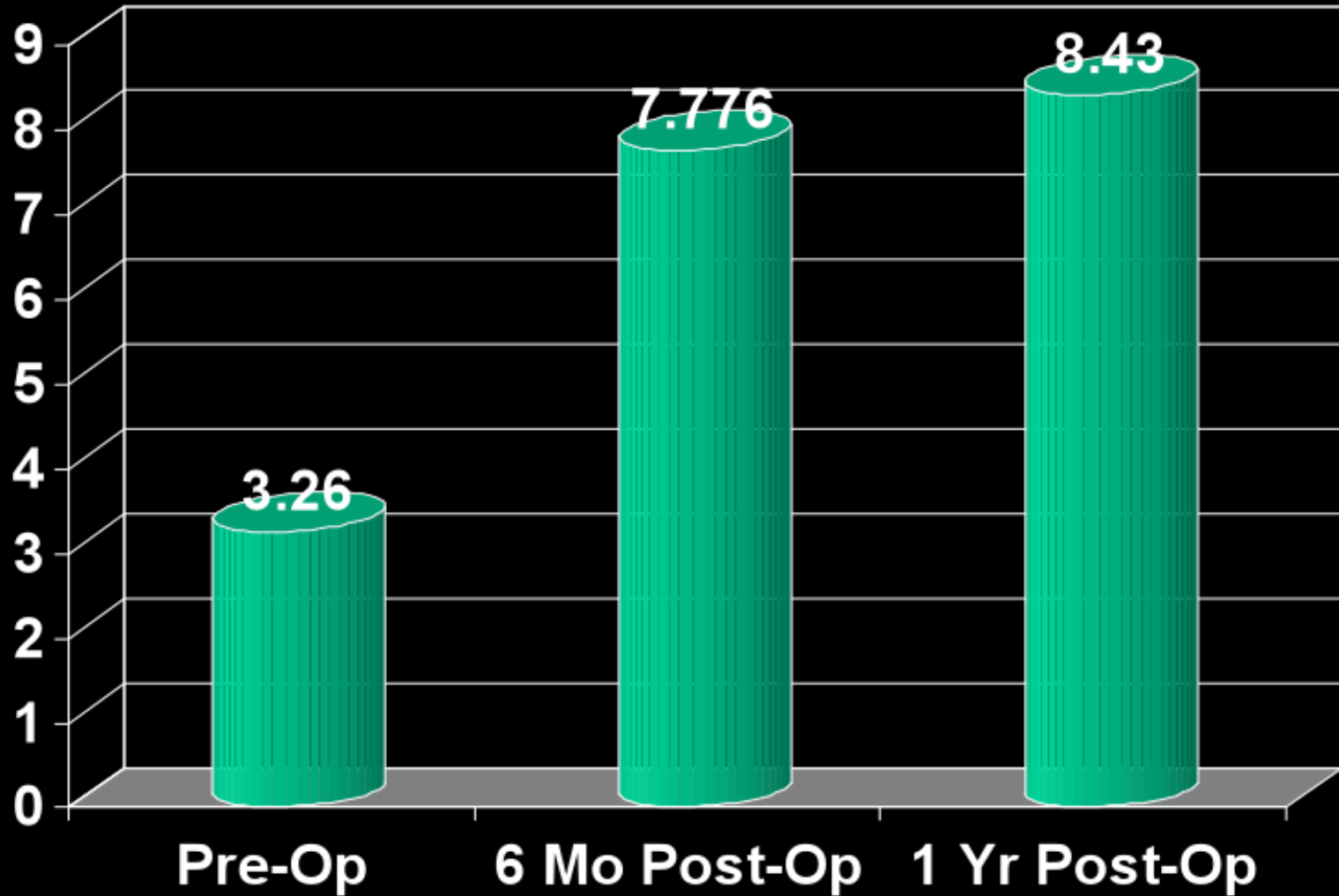
The earliest known report of shoulder arthroplasty dates back to 1808. Rivet, a French surgeon, replaced the glenohumeral joint with a platinum and rubber implant in a patient with tuberculosis. Modern shoulder arthroplasty was initiated by Shauger who reported on a titanium hemiarthroplasty in a patient with avascular necrosis in 1957. He shaped the future of shoulder arthroplasty with his work. He replaced the humeral head with an unconstrained prosthesis in 1951 with initial results in 1958.<sup>1</sup> Further development led to the introduction of total shoulder arthroplasty in the 1970s with the addition of constrained glenoid replacements. Modular systems were introduced in the 1980s to accommodate glenohumeral joint variations. Despite many new techniques in soft tissue balancing and physiological joint stabilizers introduced over the past 15 years, restoration of

normal joint kinematics with an anatomic shoulder reconstruction remains challenging. Many studies have demonstrated satisfactory short- and mid-term results in both hemi- and total shoulder arthroplasty<sup>2-6</sup>, however humeral shaft related complications (including humeral head fracture related arthroplasty) and glenoid component loosening have been the most frequently reported obstacles in conventional stemmed shoulder replacement.<sup>7-14</sup>

Articular cartilage and bone stock preservation are gaining significant importance as preservation alternatives increase in volume and a younger patient population undergoes shoulder replacement. The younger, active patient is at the highest risk for possible future revision procedures<sup>15</sup>. Shoulder hemiarthroplasty has seen more than a three-fold increase in the United States in the past decade (Table 1).



# Simple Shoulder Test



# Conclusions

## *Limited-Anatomic Resurfacing*

### *Arthrosurface System*

- Joint preservation = removal of minimal bone/cartilage
- Leaving functional tissues intact
- Retain future options
- The **patient's** unique joint geometry guides convexity mapping
- Avoids challenges with
  - Joint height
  - Inclination angle
  - Version
  - Joint volume
  - Soft tissue tension
  - Anatomic resurfacing reduces risk of eccentric glenoid loading



# **Navy Orthopaedics San Diego Thank You!**

