

The Role of Resurfacing Arthroplasty in the Knee

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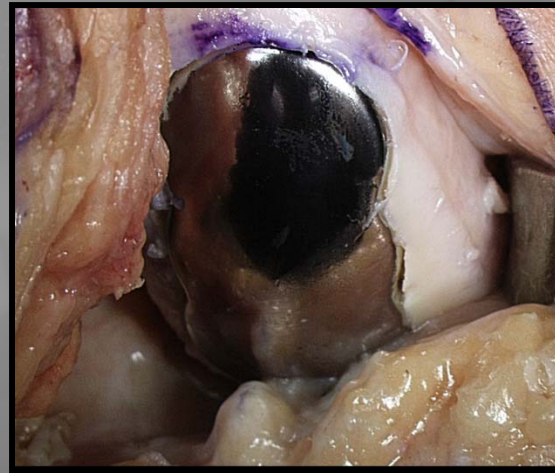
Articular Cartilage: State of the Art 2009

NYU Hospital for Joint Diseases



OUTLINE

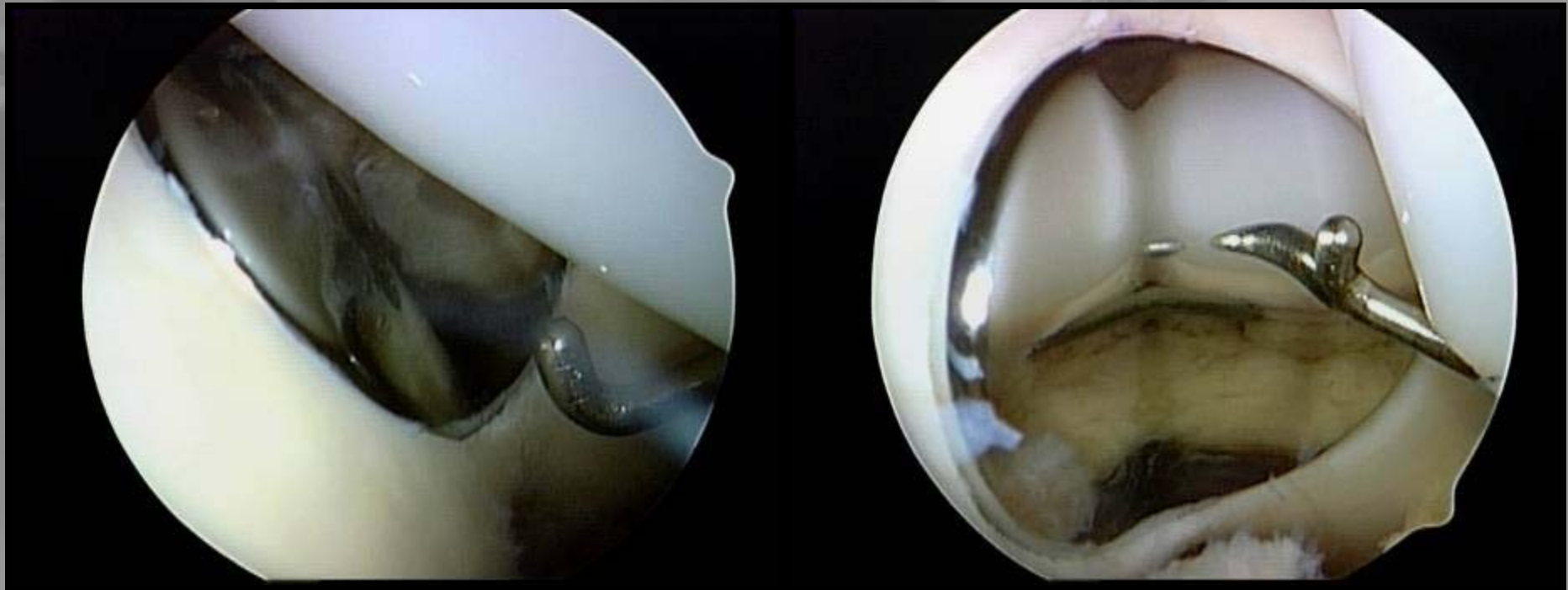
- Continuum of Options
- Introduction of Inlay Arthroplasty Concept
 - Biomechanical Basis
 - FDA Trial
- Knee CAP
 - HemiCAP, UniCAP, PF
 - Indications
 - Technique
 - Cases



Transitioning from Biological to Prosthetic Resurfacing.....

Inlay Prostheses , then--

Uni or Bicompartmental Traditional Prostheses, TKA



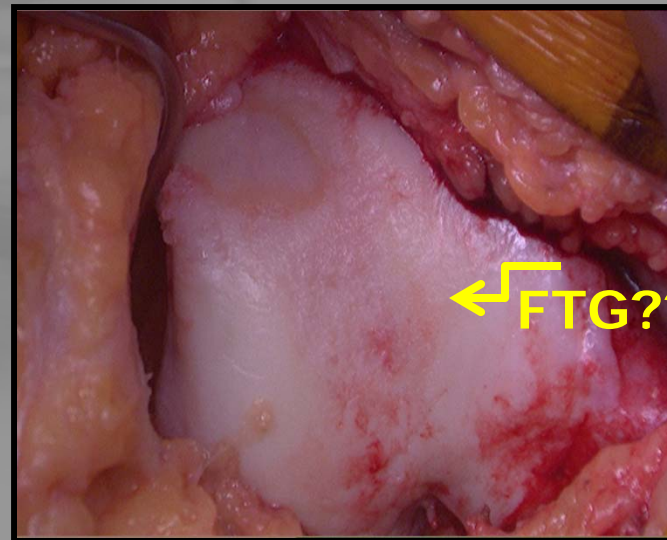
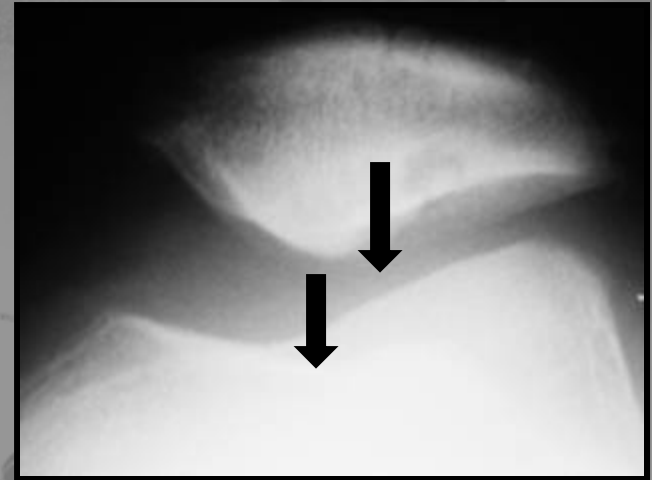
Goals/Basis of Prosthetic Knee Resurfacing

- Provide Pain Relief
- Improve Function
- Extension of Biological Cartilage Restoration
- Maintain principles and themes of Biologic Surgery
- Long lasting
- Solution for “younger patient” told “must wait for TKA”
- Minimize perioperative morbidity
- Maximize Outcomes
 - Equal, or better than traditional treatments



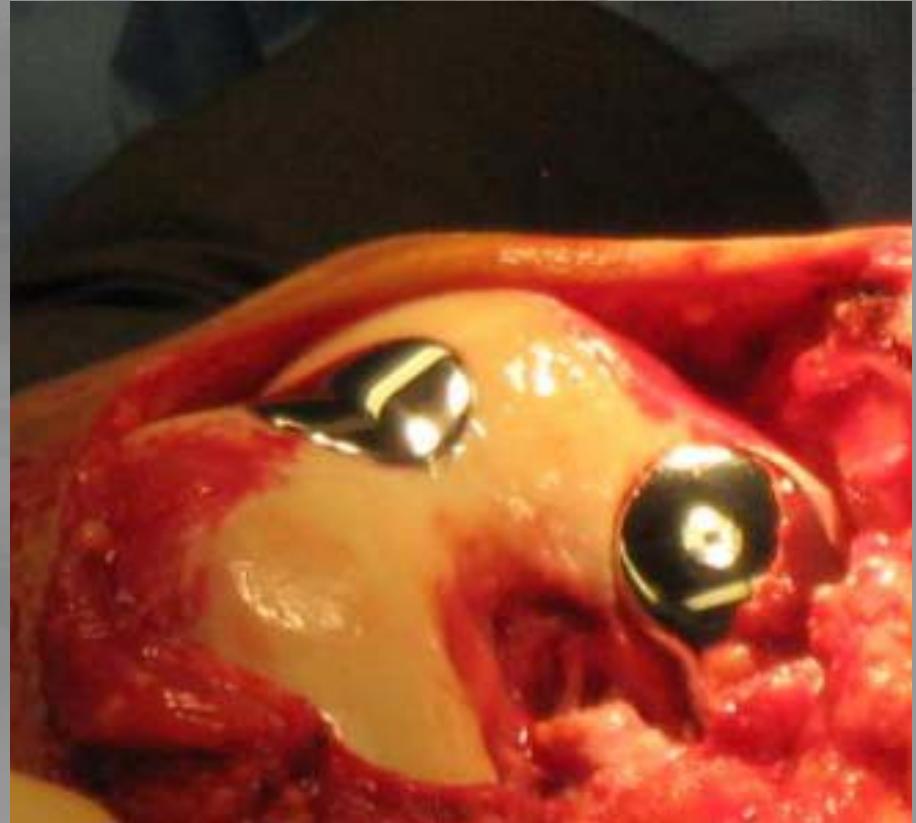
ANATOMY is KEY

- Concave and convex geometric surfaces – complex curves
- Intraoperative articular mapping involves measuring/replicating complex geometric surface configurations
- Accounts for morphologic variability
- Implants are patient driven



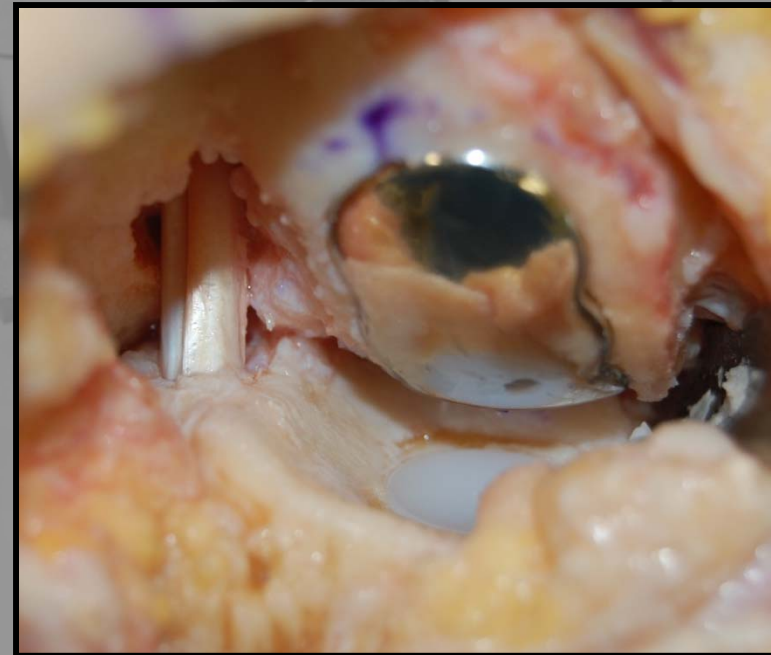
Progression of Knee Resurfacing

- Wide spectrum of options
- Individualize according to the specific patient
- Evaluate not just affected joint, BUT
 - Whole leg
 - Hip, foot/ankle
 - Alignment
 - Whole patient
 - Demands, expectations
 - Health Status
- Inlay Device is Least Invasive Prostheses



Inlay Resurfacing Device

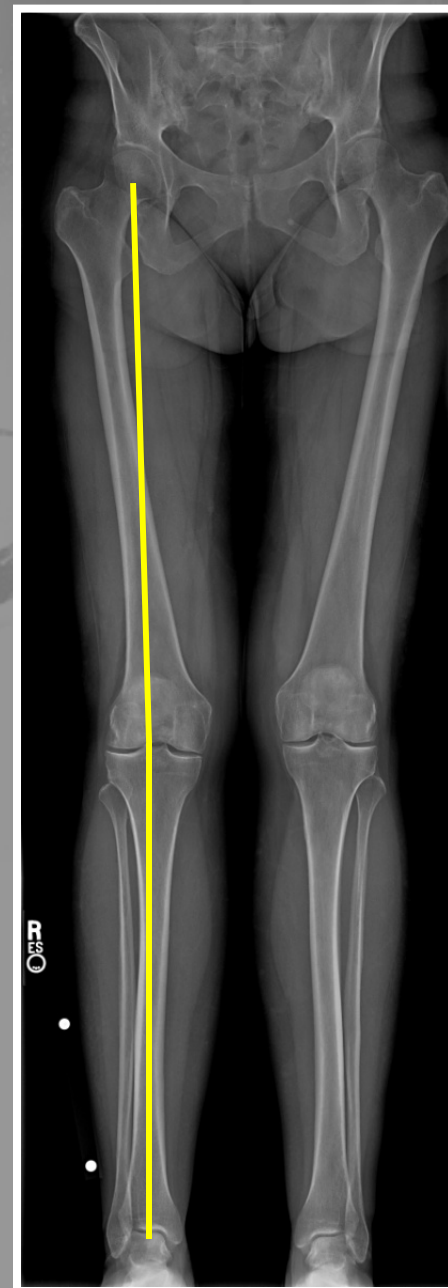
- Little or no edge loading
- Preservation of all ligaments
- No decreased proprioception
- Concurrent Procedures unlimited by volume
 - ACL, Osteotomy, etc...
- Outpatient procedure
- Minimal Blood Loss
- Canulated procedure,
 - Reproducible
 - Simple



Alignment

Guidelines for Inlay

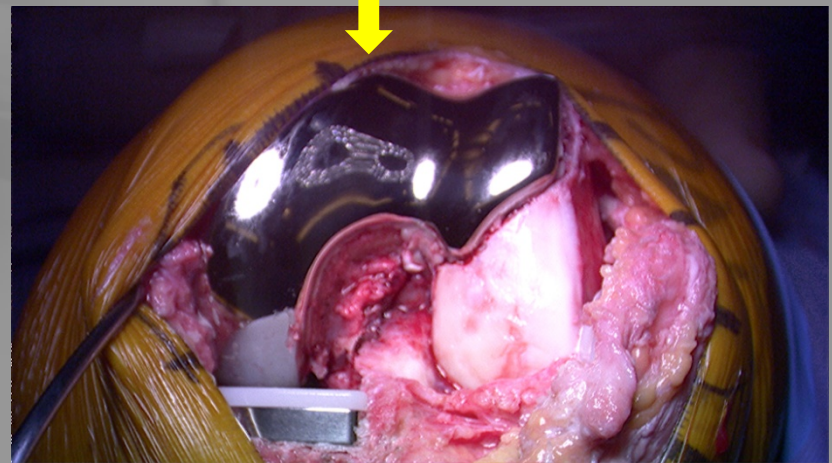
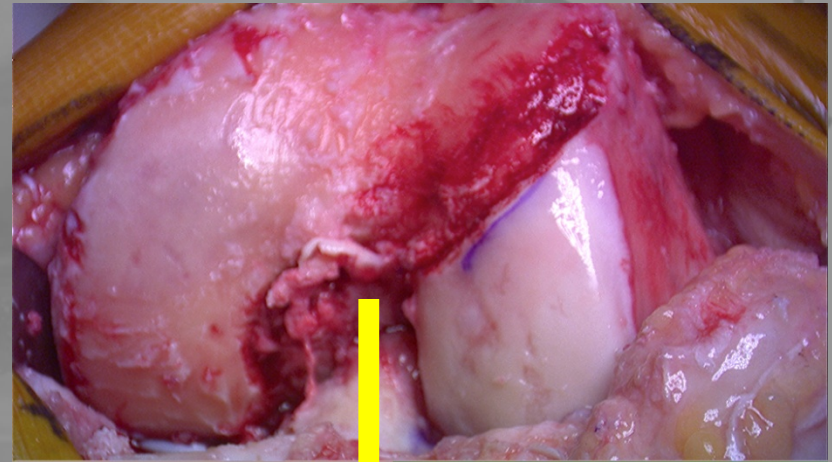
- Inlay only can restore limited joint height
- Inlay appropriate if deformity is correctable
- Stiff varus/valgus deformity may require soft tissue balancing
- Medial Inlay $< 5^{\circ}$ varus
- $5-10^{\circ}$ varus, consider more traditional Uni
- $> 10^{\circ}$, consider osteotomy together with resurfacing



Onlay Arthroplasty

Implants generated from patient anatomy

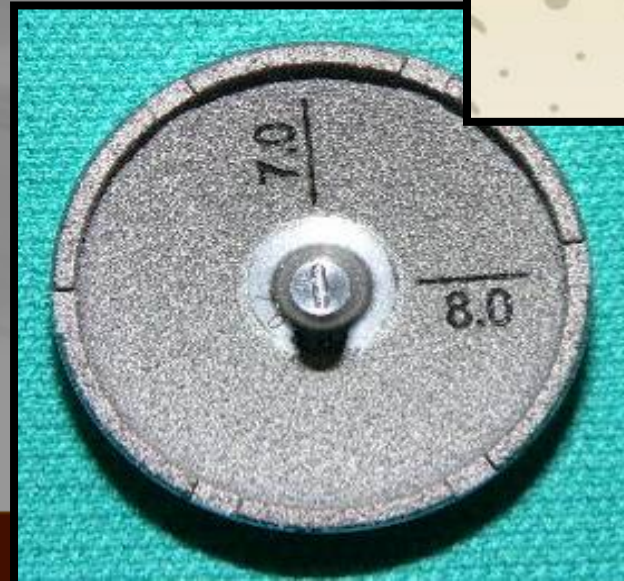
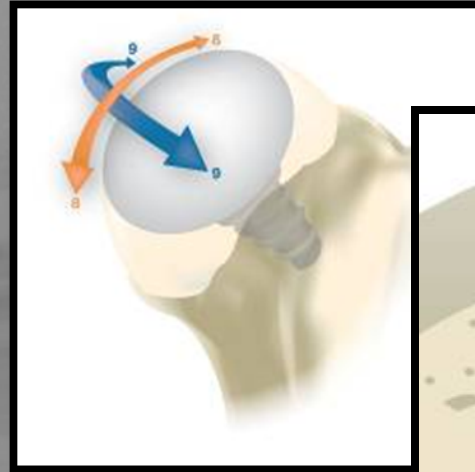
- Implants manufactured from individual patient digital data (CT or MR)
- Less bone resection than TKA
- Can preserve ligaments
- Allows greater angular and height correction
- More invasive than inlay
- Another complimentary option



Introduction of CAP

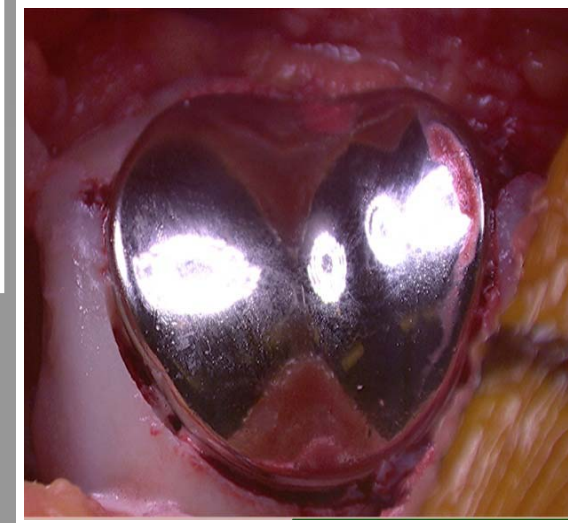
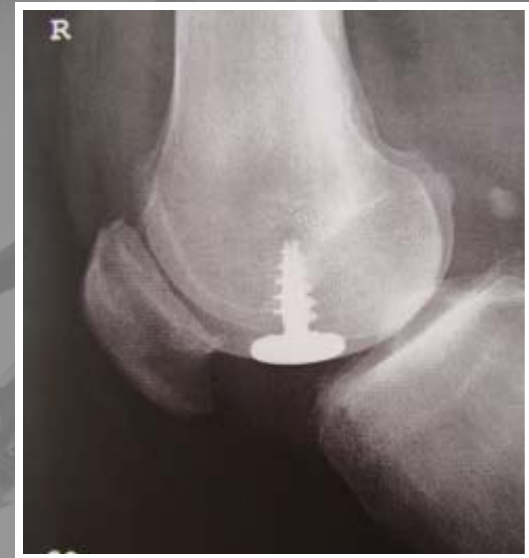
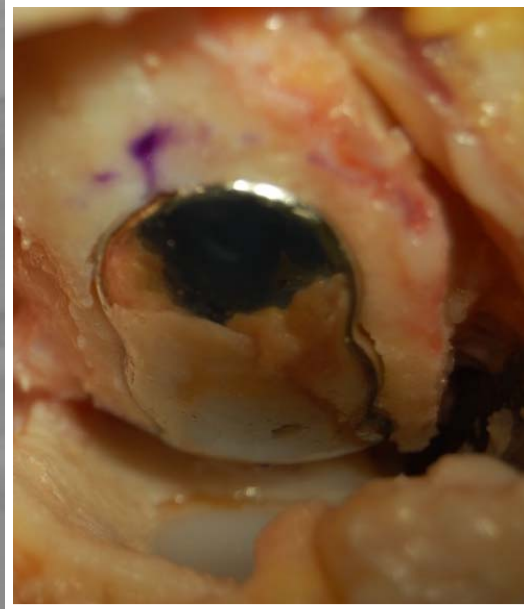
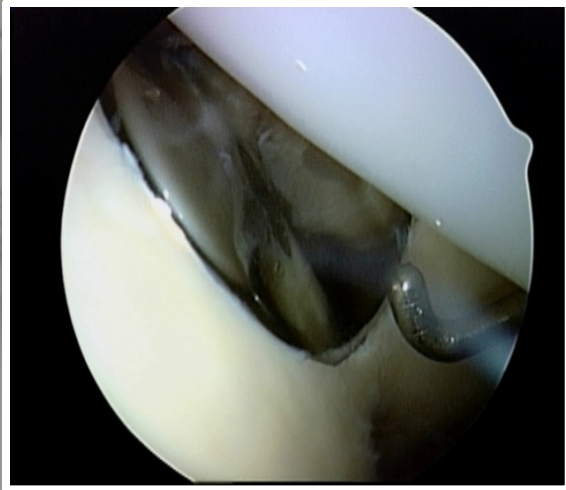
(contoured articular prosthesis)

- Geometry based on patient's native anatomy
- Intraoperative joint mapping (topo map)
- Account for complex asymmetrical geometry
- Extension of biological resurfacing

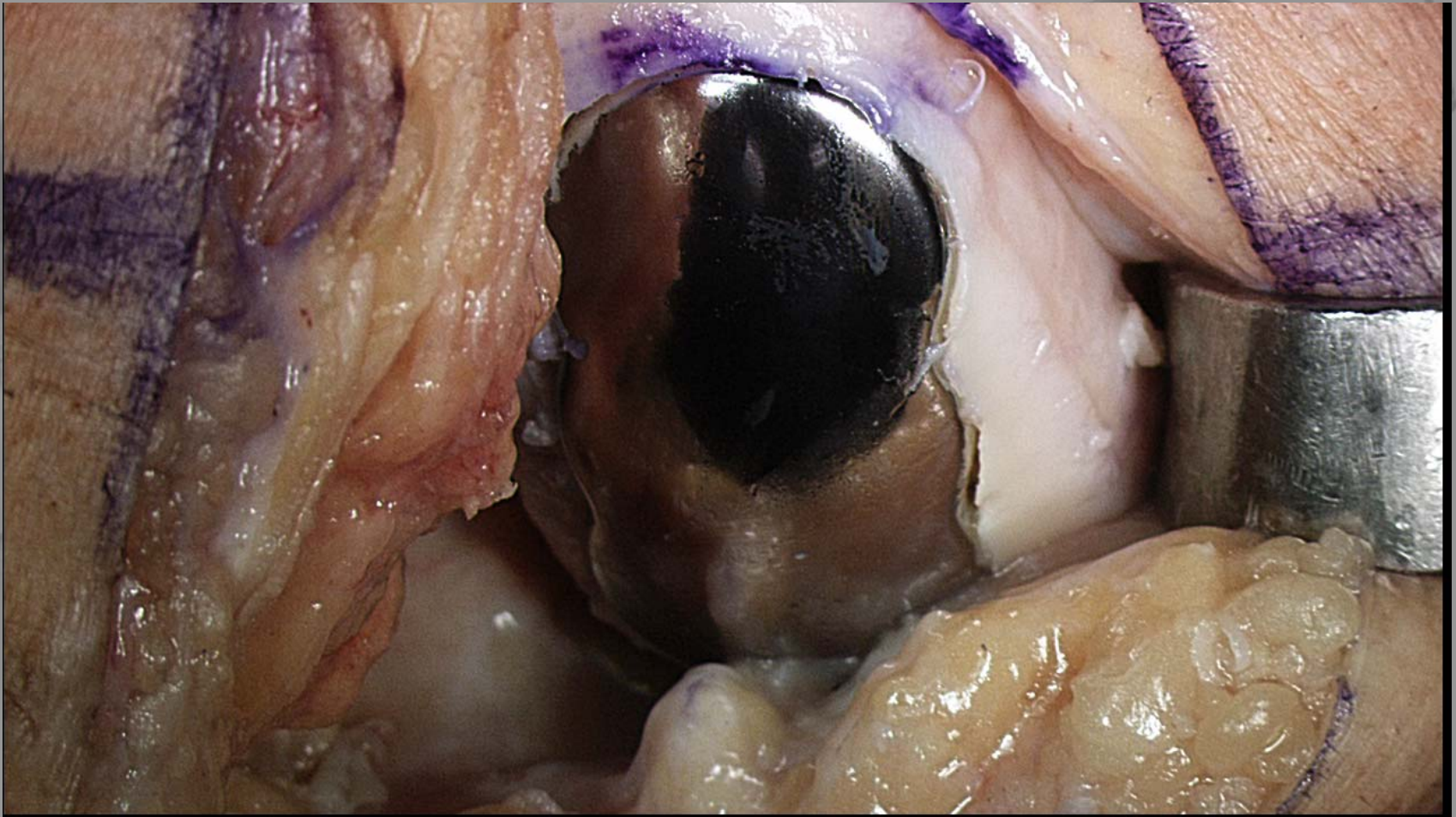


Knee Implants

- HemiCAP (unipolar knee)
 - Not currently FDA approved in US
- UniCAP
- PF HemiCAP
- PF XLT



1st question I asked:
“what about the reciprocal surfaces”

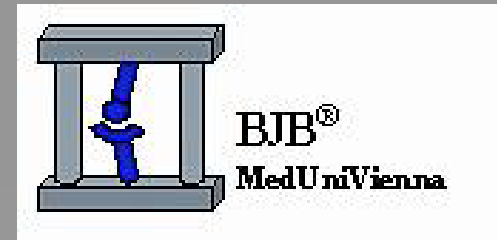


Basic Science- Contact Pressure

Tibiofemoral peak contact pressure in focal anatomic femoral resurfacing: A biomechanical study

Becher C¹, Tibesku CO¹, Fuchs-Winkelmann S¹, Thermann H², Pässler HH²

Skrbensky G, Huber R



*¹Department for Orthopaedic Surgery,
University of Marburg*

*²Center for Knee- & Foot Surgery
ATOS CLINIC, Heidelberg*

*Biomechanic and Biomaterial
Testing Laboratory
University of Vienna*

Basic Science – Contact Pressure Study of HemiCAP

- No statistically significant differences in peak contact pressure for untreated knee and flush HemiCAP[®] during the
 - dynamic knee bending cycle
 - during static testing
 - two times body weight at 30° static testing
- 90% to 217% increase in peak contact pressure for 1mm proud implant across all testing cycles
- Conclusion: Slightly recessed implantation!

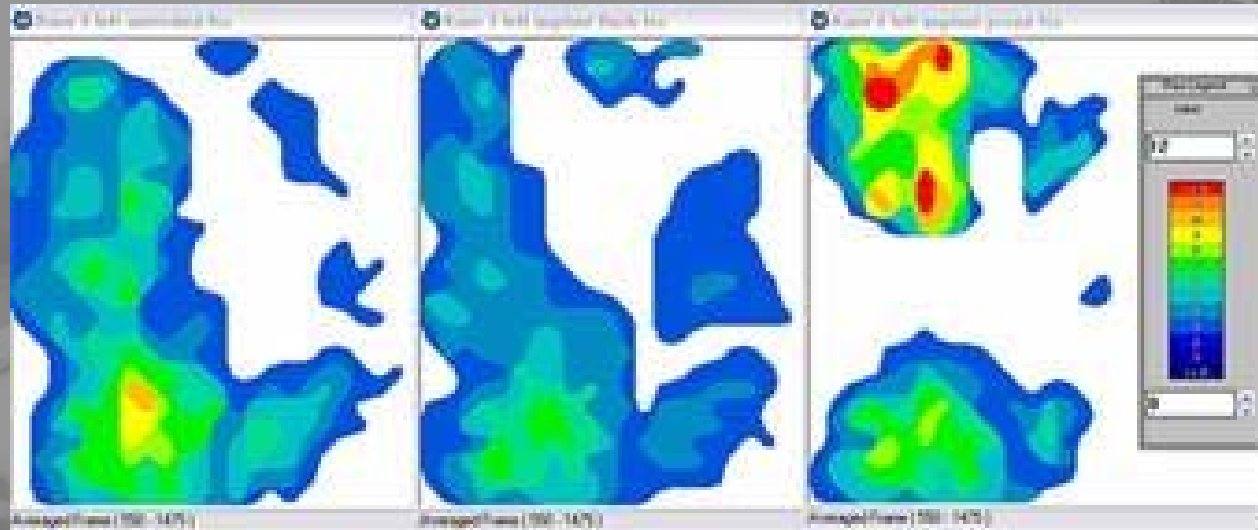
Becher C et al. Knee Surg Sports Traumatol Arthrosc. 2008 Jan;16(1):56-63



Basic Science- reciprocal surface (tibial plateau)

Anterior

Posterior



untreated knee

flush HemiCAP®

1mm proud HemiCAP®

Multiple frames summary Tekscan Sensor:

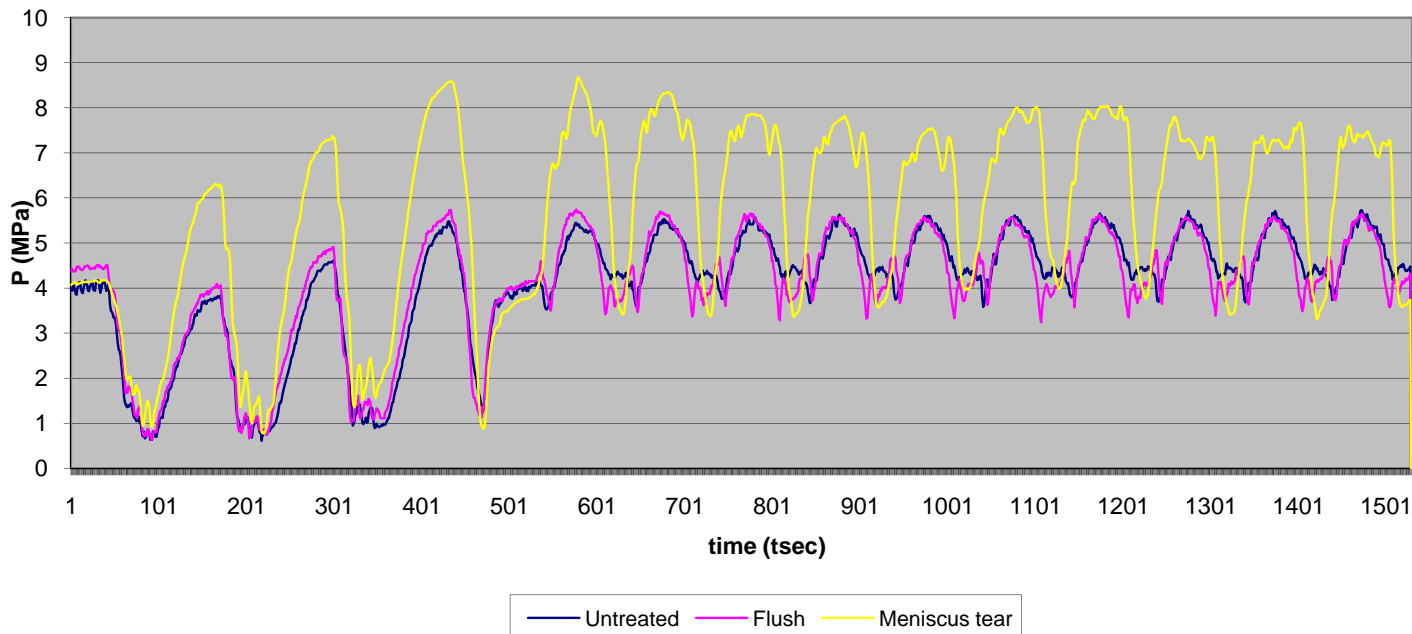
- Peak contact pressure with contact averaged over 10 dynamic cycles
- 1x body weight ground reaction force (70kg)
- Range of Motion: 5 to 45 degrees

Basic Science- Relative Loading

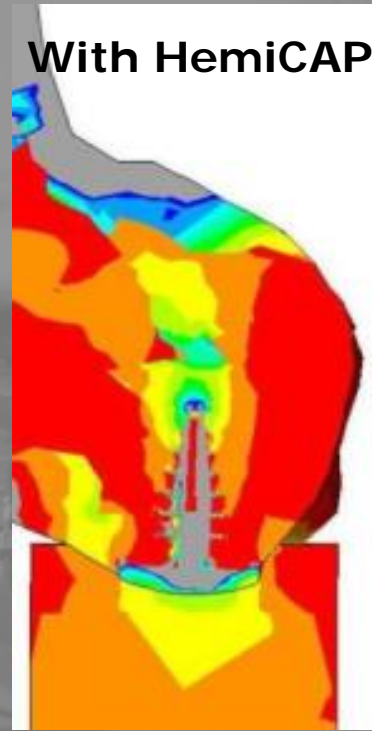
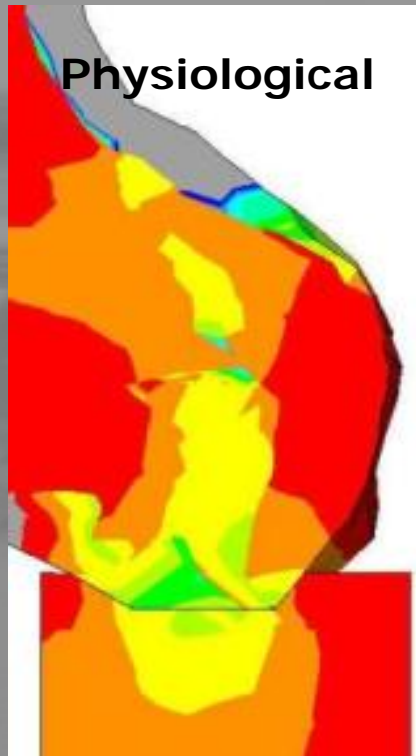
Tibiofemoral peak contact pressure with a contoured articular prosthesis and a ***complete resection of the meniscus*** (posterior horn)

- Tibiofemoral peak contact pressure:
 - Untreated and flush demonstrate matching curves.
 - Significant increase with non-functional meniscus / radial tear

Peak contact pressure



2nd question, “is the construct as stable and mechanically sound as we would theorize”?



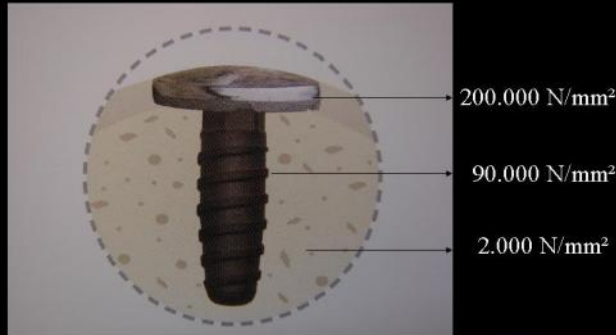
Finite Element – Analysis

v. Hasselbach, German Congress for Orthopaedics and Traumatology, Berlin 2007

- No stress shielding
- Effective load transmission into underlying bone

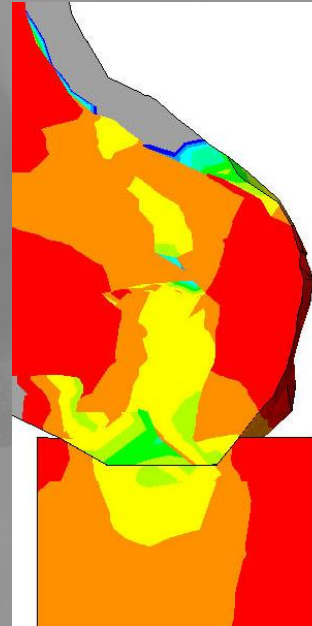
Finite Element - Analysis

E-Module Hemi CAP

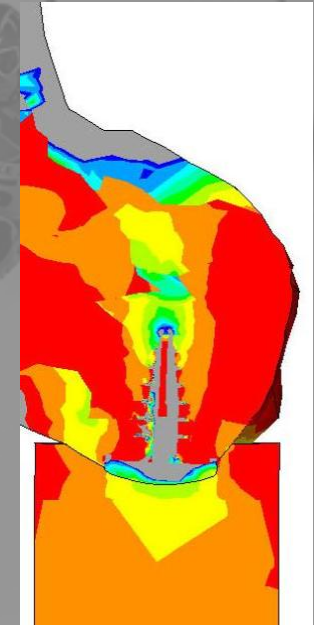


v. Hass.

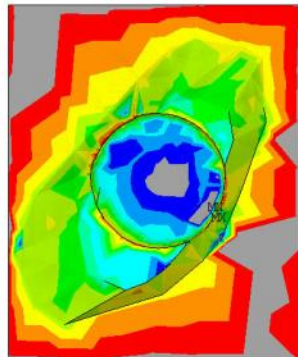
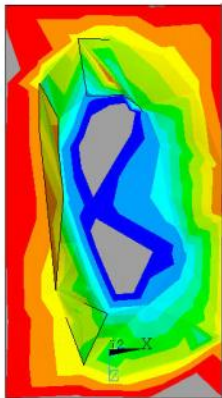
Physiological



With HemiCAP



ANSYS 10.0
APR 30 2007
14:22:52
PLOT NO. 1
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
S3 (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.237666
SMN =-.25243
SMX =.074683
-.18
-.16
-.14
-.12
-.1
-.08
-.06
-.04
-.02
0



Conclusion:

- No stress shielding
 - only 10-14% of articular surface coverage
- Effective load transmission into underlying bone

Focal Anatomic Resurfacing of the Femoral Condyle: 1 and 2 year Multicenter Results

***John Uribe MD¹, Anthony Schepsis MD², Annunziato Amendola MD³,
Joshua Siegel MD⁴, Frederick Flandry MD⁵, John Zvijac MD², Bryan Kelly MD⁶,
Robert Buonnano MD⁷, David Moss MD⁷, Robert Litchfield MD⁸, Marc Froimson MD⁹,
Richard Parker MD⁹, Wael Barsoum MD⁹, Anthony Miniaci MD⁹***

*1 UHZ Sports Medicine Institute - 2 Boston University Medical Center, Boston, MA , University of Miami,
Miami, FL -*

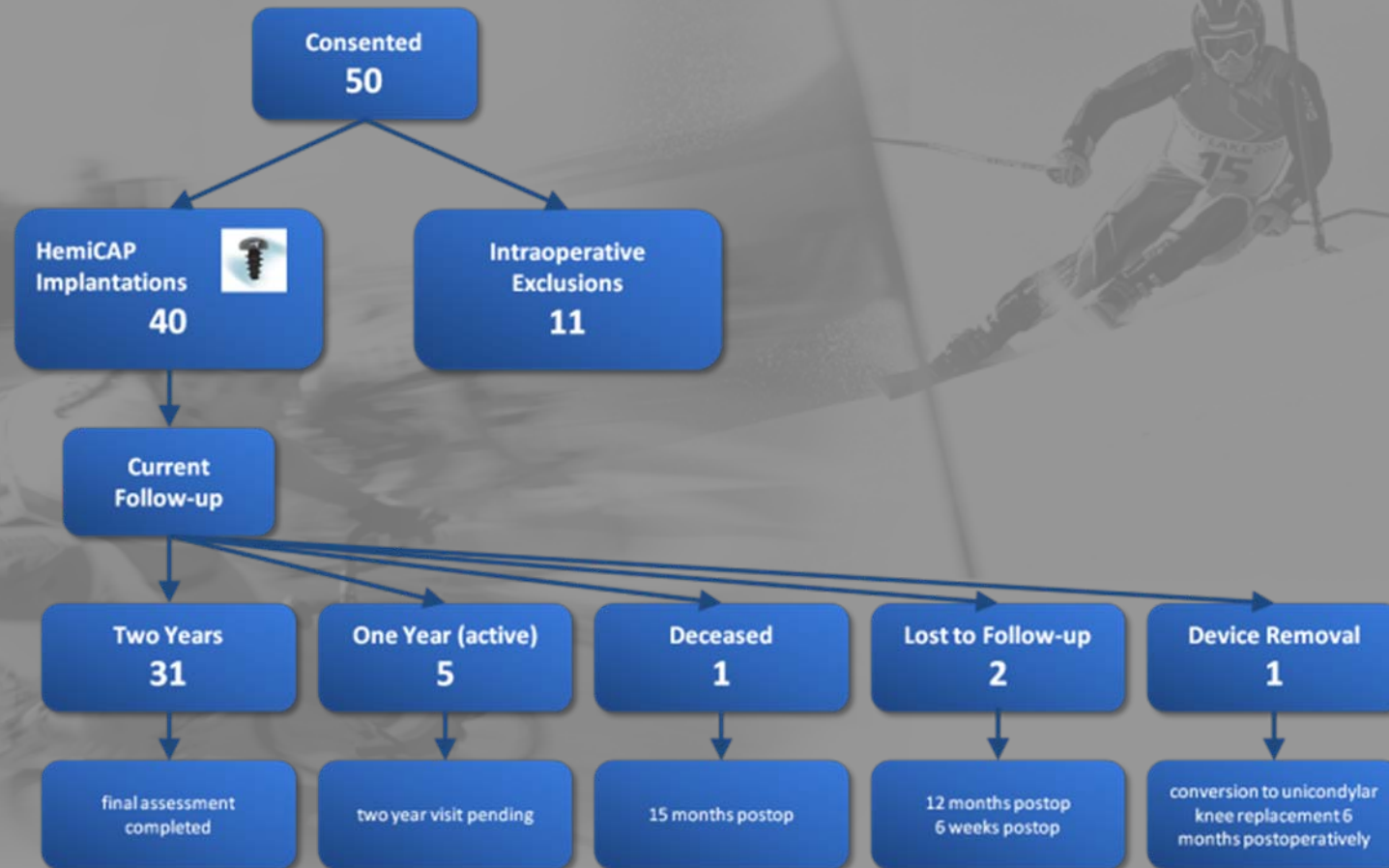
*3 University of Iowa, Iowa City, IA – 4 Access Sports Medicine & Orthopaedics, Exeter, NH – 5 Hughston
Clinic, Columbus, GA –*

*6 Hospital for Special Surgery, New York, NY – 7 Center for Orthopaedics, Johnston, RI – 8 Fowler Kennedy
Sports Medicine Clinic, University of Western Ontario, London, ON – 9 Cleveland Clinic, Cleveland,
OH*



Clinical Results- US FDA HemiCAP trial

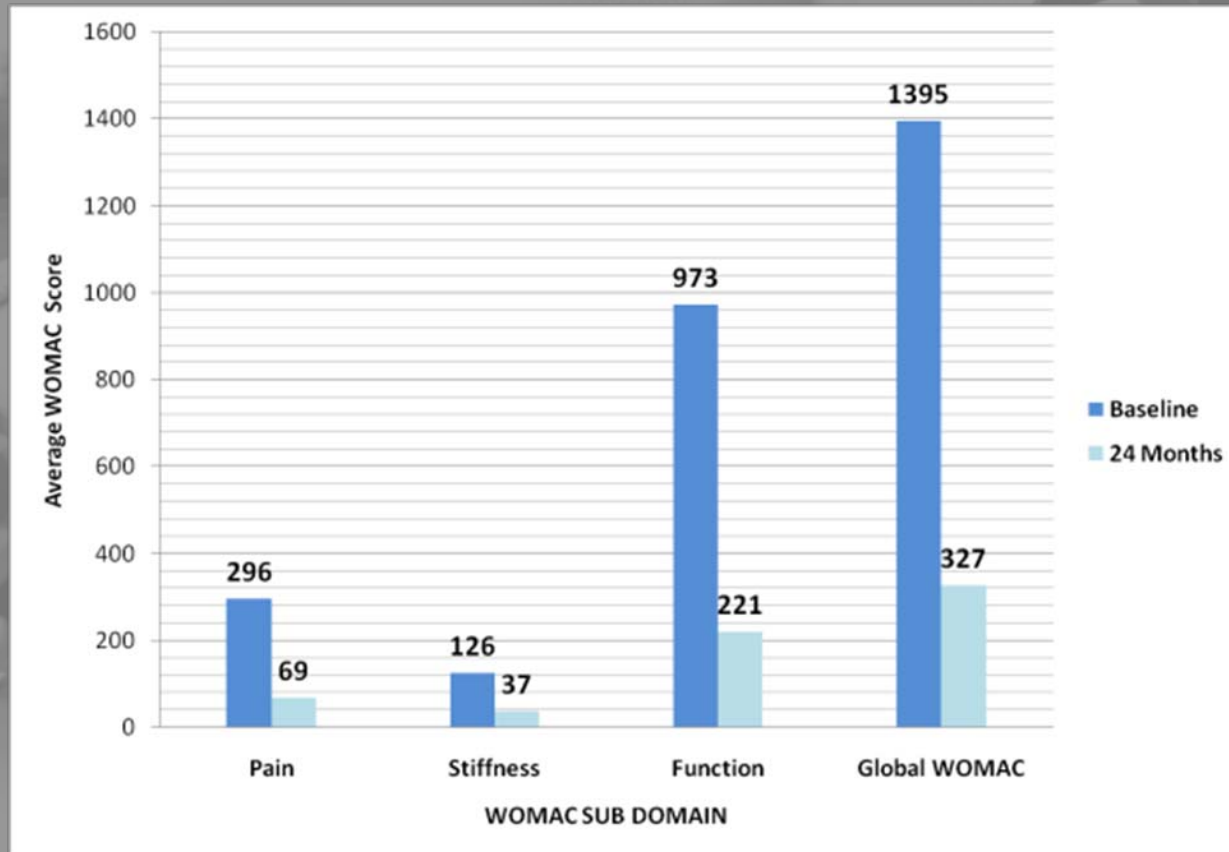
US Multicenter Study: Study Population and Current Follow-up



Clinical Results

US Multicenter Study (N=31)

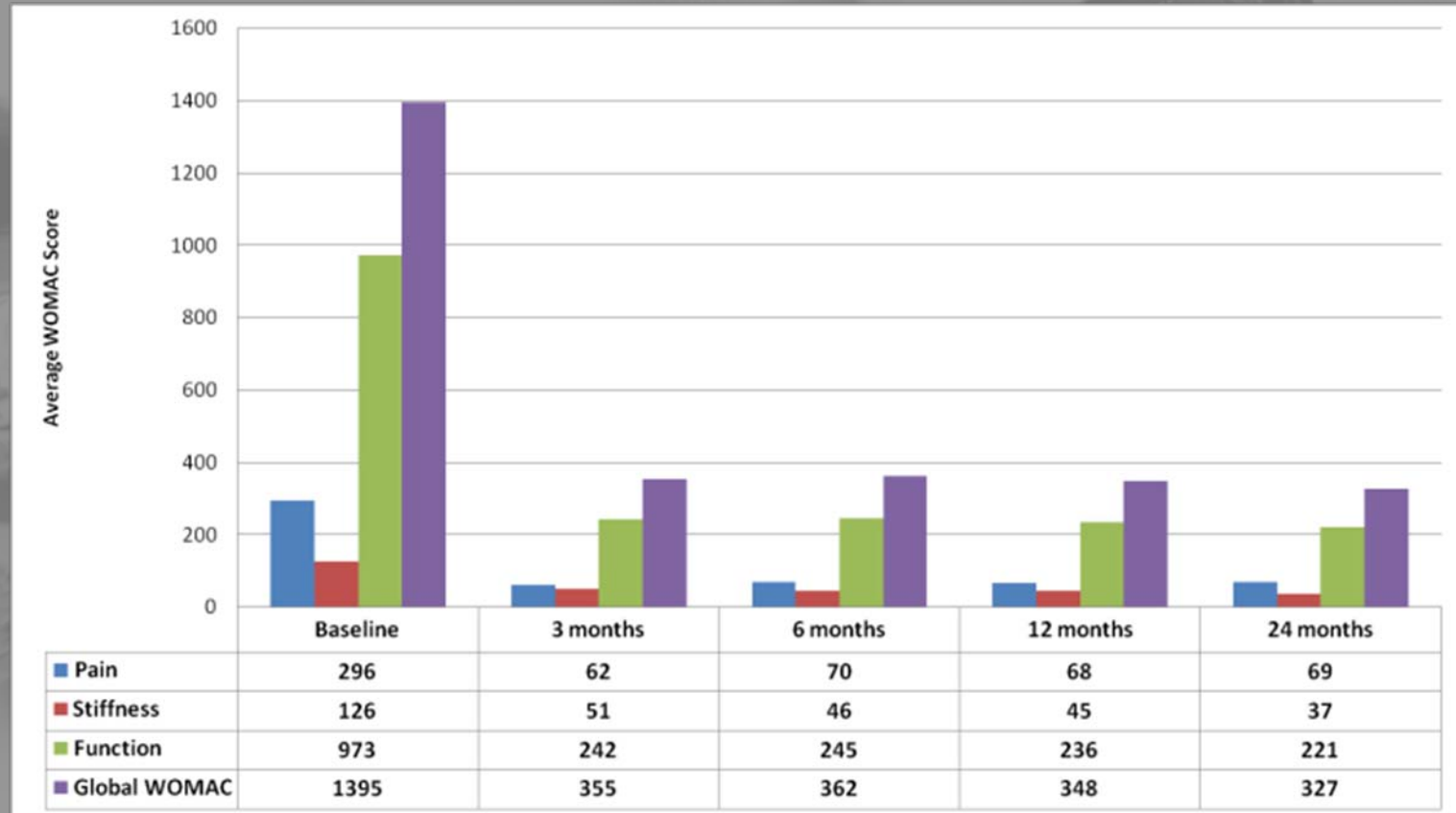
- Average WOMAC Domain Score Comparison: 24 mo to baseline



Clinical Results

US Multicenter Study (N=31)

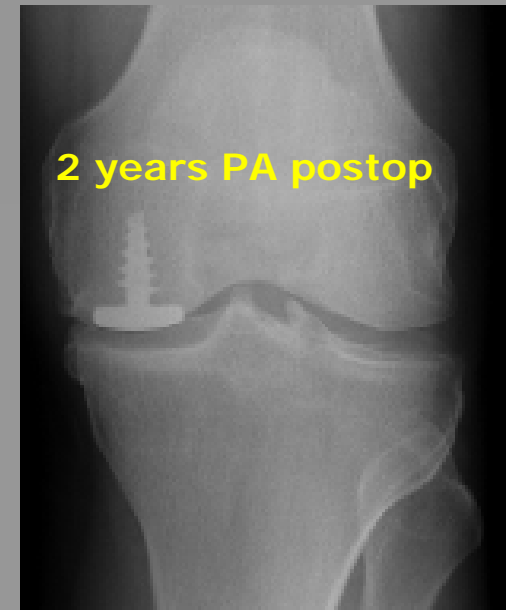
- Average WOMAC Domain Score Comparison per Time Point



Clinical Results

2 Year Radiographic Evaluation:

- **No evidence** in any patient at any time point for:
 - Progression of peri-prosthetic radiolucency
 - Device migration/subsidence into the bone
 - Disassembly of the CAP and screw
 - Joint space narrowing
 - Peri-prosthetic cyst formation



Clinical Results (HemiCAP for Femoral Condyle)

C. v. Hasselbach, Essen, Presented at German Congress
for Orthopaedics and Traumatology, Berlin 2007

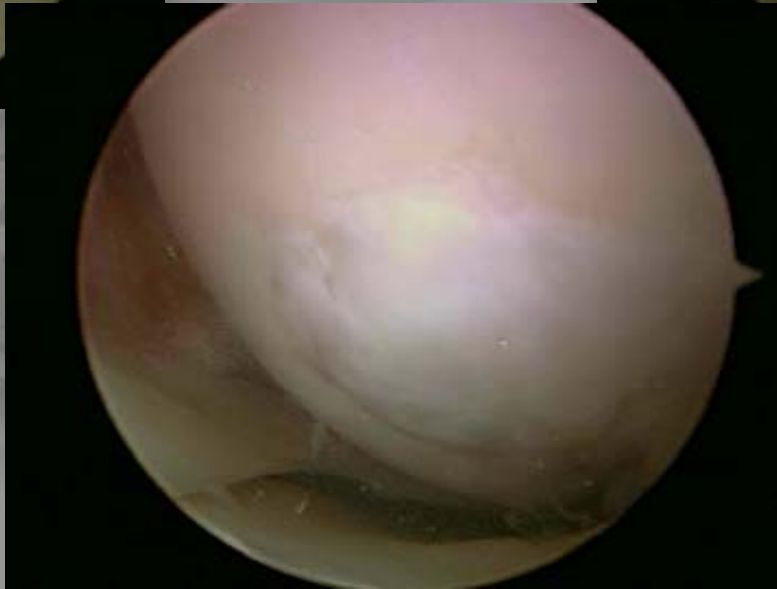
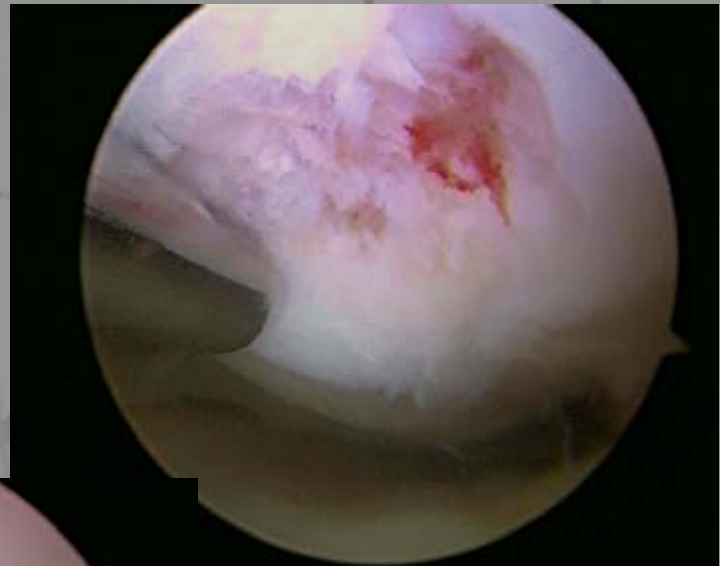
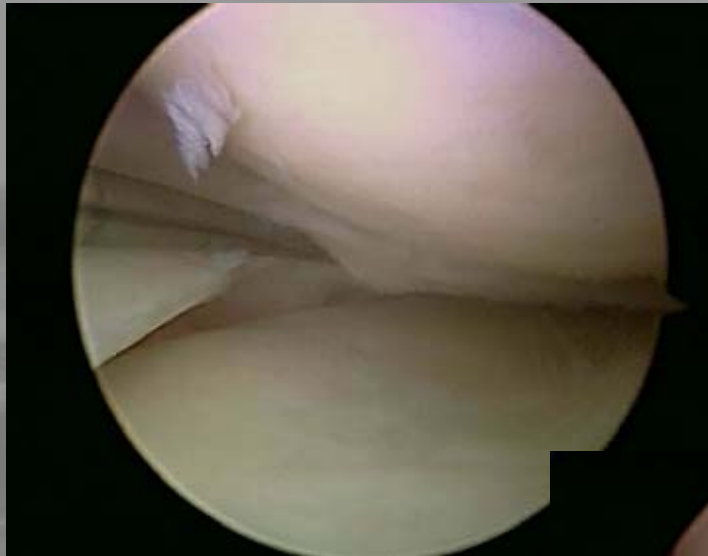
- Patient Population: N = 121
- Follow-up: Mean 14 months (1-25)
- Patient Age: Mean 52,5 years (34-67)
- Gender: Female N = 13 (29,5%), Male N = 31 (70,5%)
- Previous Cartilage Procedures: Mean N= 2.3 (0-6)
- Procedure Duration: 24 minutes
- Postoperative Recovery until Return to Work: Mean 35.3 days (15-82)
- HSS Knee Scores improved from 85.2 preop to 95.3 postop
- 17 Re-look Arthroscopies: Contoured Implant Integration, No Deleterious Cartilage Effects
- Radiographic Examination: No peri-Prosthetic Radiolucency, or Implant Subsidence

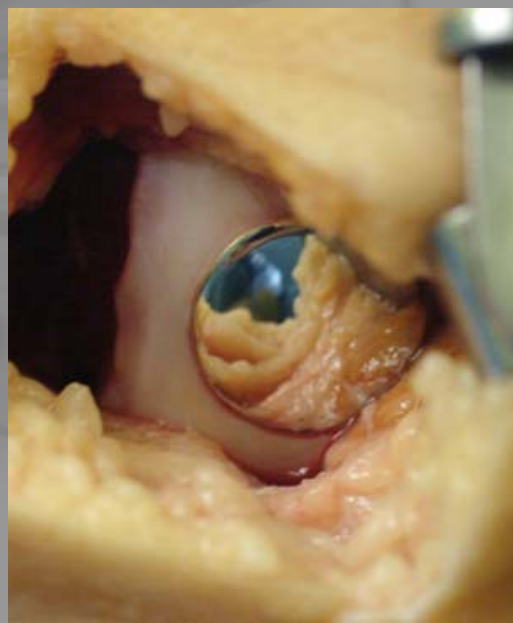
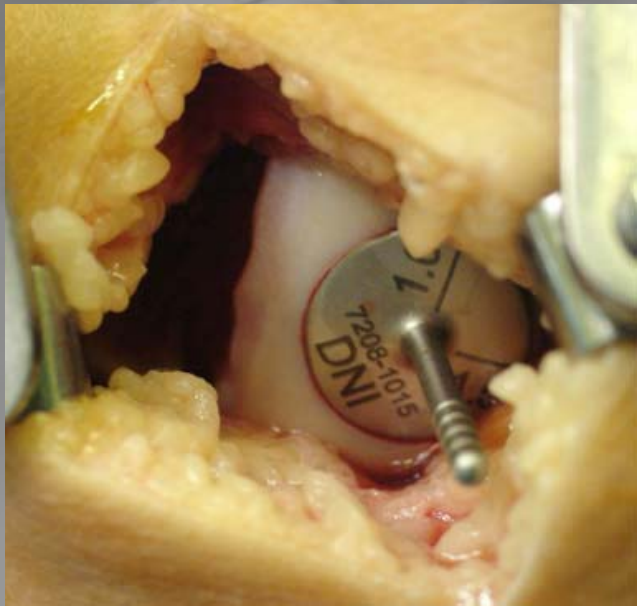
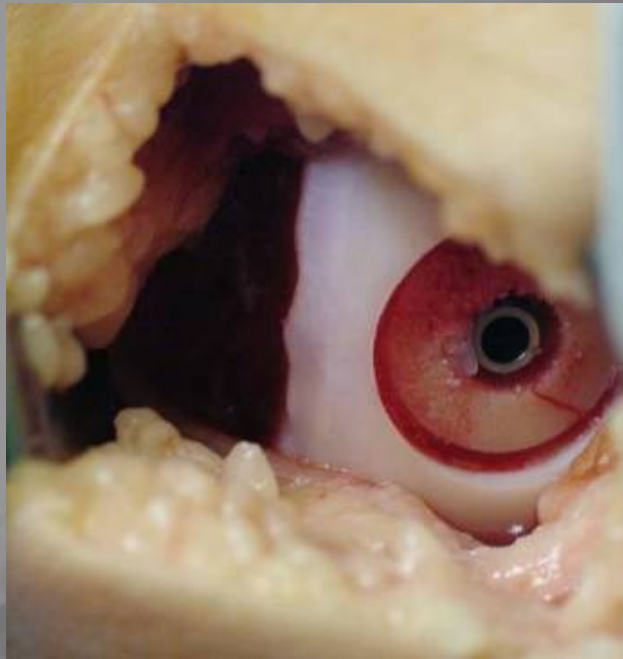
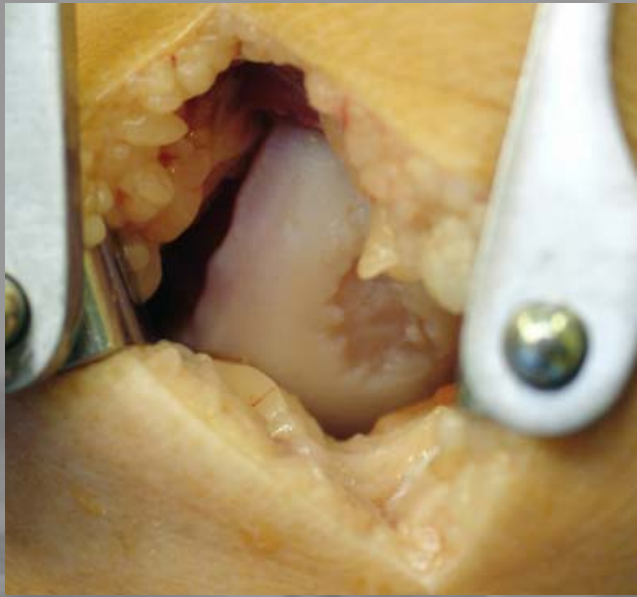


Clinical Results - Australian National Knee Registry

- HemiCAP[®] Resurfacing of Femur (initial experience)
- N=90 implants in 81 patients reported over the course of 4 years up until 12/31/07
- Observed component years: 107 (~mean follow-up around 1 year)
- Male = Female
- 8 revisions
 - progression of disease (N=4) and
 - Continued pain (N=4)
 - 5/8 revised to unicondylar knee; 3/8 to TKA

Case Presentation: 41 year old male –
2 yrs post MFX for medial pain, worsening with time



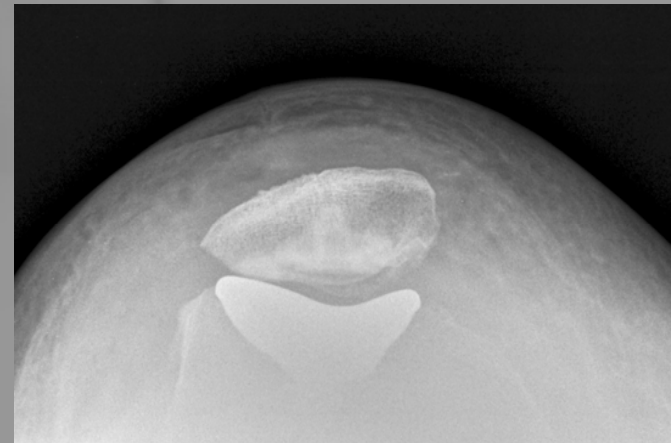


Arthrosurface P-F Inlay Prosthesis



PF- PROSTHETIC RESURFACING

- Vast difference between traditional PFA and Inlay
- Traditional prostheses limited success and rarely used
- Inlay device allows for concurrent re-alignment
- Inlay device for younger patients
- Excellent new solution for vexing problem



Trochlear Implants

Variety of Geometry



Patellar Implants

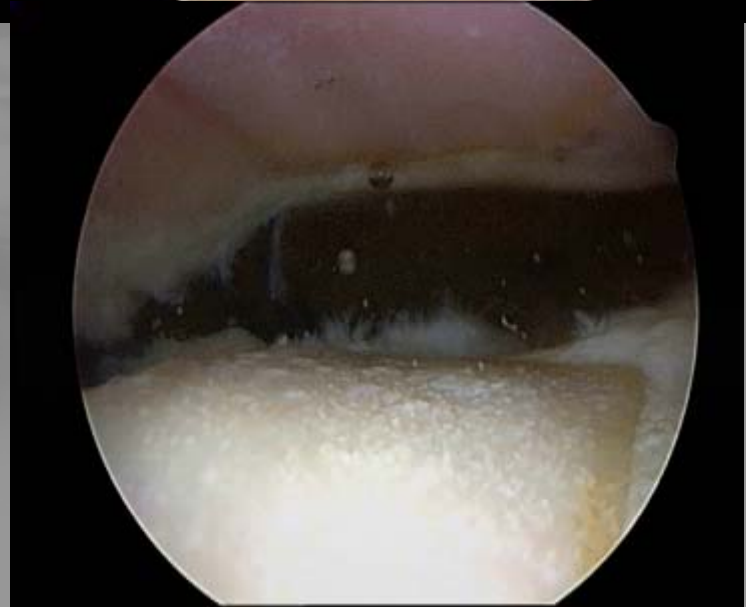
Variety of Sizes/Shapes, Cemented



Case Report

#1

- 41 year old female
- 2 prior knee surgeries
- Anterior knee pain
- Former “hard core” athlete
- Could not even walk with kids



Case #1

(healthy medial and lateral)



Surgical Exposure

1st - Arthroscopic Lateral Release



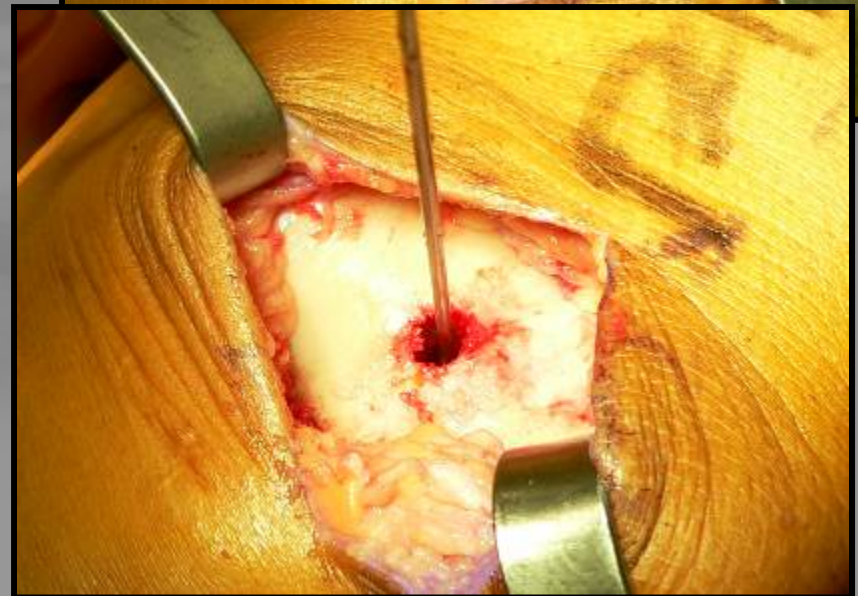
Surgical Exposure

Either MIS medial incision (or midline)

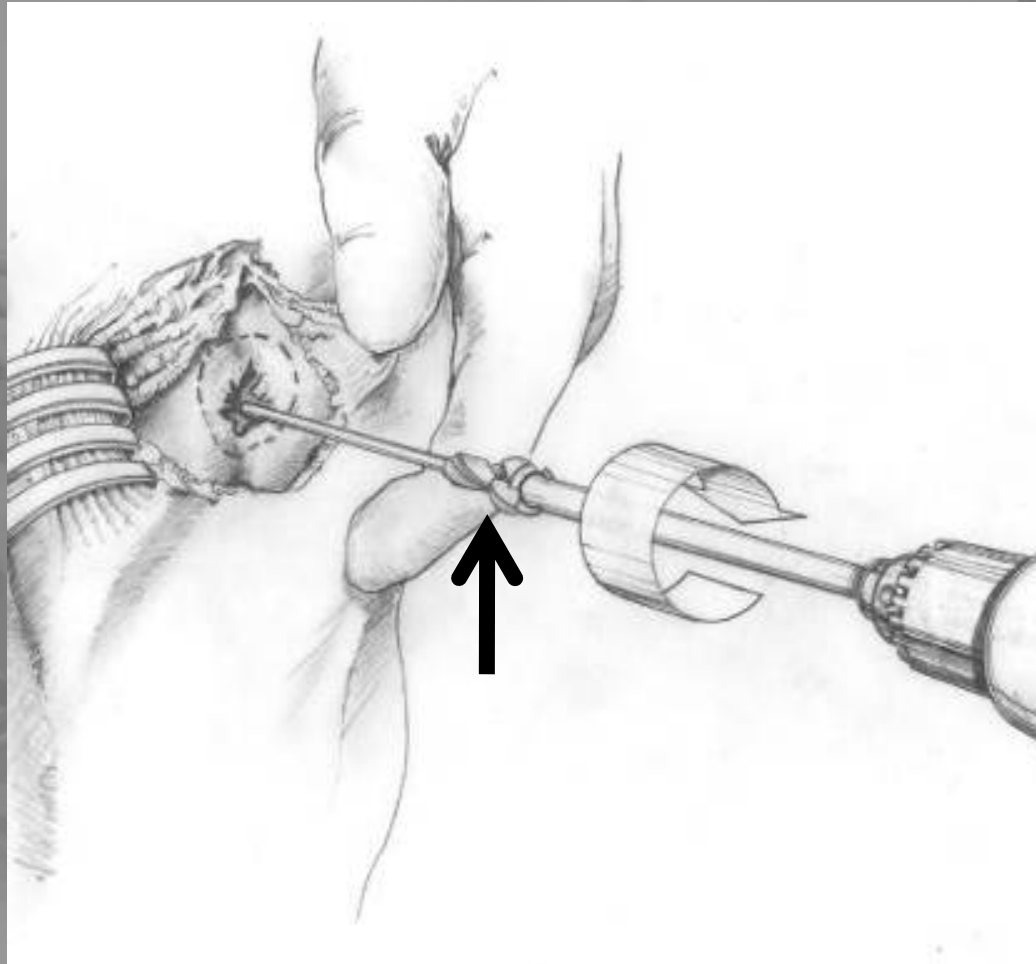


Technique –

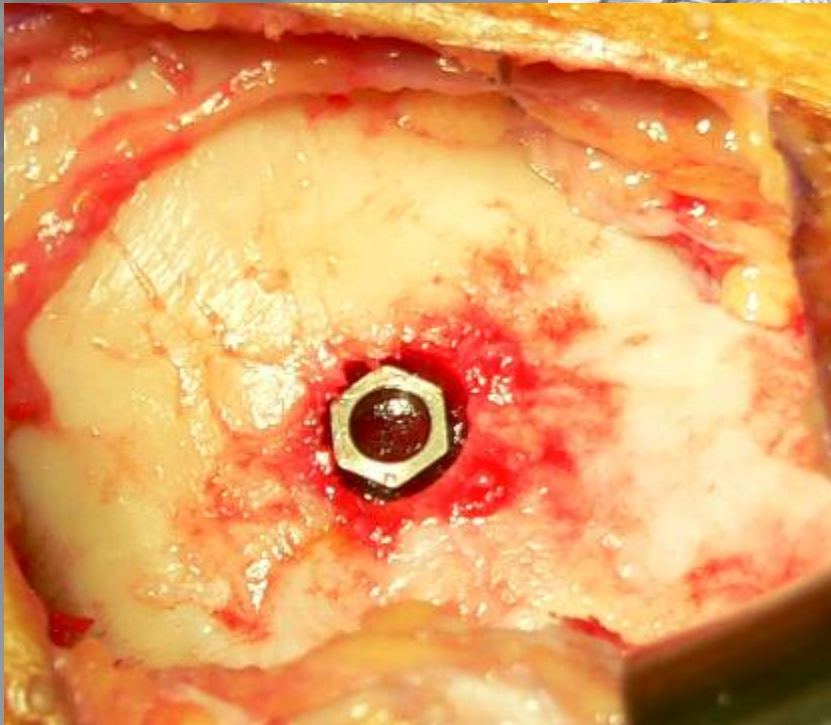
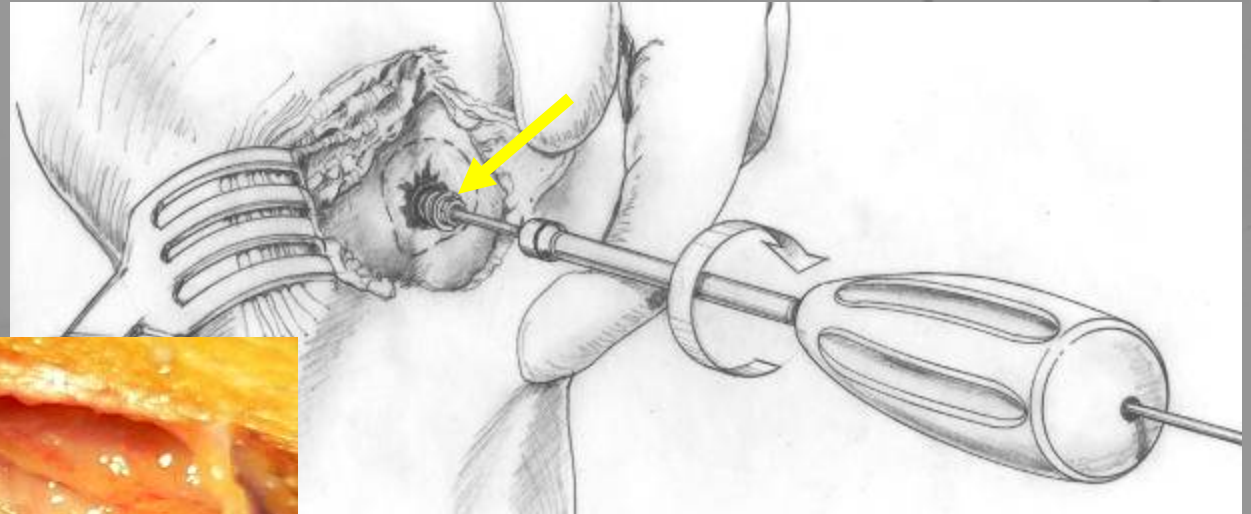
- Guidewire key to cannulated system
- **Perpendicular placement**
 - Careful attention to this!!



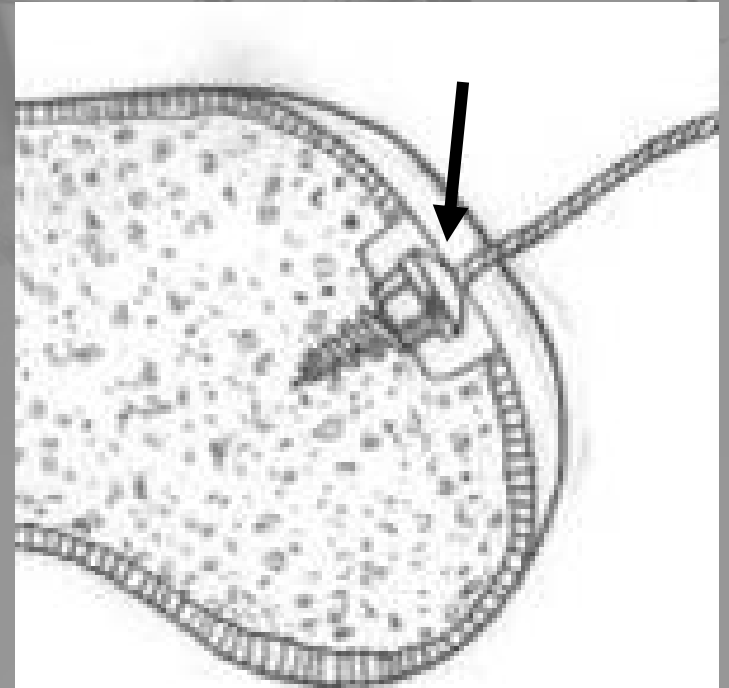
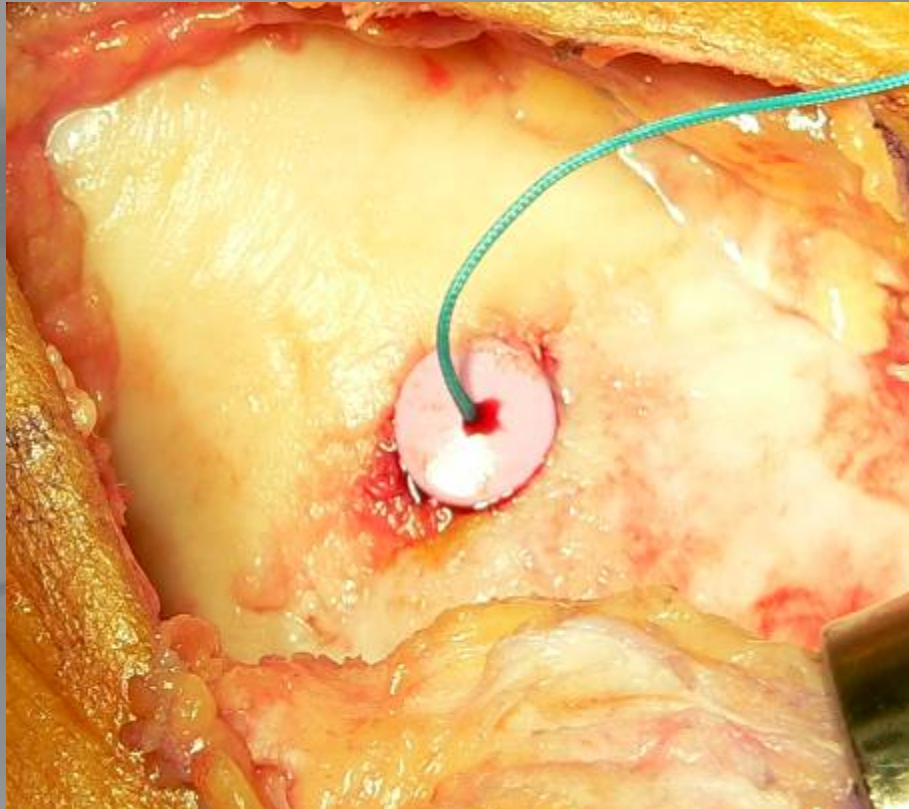
Technique- Drill for set screw (no plunge)



Insert set screw (not too deep!)



Height measuring cap



Articular Mapping

... if measured values NOT on chart, must consider WHY

arthrosurface®
Patello-Femoral
Femoral Component

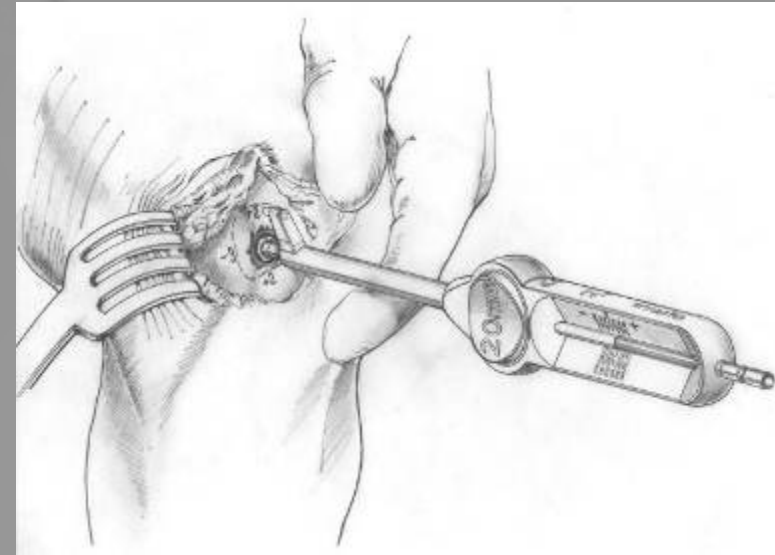
Fill in all 4 circles

Sizing Card

- Maximum SI Minimum ML
- Select HemiCAP® offset values

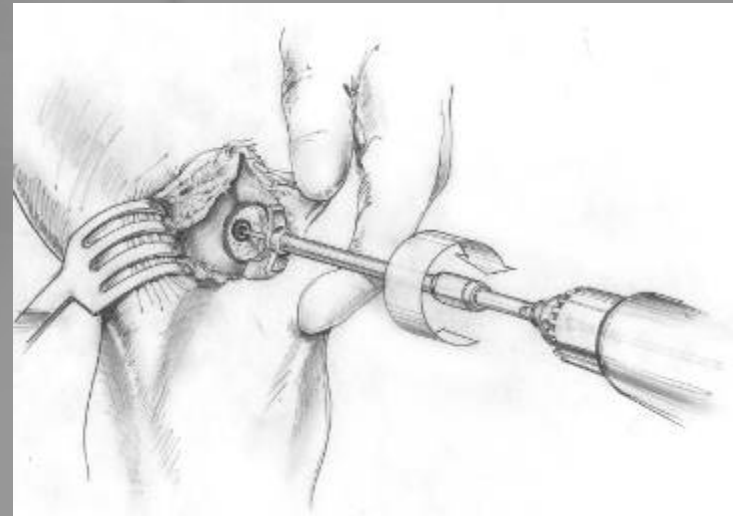
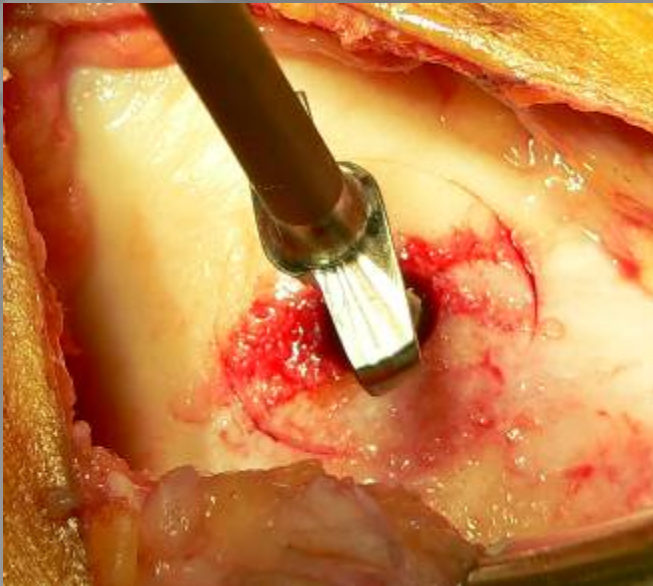
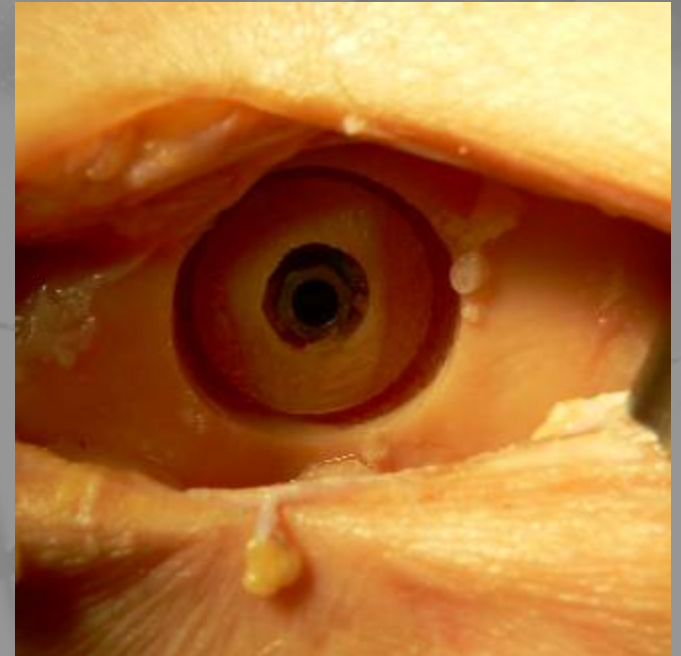
S/I	M/L
2.0 mm	2.0 mm
2.0 mm	2.5 mm
2.0 mm	3.0 mm
2.5 mm	2.0 mm
2.5 mm	2.5 mm
2.5 mm	3.0 mm
3.0 mm	2.0 mm
3.0 mm	2.5 mm
3.0 mm	3.0 mm
3.0 mm	3.5 mm
3.5 mm	2.0 mm
3.5 mm	2.5 mm
3.5 mm	3.0 mm
- Select Surface Reamer size
Choose the Surface Reamer that matches the SI (+) offset value. Confirm with the color code on the HemiCAP® articular component package.

RW 2003-1120-Rev C

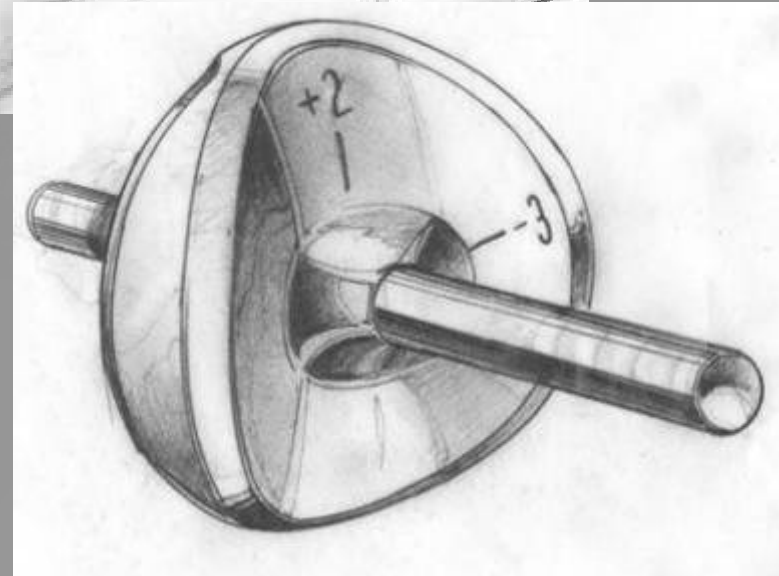
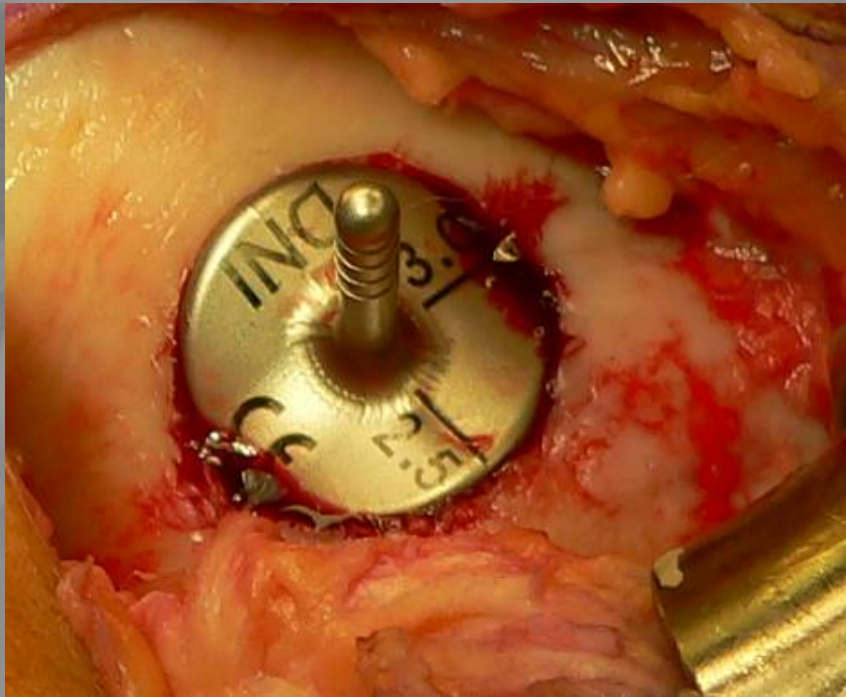
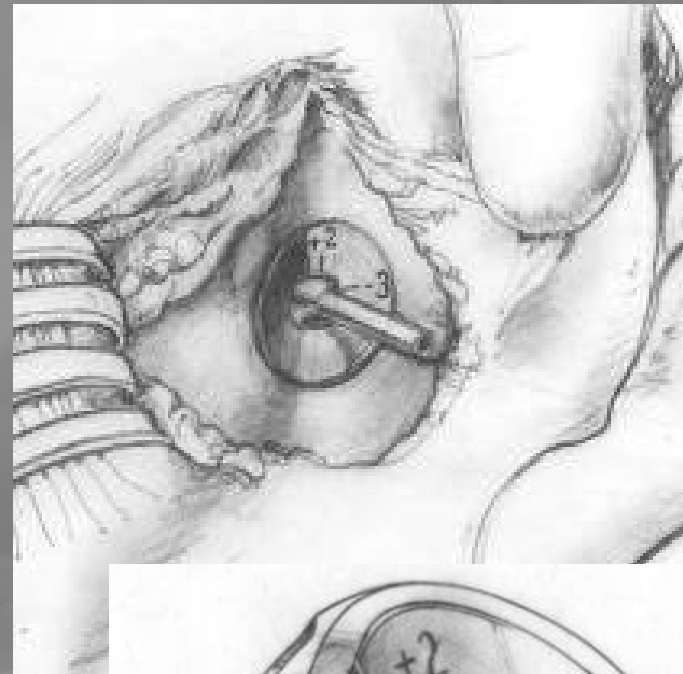


Drilling for implant

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

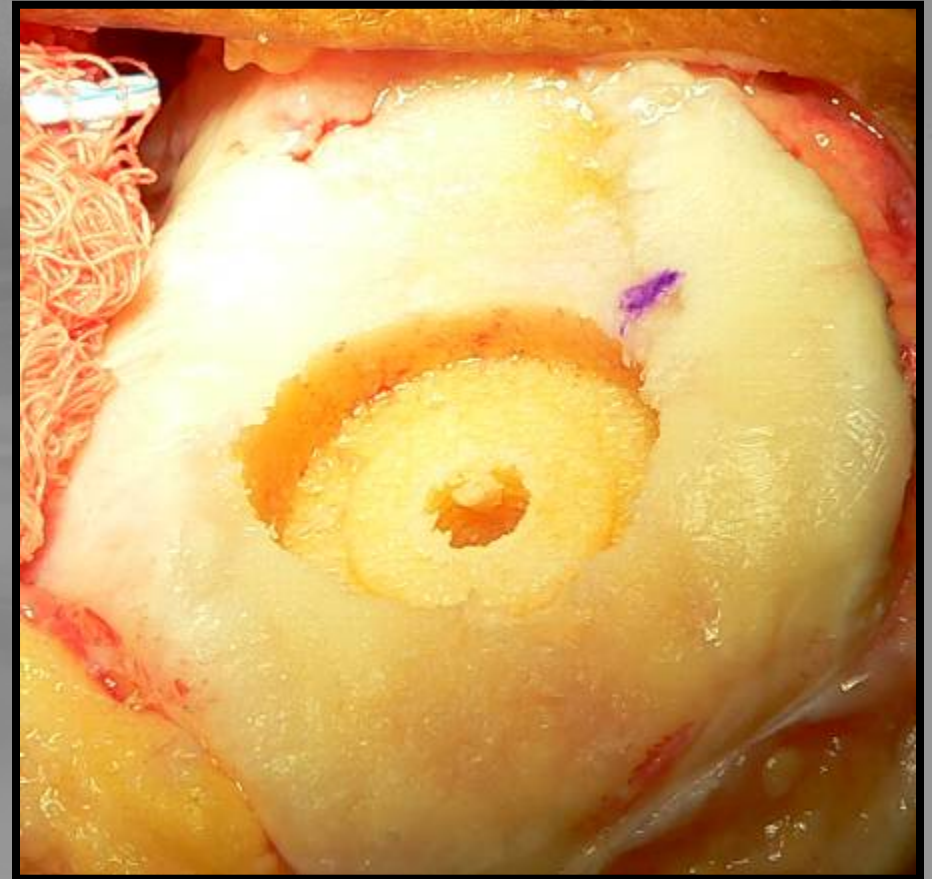
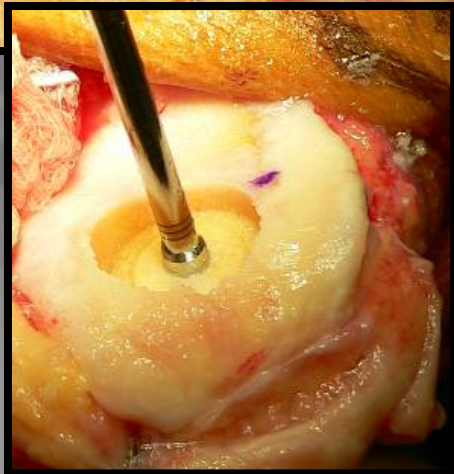


Device Trial – can adjust/mark rotation

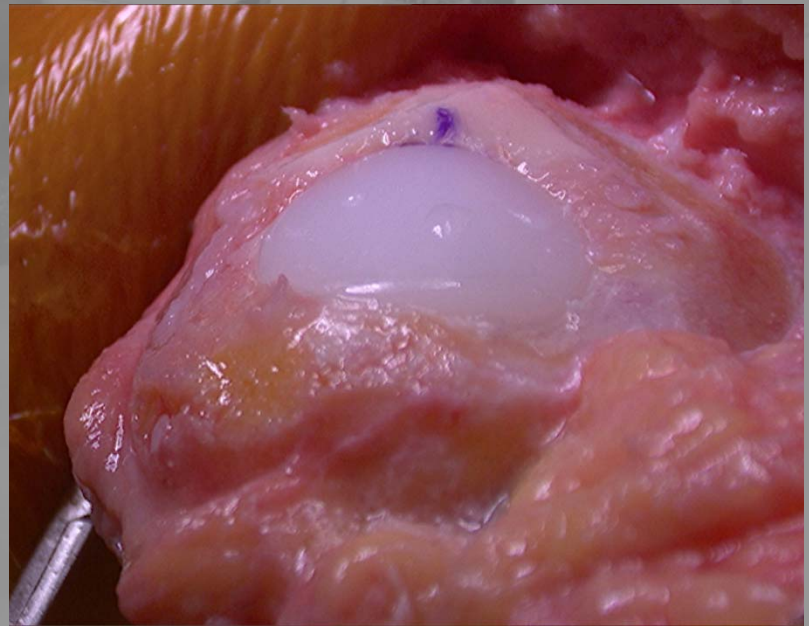
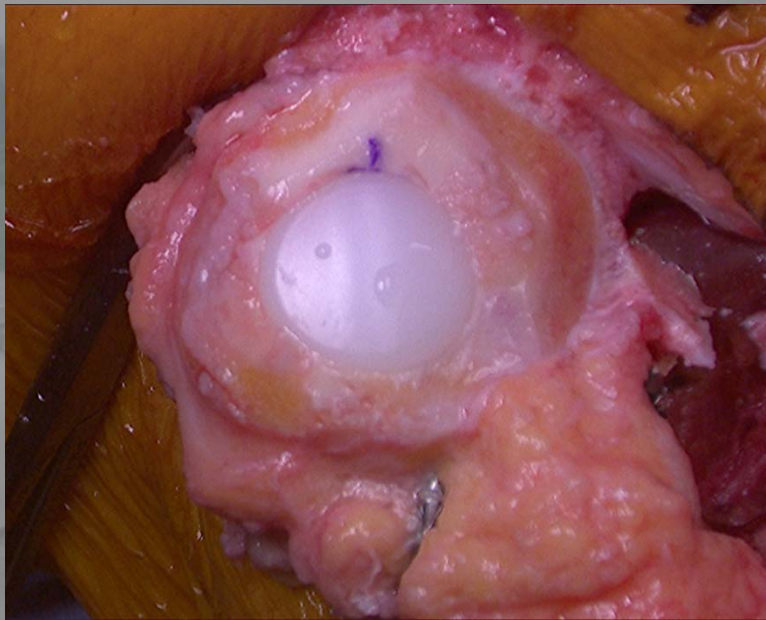


Patellar Preparation

basically need patella “deep enough”

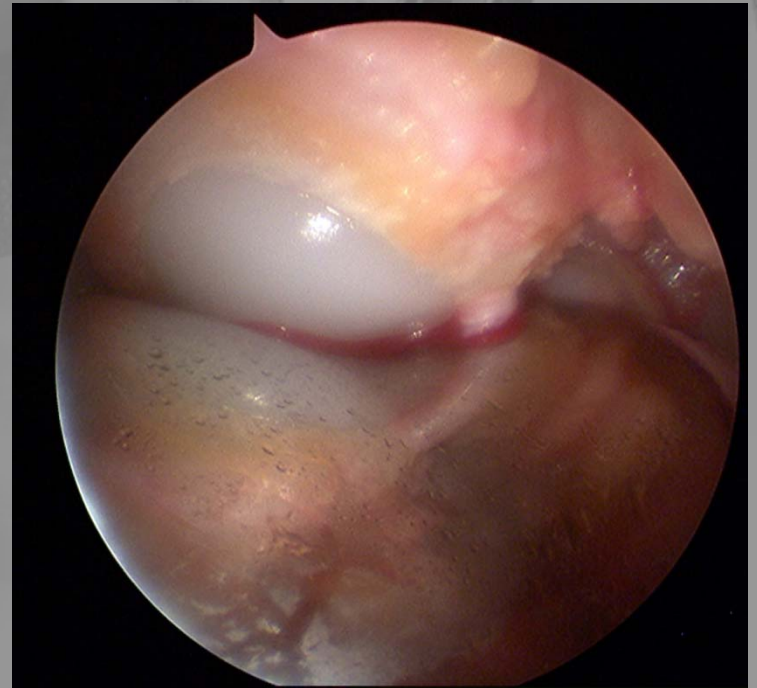
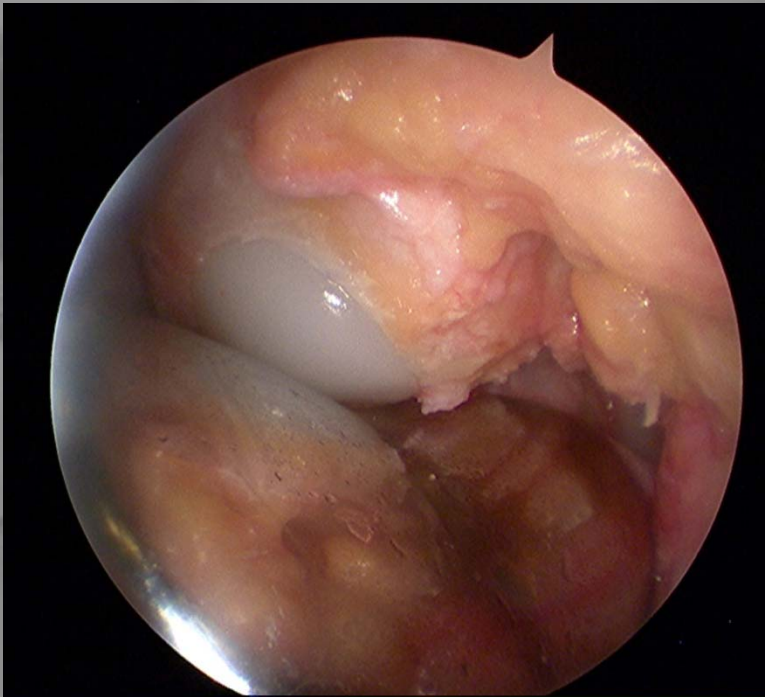


Patella in place

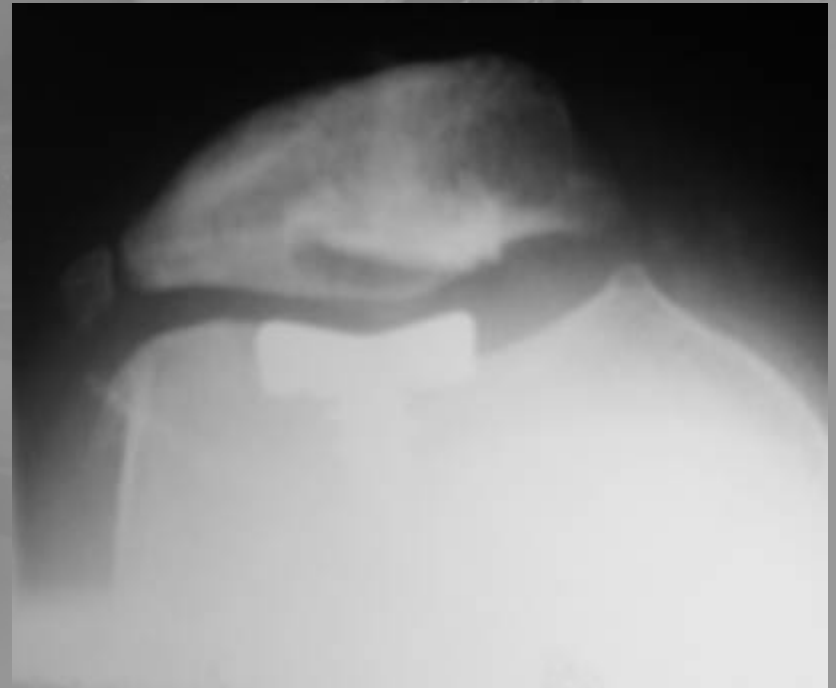
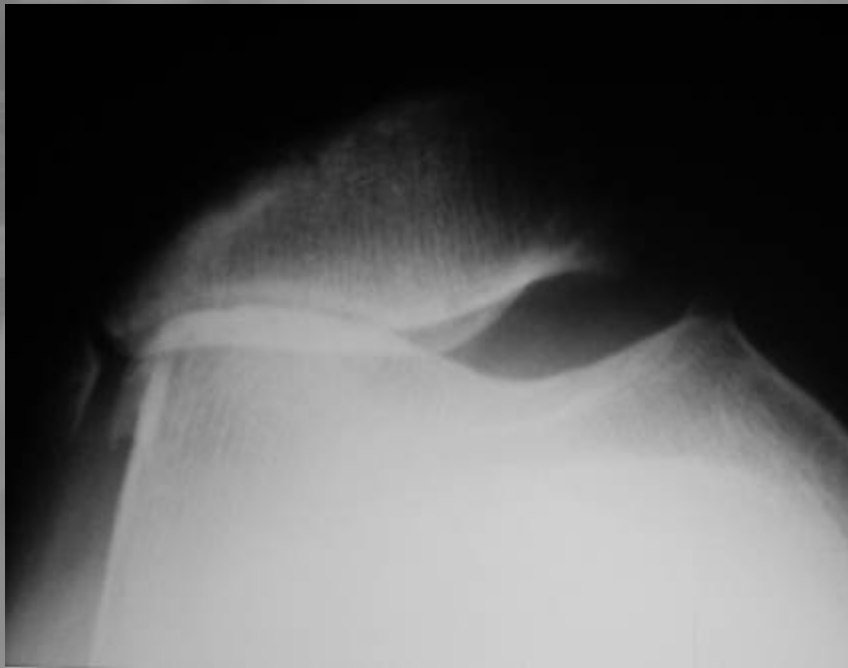


Patella- Trochlea alignment

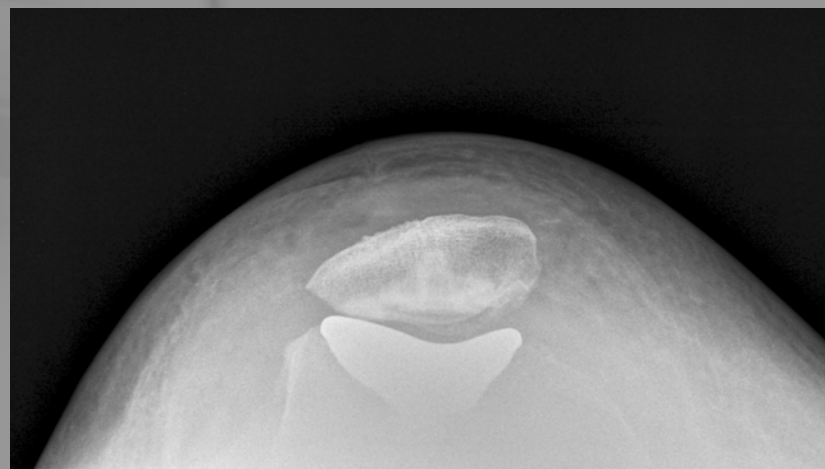
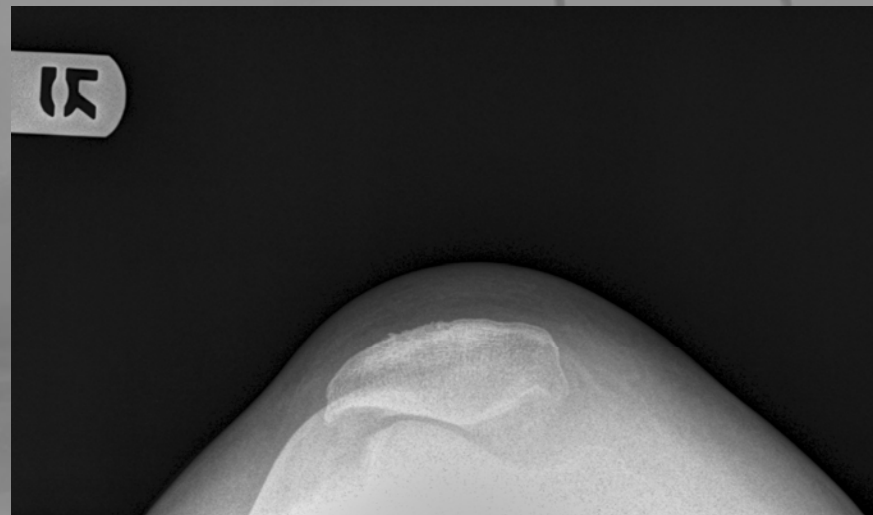
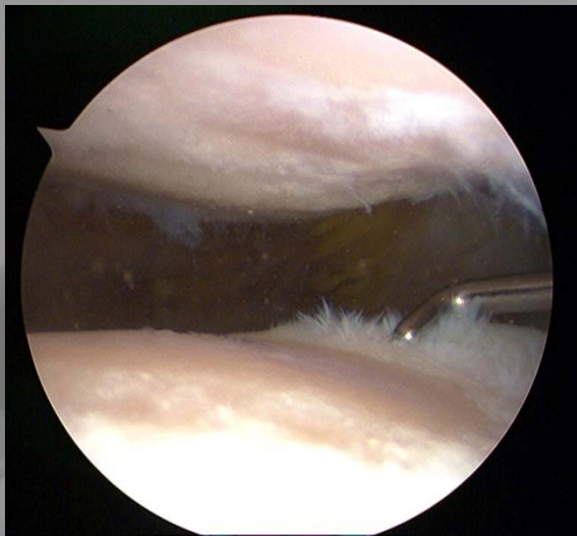
Key step- want (need) Patella directly over FTG
cannot have poly on cartilage/bone



Radiographs pre and post

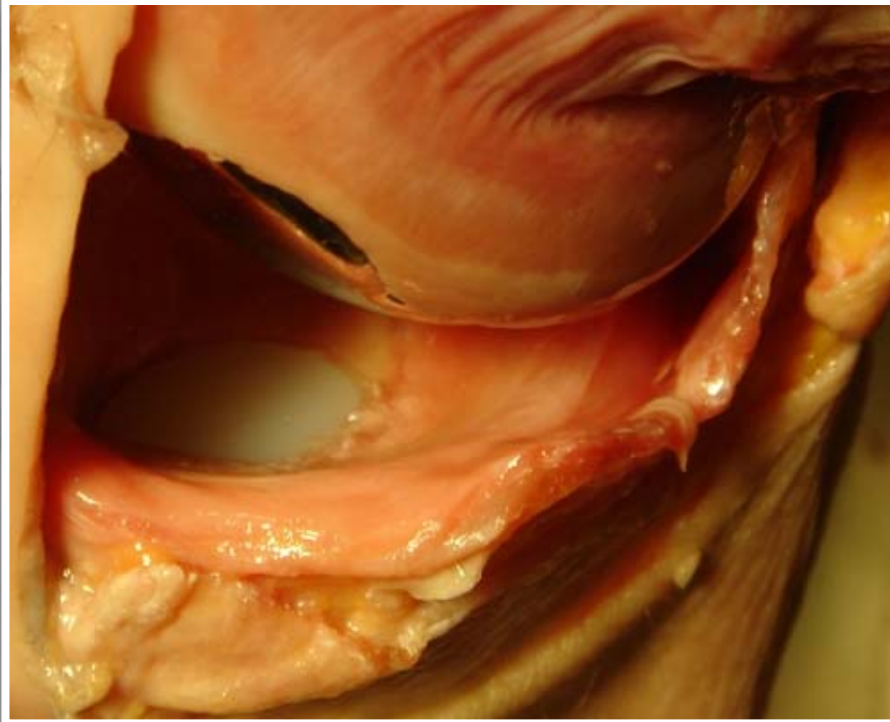


PF Resurfacing – Before and After



UniCAP™

aka... inlay arthroplasty, scope assisted Uni, AKR , etc..



UniCAP Advantages

- UniCAP may prevent patello-femoral complications/encroachment of conventional UKA through inlay resurfacing
- Revision to standard UKA may be possible due to shallow implant bed resurfacing technique
 - UniCAP avoids L-cut
 - Ample room for ACL, osteotomy, soft tissue procedures
- UniCAP limitations are at the same time its advantages:
 - Meniscal sparing technology for patients with healthy, functional meniscus

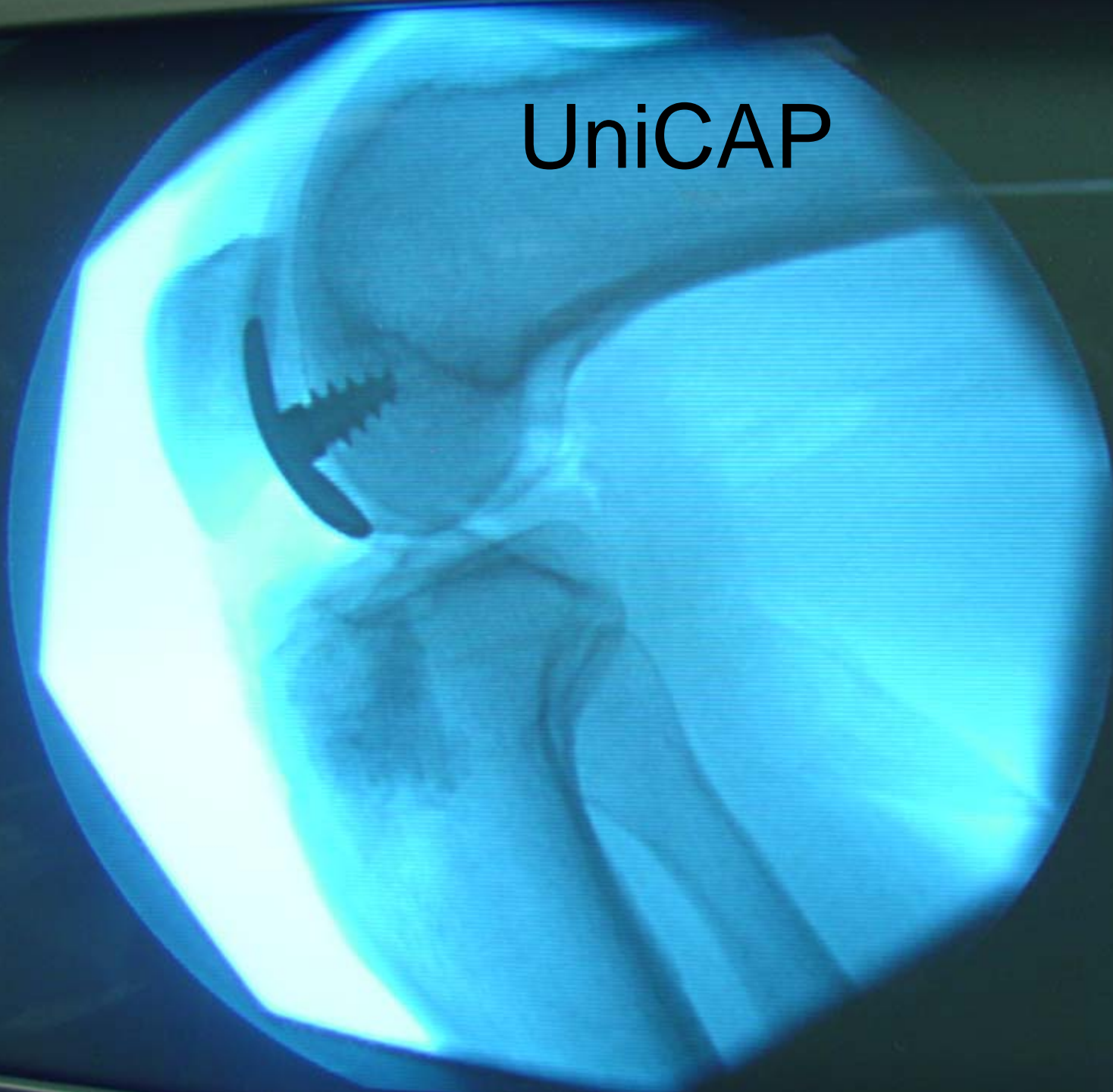


UniCAP Advantages

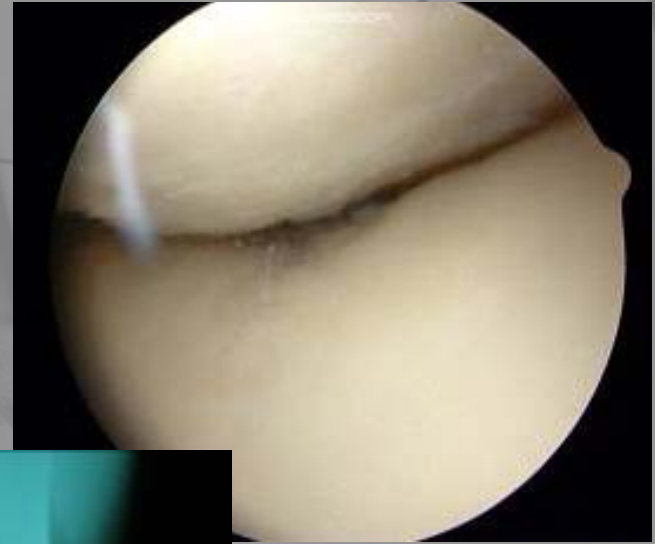
- Knee biomechanics are left intact through inlay resurfacing
 - Joint height, soft tissue tension are maintained
 - Conventional UKA are at risk of “overstuffing” the joint
- Patient selection remains critical:
 - Proper joint stability, avoiding increased translational movement
 - Monocompartmental degeneration, or concurrent multi-compartmental resurfacing, avoiding continuation of “referred pain”



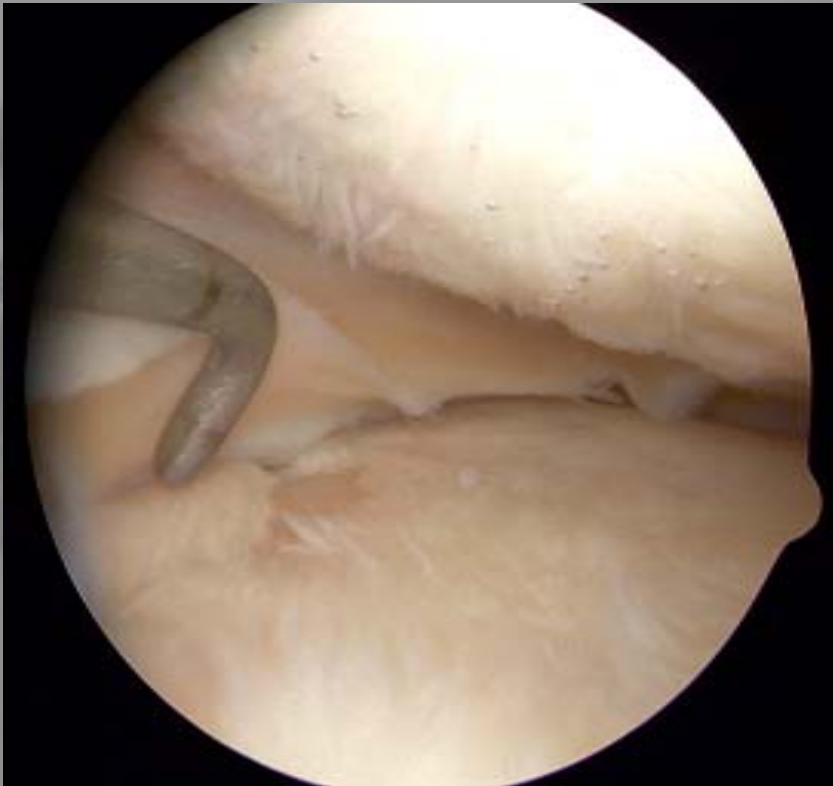
UniCAP



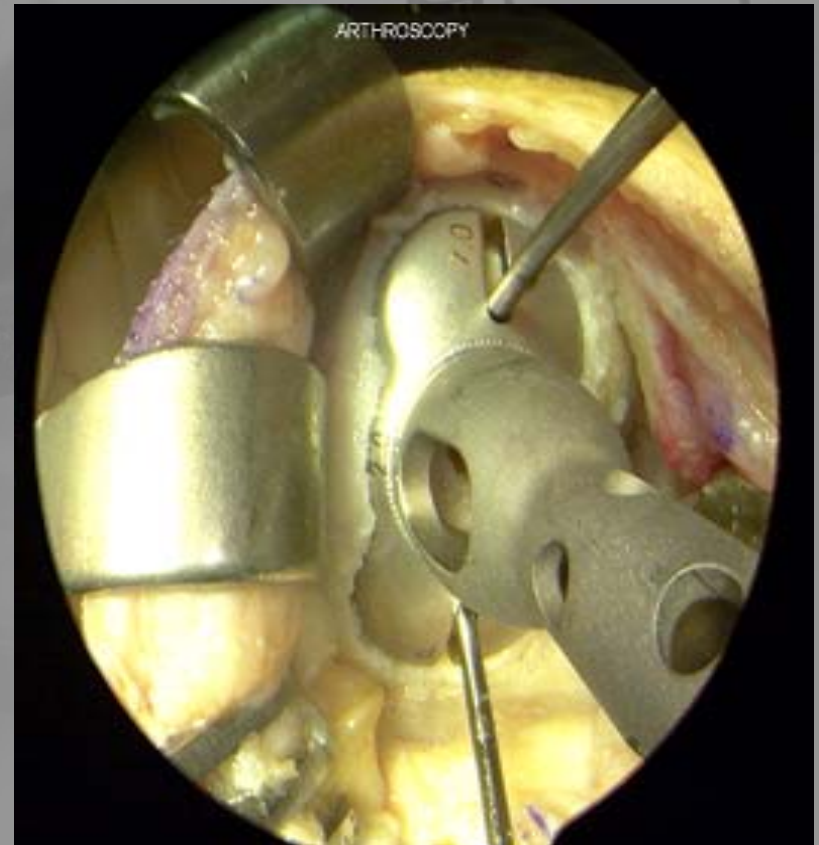
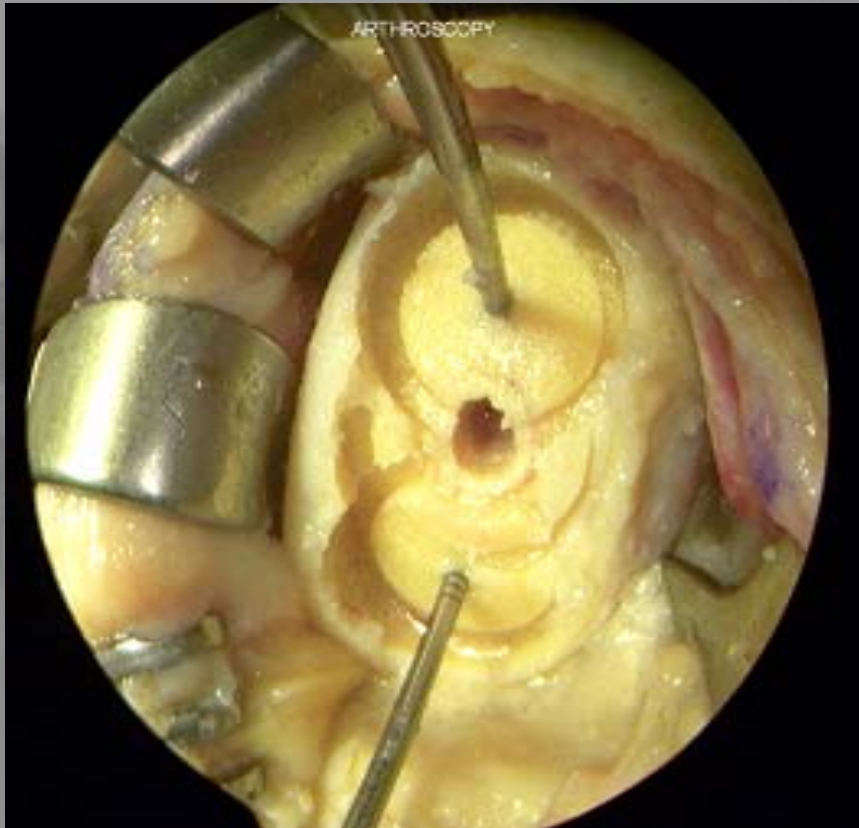
UniCAP case example – medial knee resurfacing 46 year old cyclist



UniCAP – medial knee resurfacing



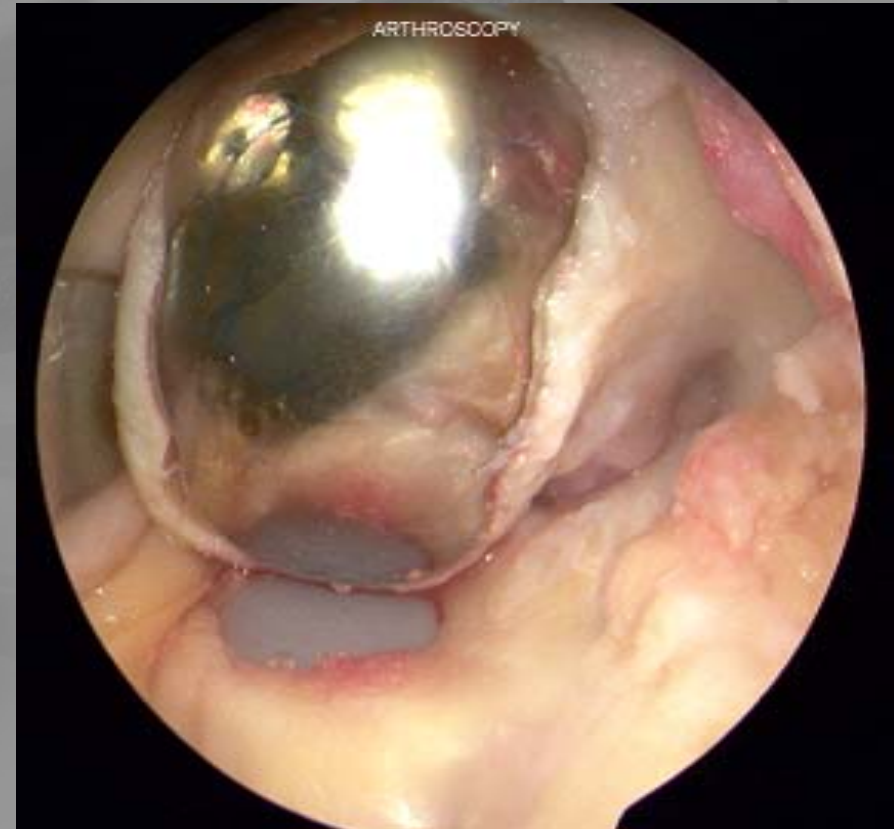
UniCAP – medial knee resurfacing



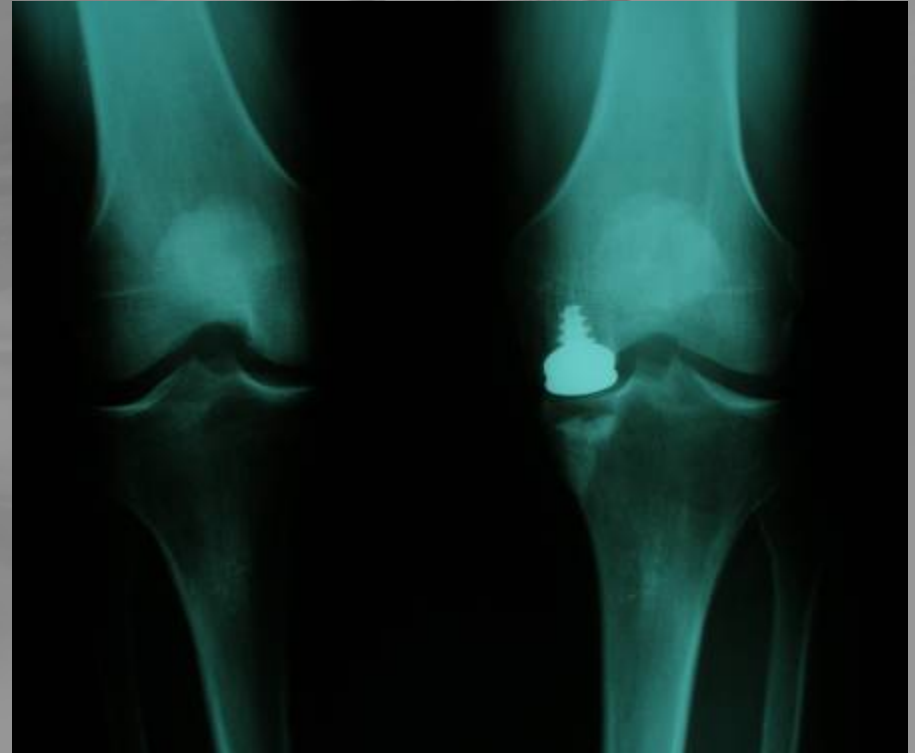
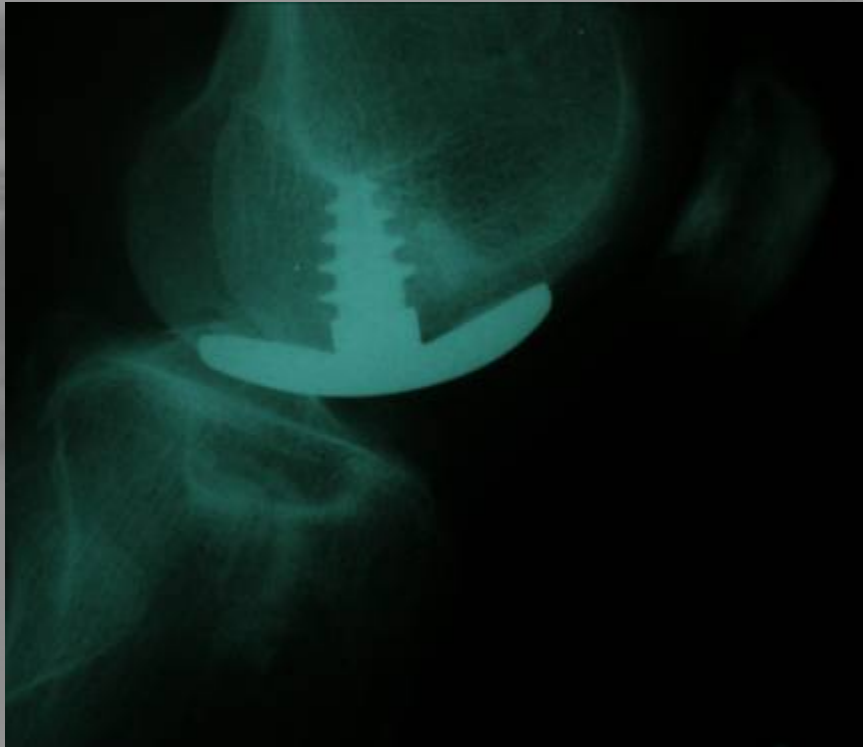
UniCAP – medial knee resurfacing



UniCAP – medial knee resurfacing



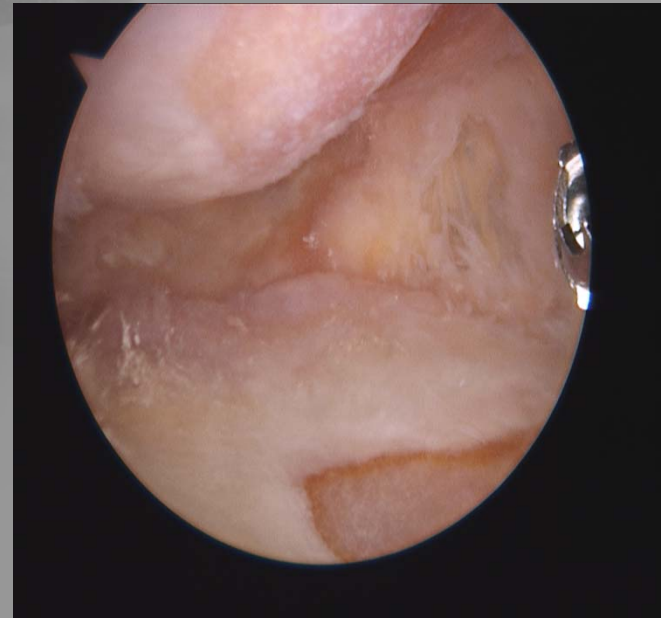
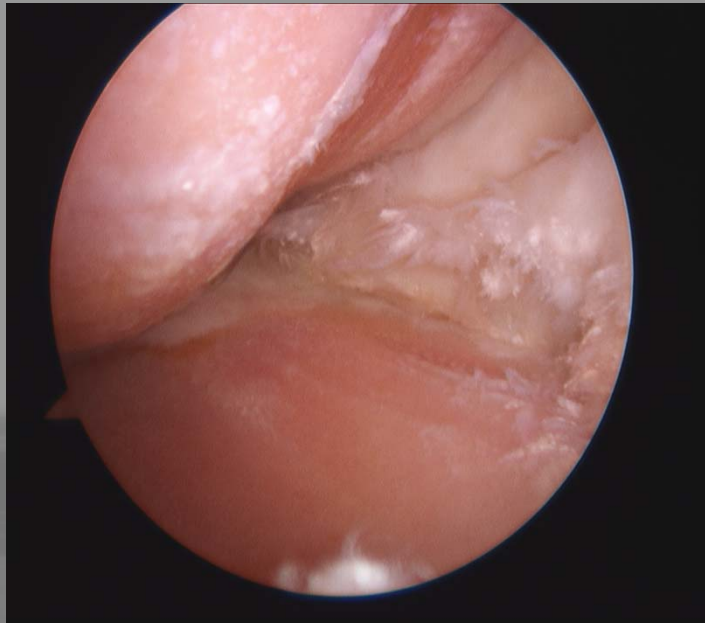
UniCAP – medial knee resurfacing

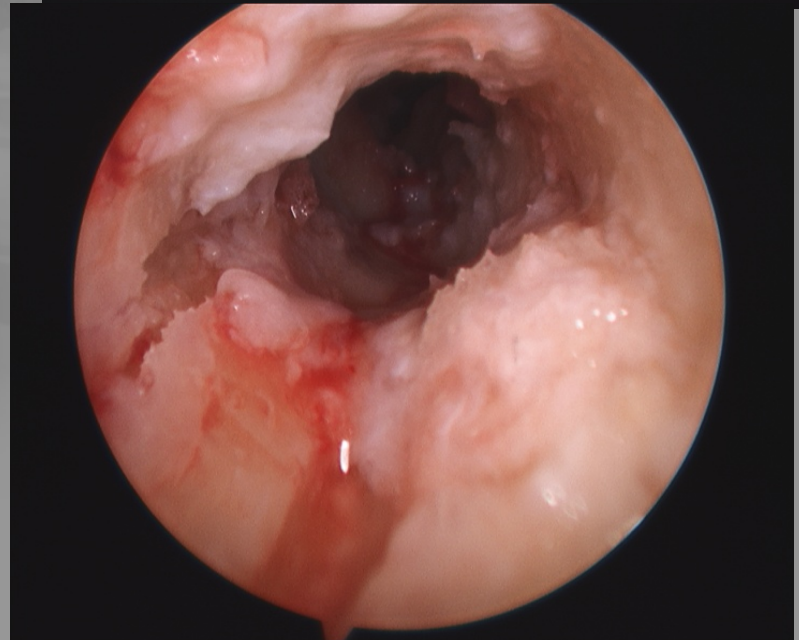
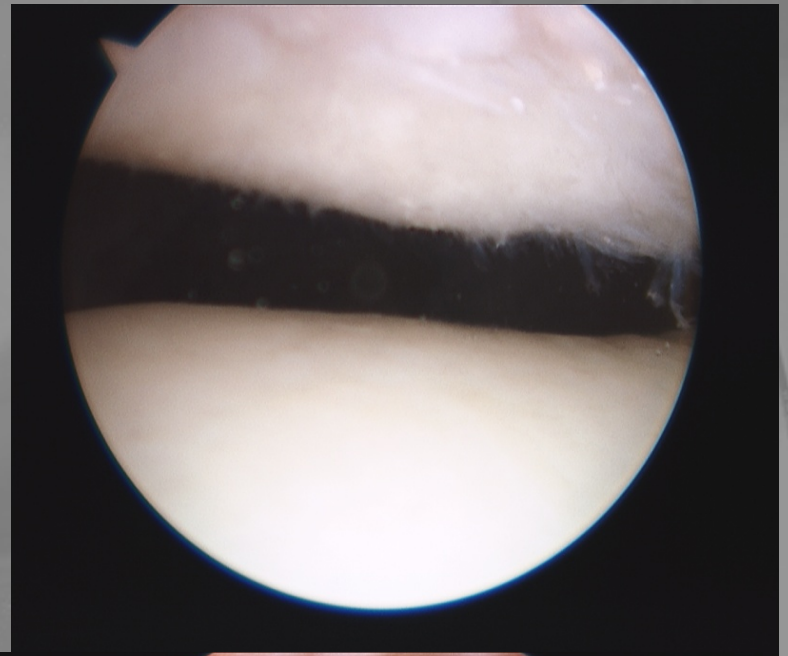
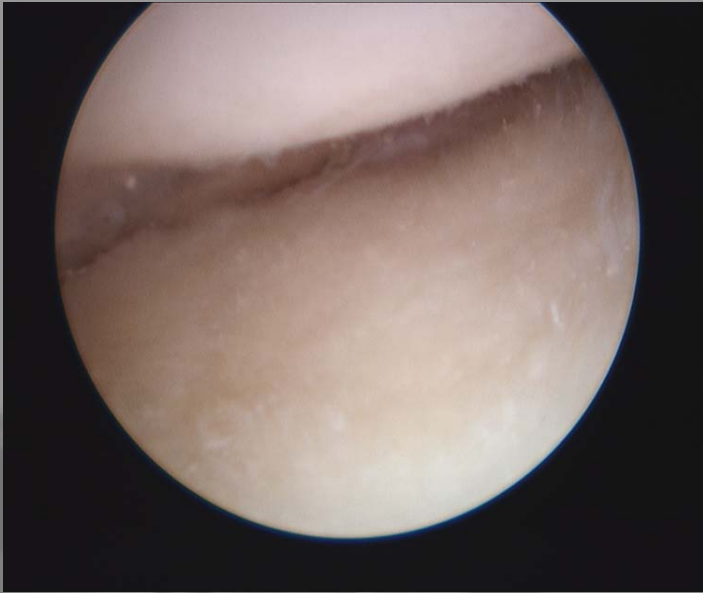


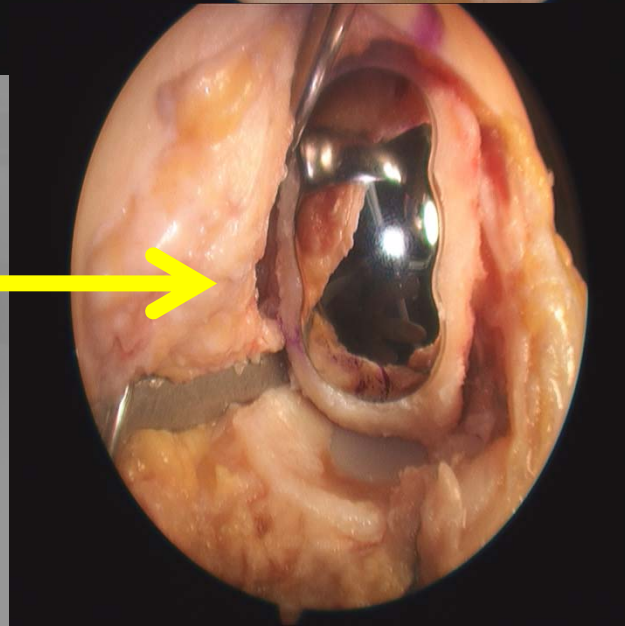
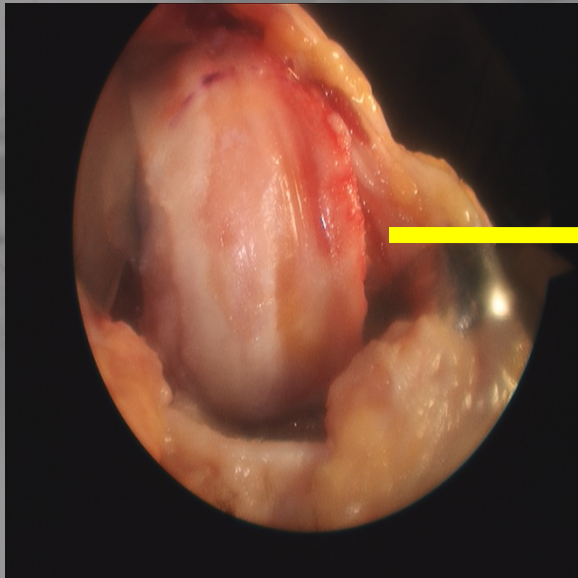
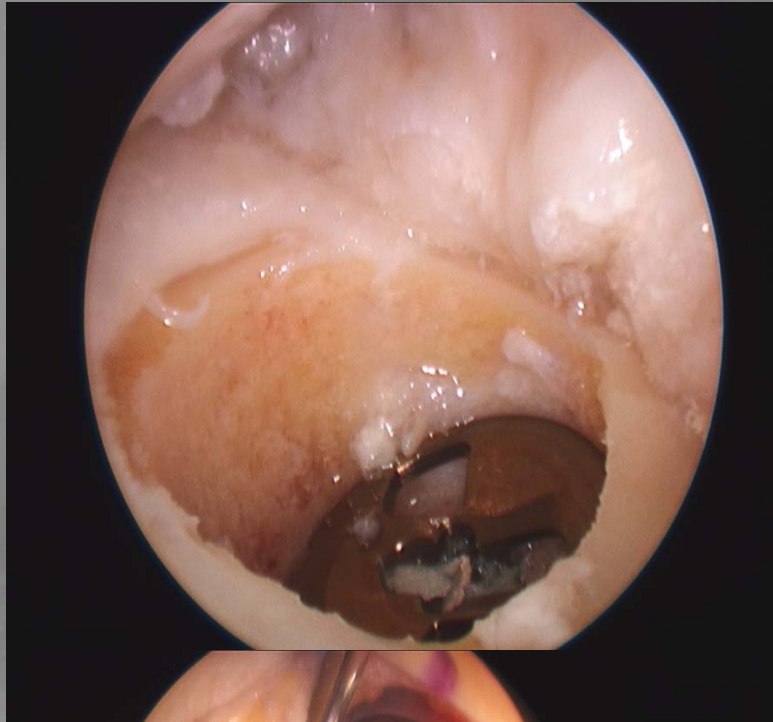
Case Report – 51 year old dancer

- Chronic knee pain and instability
- Prior (30 yr ago) ACL reconstr
- 5 degree varus
- No Patellar nor lateral pain

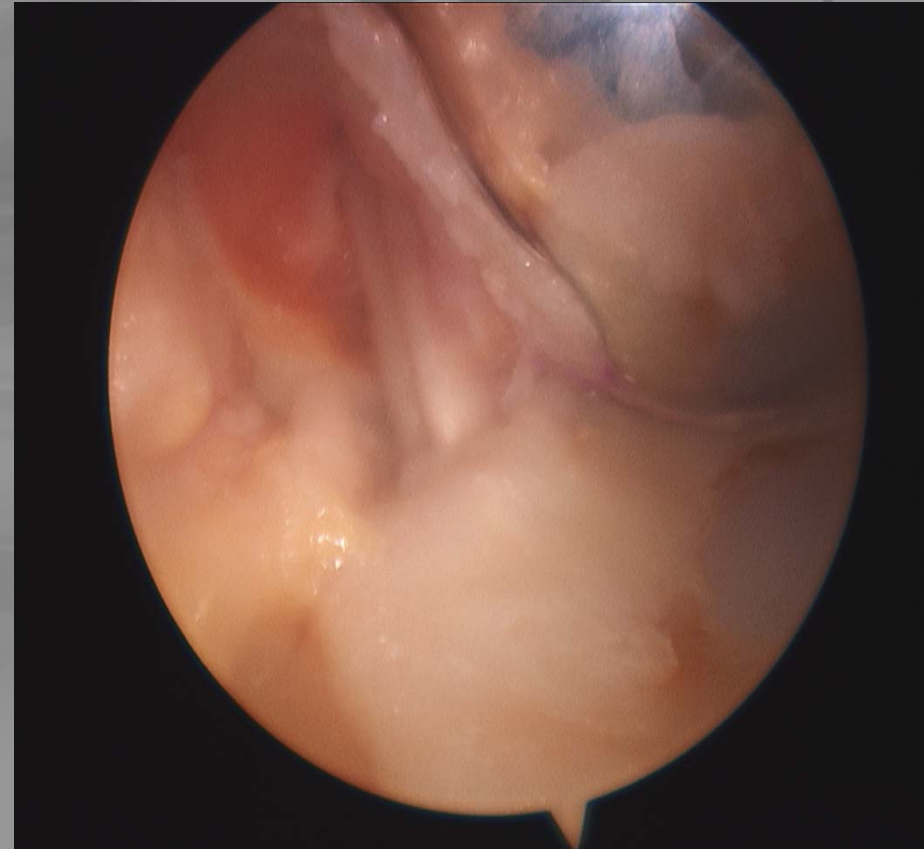


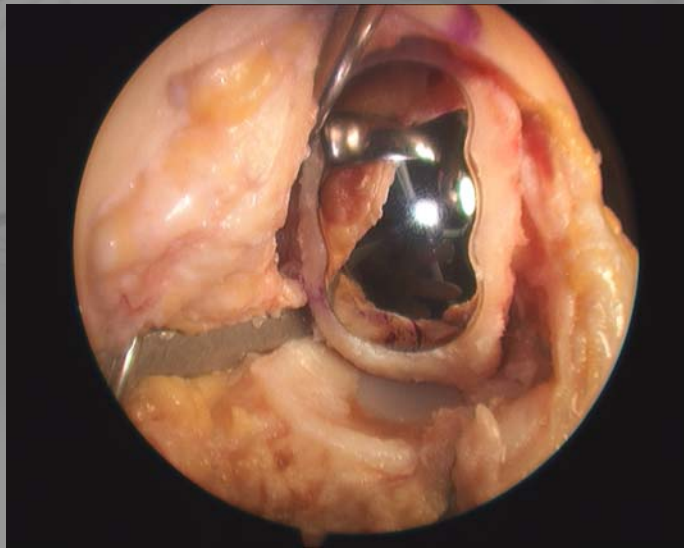
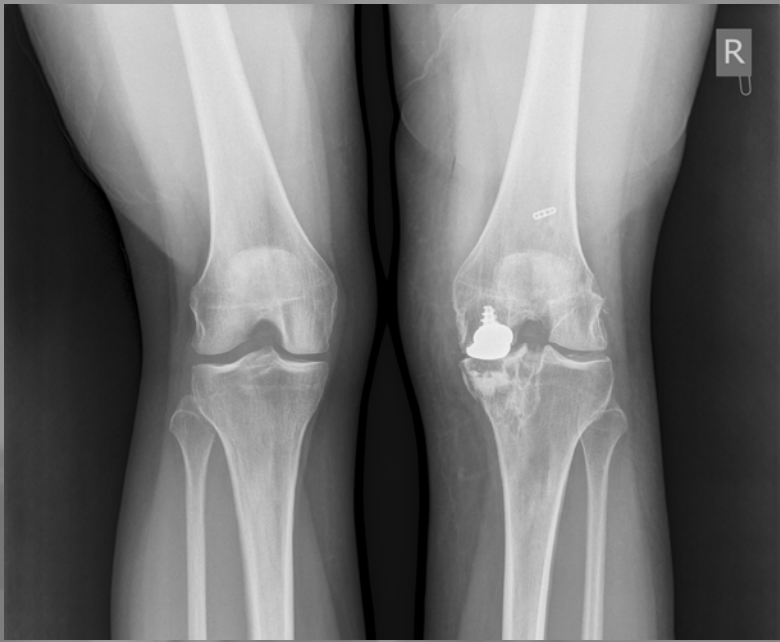






ACL graft – Medial UniCAP





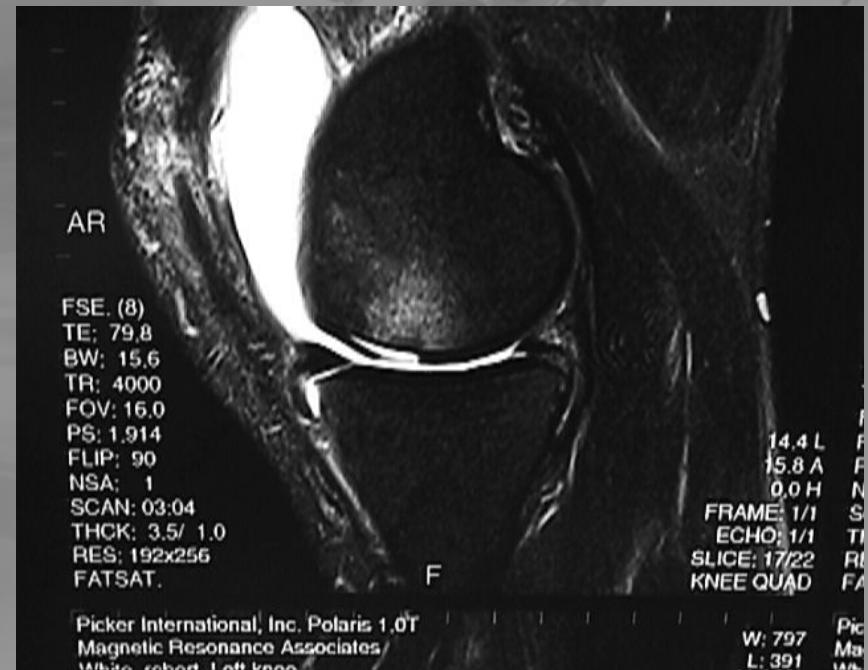
“Ideal” First Patient for CAP

- 30-60 yrs (APPX)
- Nearly normal align
- Any comorbidity mitigating against Biological solution
- Unicompartmental medial disease



Resurfacing Arthroplasty Allows Expanded Indications Beyond “Focal Defects”

- Osteoarthritis
- Post traumatic arthritis
- Unicompartmental Disease
- Multicompartmental Disease
- Concurrent Procedures
- Outpatient Procedure
- Truly minimally invasive



Advantages of Inlay Resurfacing Arthroplasty

- Immediate, excellent pain relief
- Simple, canulated, reproducible, yet elegant surgery
- Very few soft tissue balancing challenges
- Minimally bone sacrificing
- Minimal EBL, can be outpatient
- Can easily convert to traditional arthroplasty
- Patient acceptance
- Allows concurrent soft tissue procedure
- Maintain cartilage restoration principles
- Based on patient, or ambient anatomy



Thank You
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