Boomer Knee: OA in the Young and Active Patient

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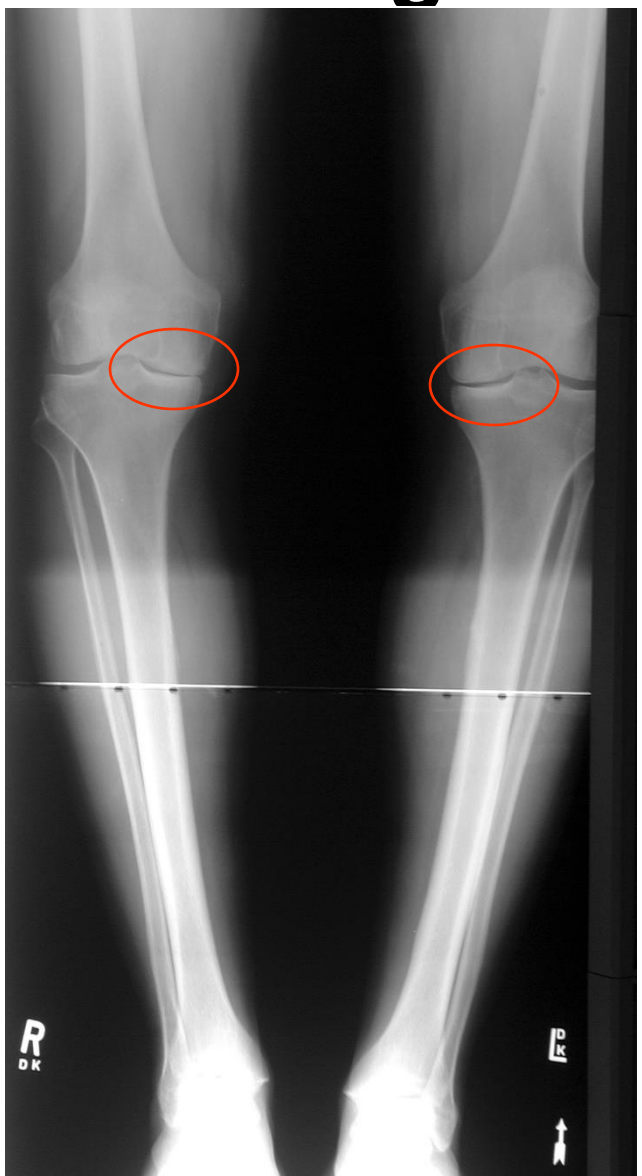
Professor of Orthopaedic Surgery
Chief, Division of Sports Medicine
Executive Director, Urbaniak Sports Sciences Institute
Duke University

Disclosures

- Arthrex: consultant and royalties
- Bone Solutions Inc : SAB/ Stock
- Arc Techtonics: Stock
- Miach : Stock
- Rubber City Bracing: Stock
- WolterKluwer: royalties
- Springer: royalties

Unicompartmental OA in the Young Patient

- Medial > lateral
- Varus > valgus
  - *Post meniscectomy*
  - *Post ACL injury*
  - Primary knee OA

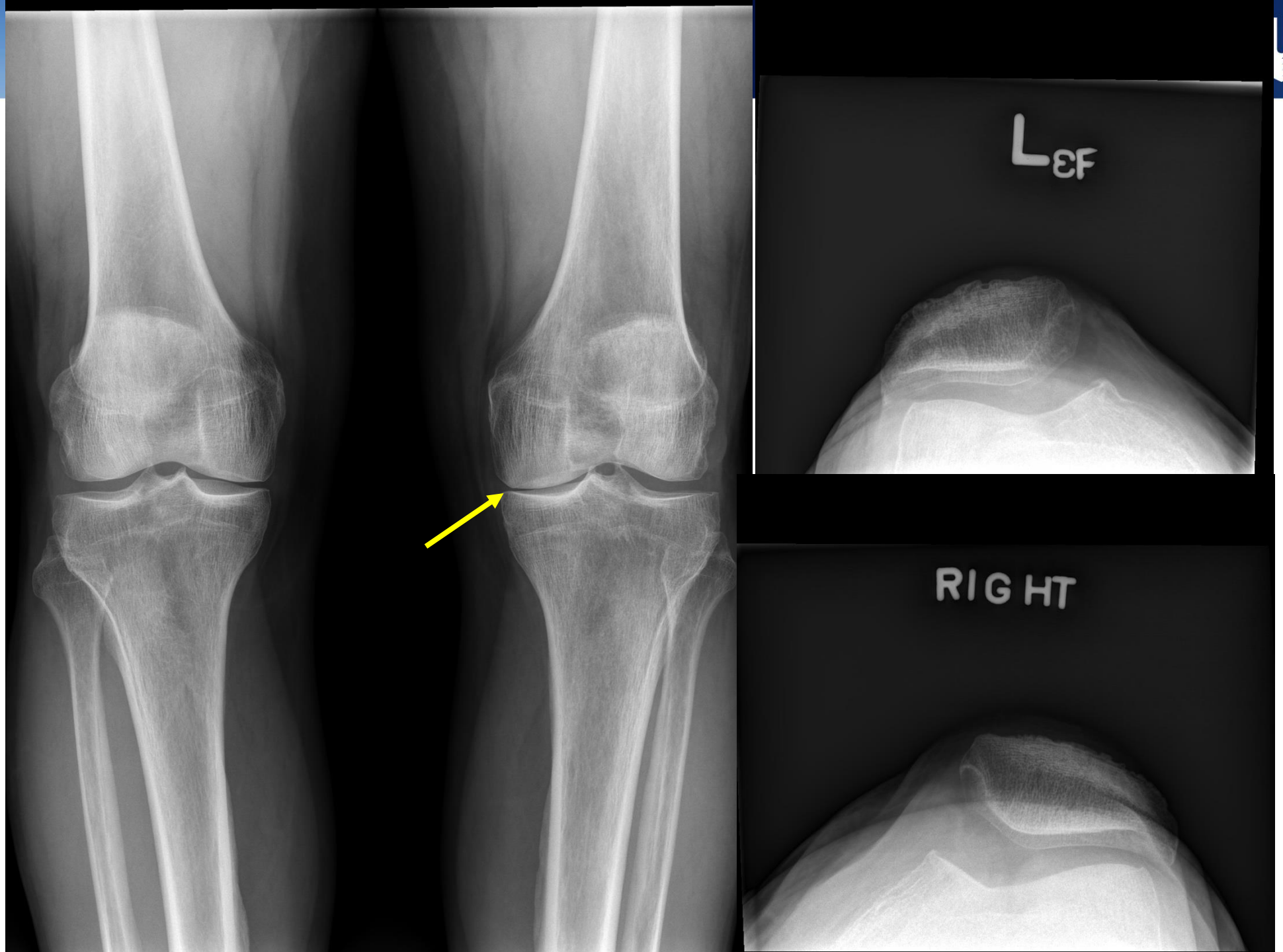


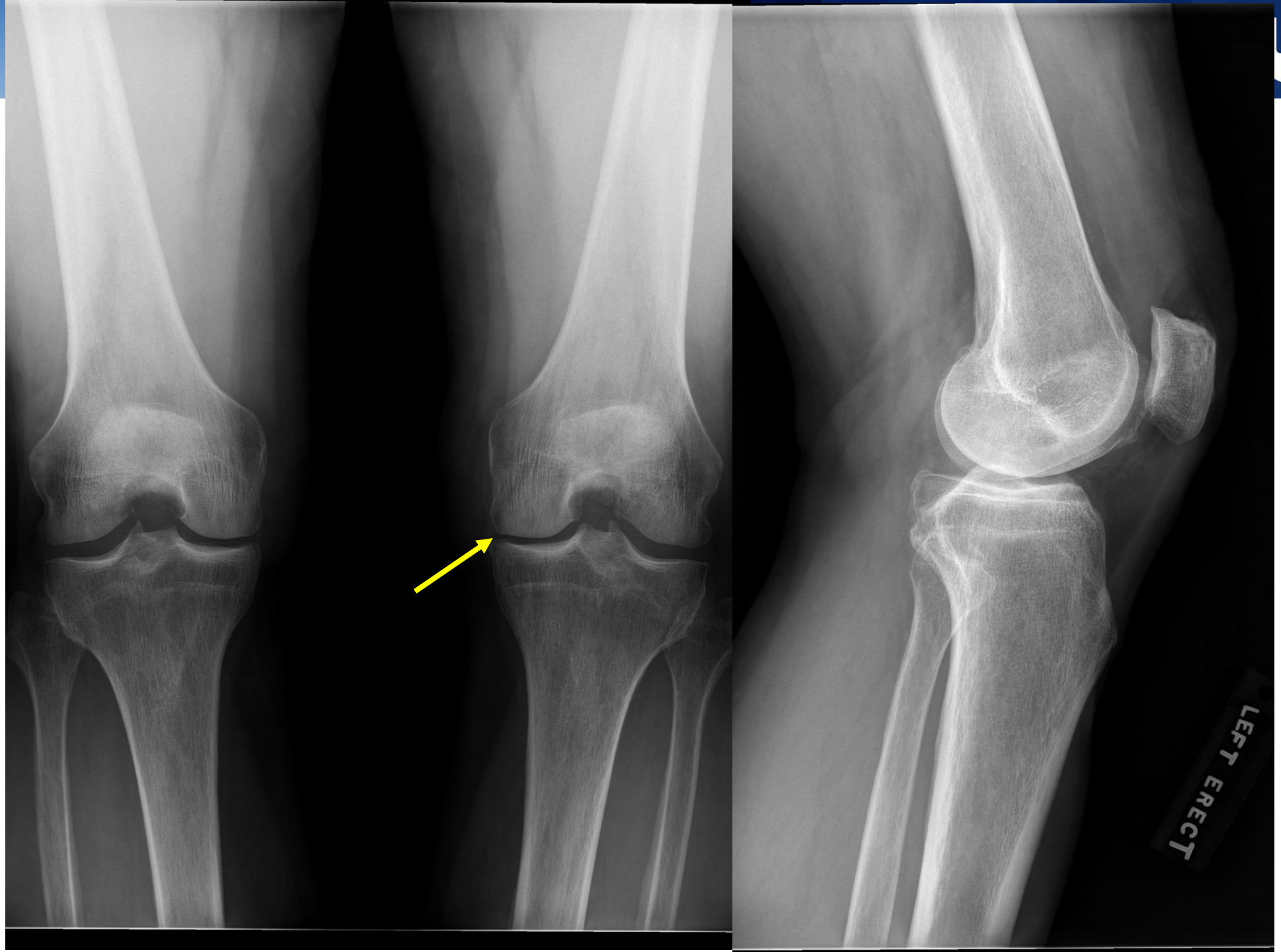
The “Baby Boomer” Knee

K Academy

The Degenerative Knee :
Non-operative Treatment

- Function is still pretty good but wants to continue high level of activity despite focal changes and pain *("Boomeritis")*
- Need to optimize **non-operative** management
- Careful with operative Rx


LEFT
RIGHT


LEFT ERECT

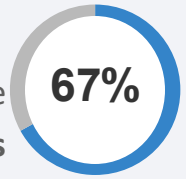
Musculoskeletal Care Today USA

Substantial opportunity to improve value if delivered at the *condition level*

Who is the DJD patient?

Chronic disease

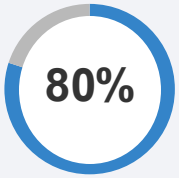
2/3 have psychologic distress



Who cares for them?

80% by orthopedic surgeons

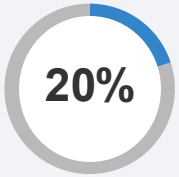
Chronic disease cared for by procedural specialists

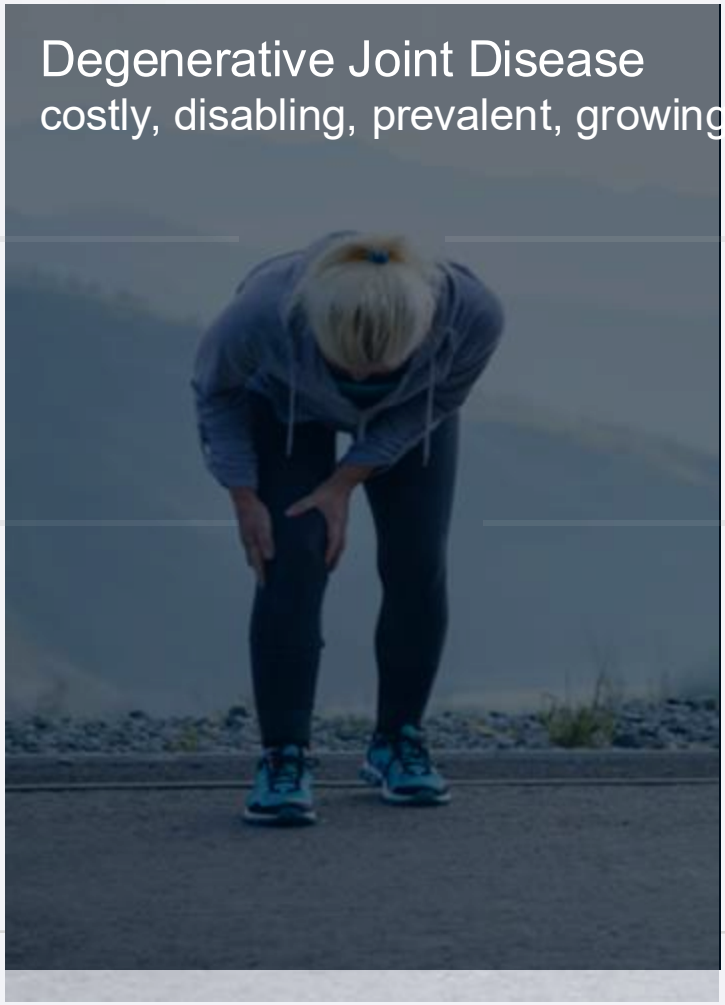


How are they treated?

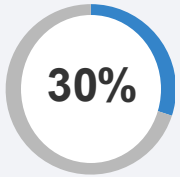
20% have a joint replacement

Disproportionate focus on surgery





Evidence-based care?

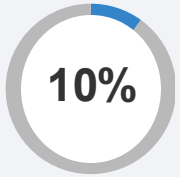


Limited alignment with guidelines

30% of spend is low value

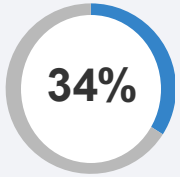
Void of high value non-op care

Equity?



10% of patients account for half of non-operative spend

Appropriateness?



34% of TKA are not appropriate

44% are clearly appropriate

Courtesy of Chad Mather

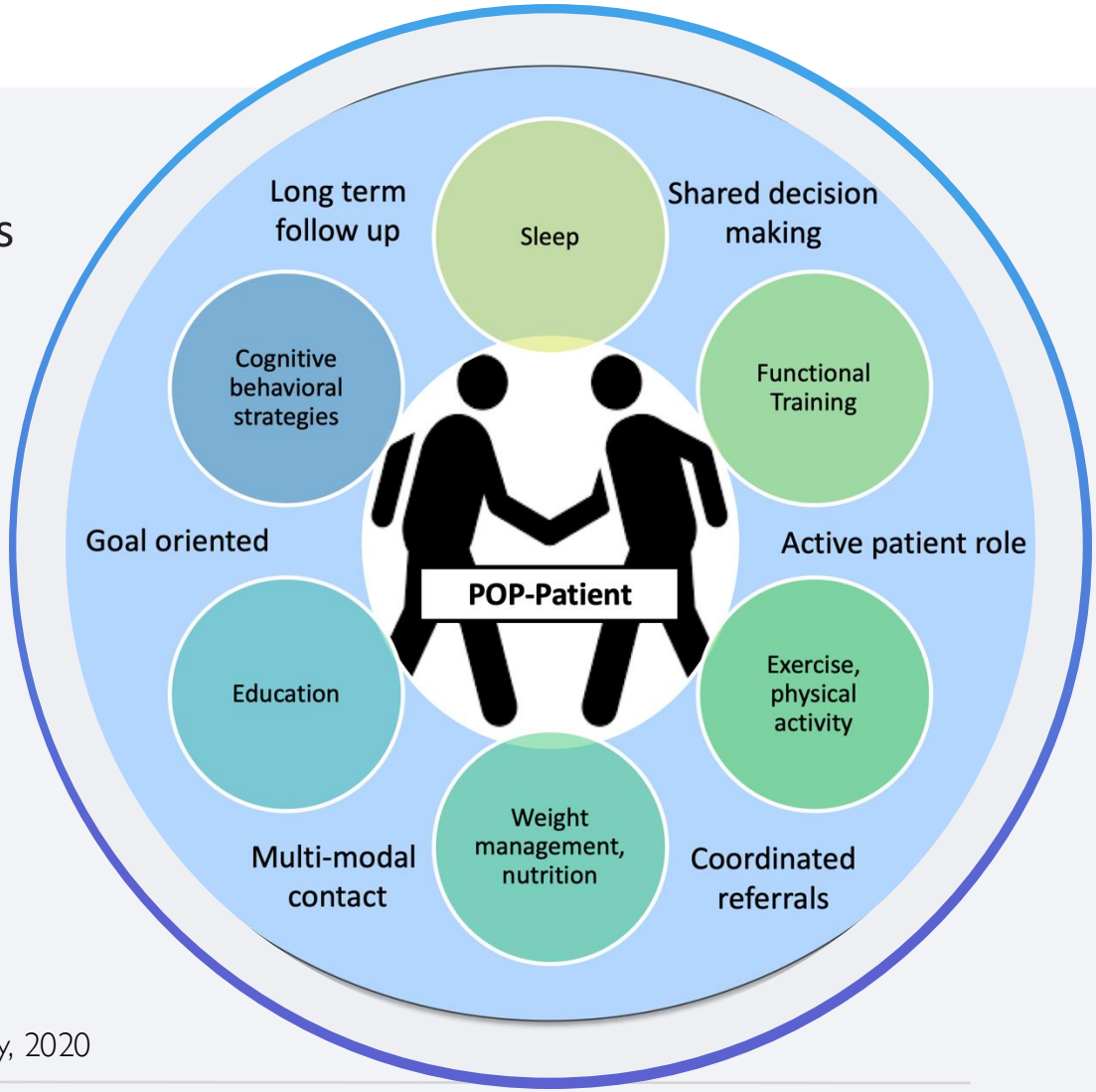
The Early Degenerative Knee : *Non-operative Treatment*

- **Education** : ***this is often difficult***
- **Optimize joint function**
  - Exercise/ PT
    - Muscle Strengthening/flexibility/balance
- **Reduce joint load**
  - Weight Loss
  - Try to modify activity (ie running to cycling)
  - Bracing
  - Footwear/Orthotics
- **Pharmacologic** (***NOT Opioids***)
- **Biologics**

Specialty Primary Care

Longitudinal, scalable, distributed osteoarthritis care model
Delivered by a ***multidisciplinary provider***

Joint Health Program
moving lives forward



Malay, Phys Therapy, 2020

Interest in orthobiologics:

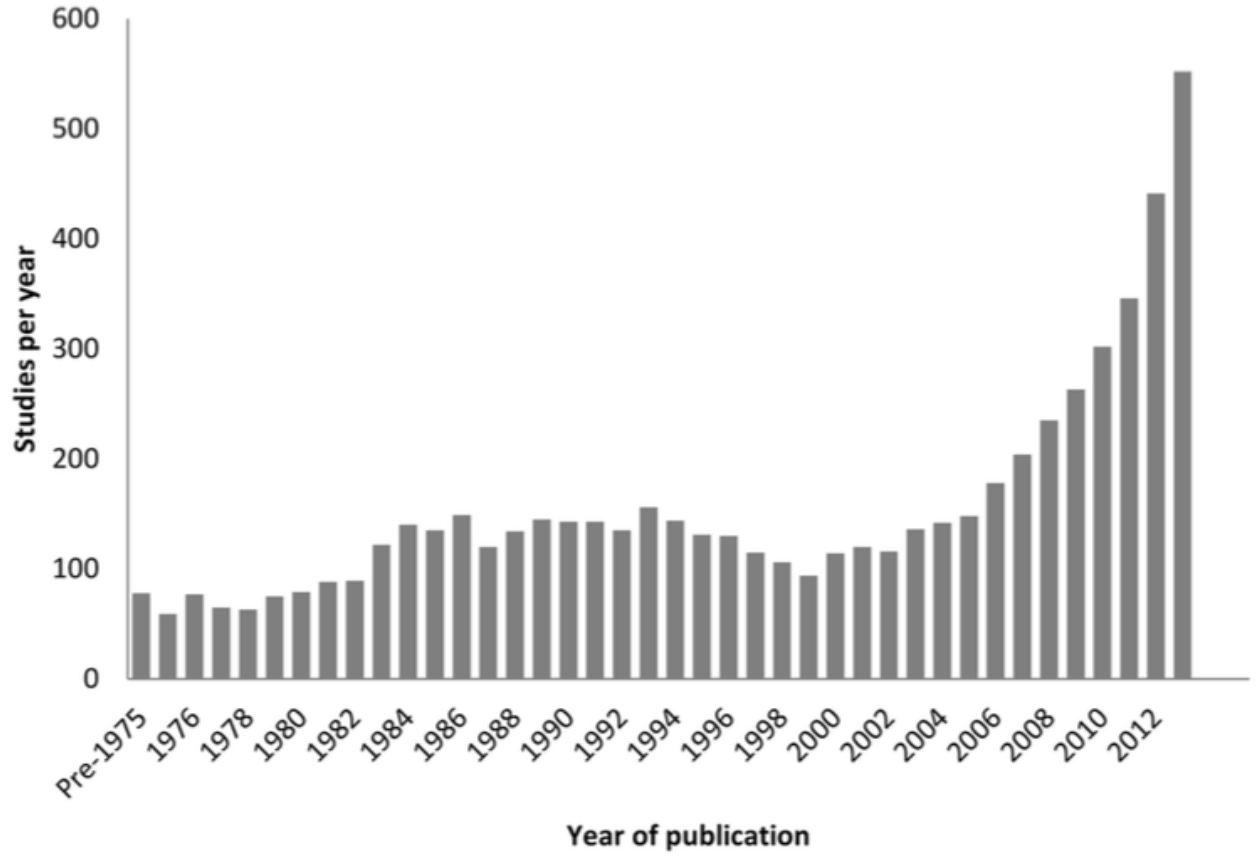


Figure 1. Number of publications per year featuring the term *platelet-rich plasma*. Source: PubMed database.

Orthobiologics for Knee OA

Acta Orthopaedica 2017; 88 (6): 670–674

Biological treatment of the knee with platelet-rich plasma or bone marrow aspirate concentrates

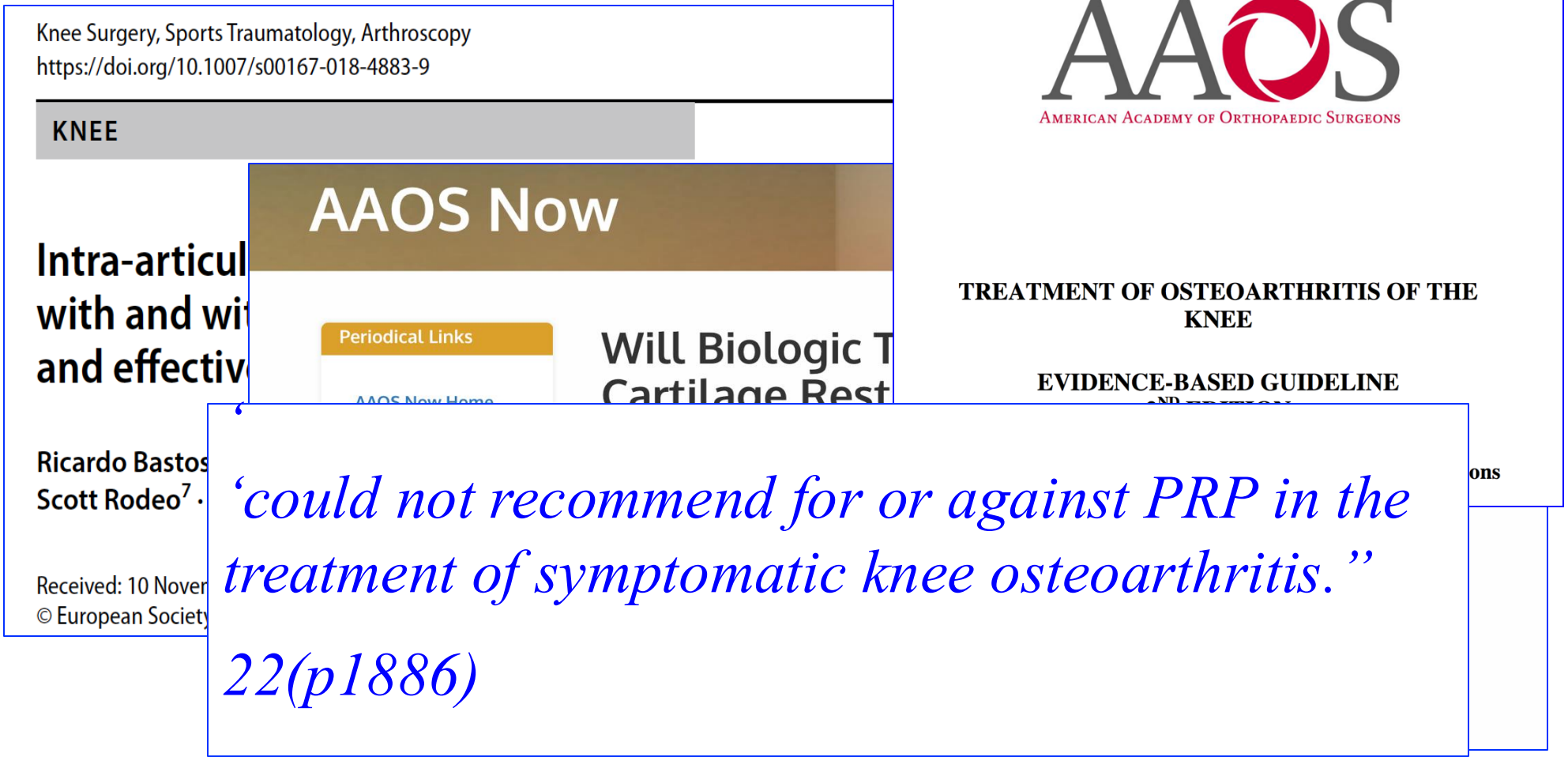
A review of the current status

Gilbert MOATSHE [1,2,3], Elizabeth R MORRIS [2], Mark E CINQUE [2], Cecilia PASCUAL-GARRIDO [5], Jorge CHAHLA [2], Lars ENGEBRETSEN [1,3], and Robert F LAPRADE [2,4]

[1] Oslo University Hospital and University of Oslo, Oslo, Norway; [2] Steadman Philippon Research Institute, Vail, CO, USA; [3] OSTRC, The Norwegian School of Sports Sciences, Oslo, Norway; [4] Steadman Clinic, Vail, CO, USA; [5] Washington University Orthopaedics, St. Louis, MO, USA
Correspondence: drlaprade@sprivail.org
Submitted 2017-04-03. Accepted 2017-07-21.

- Poor research methodology
- Biased research
- Too many variables

ORTHOBIOLOGICS: FLIGHTS OF FANCY OR HERE TO STAY?

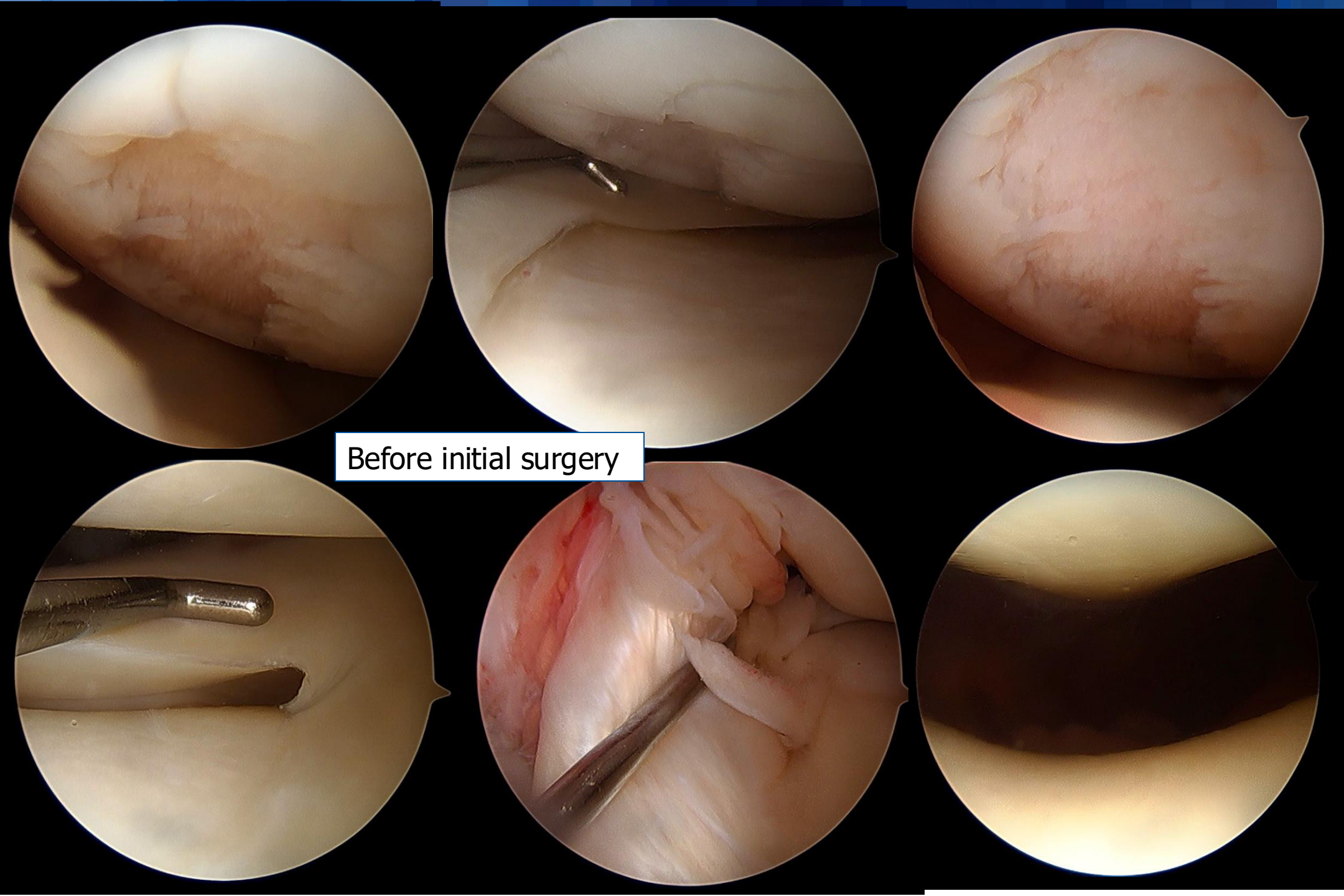


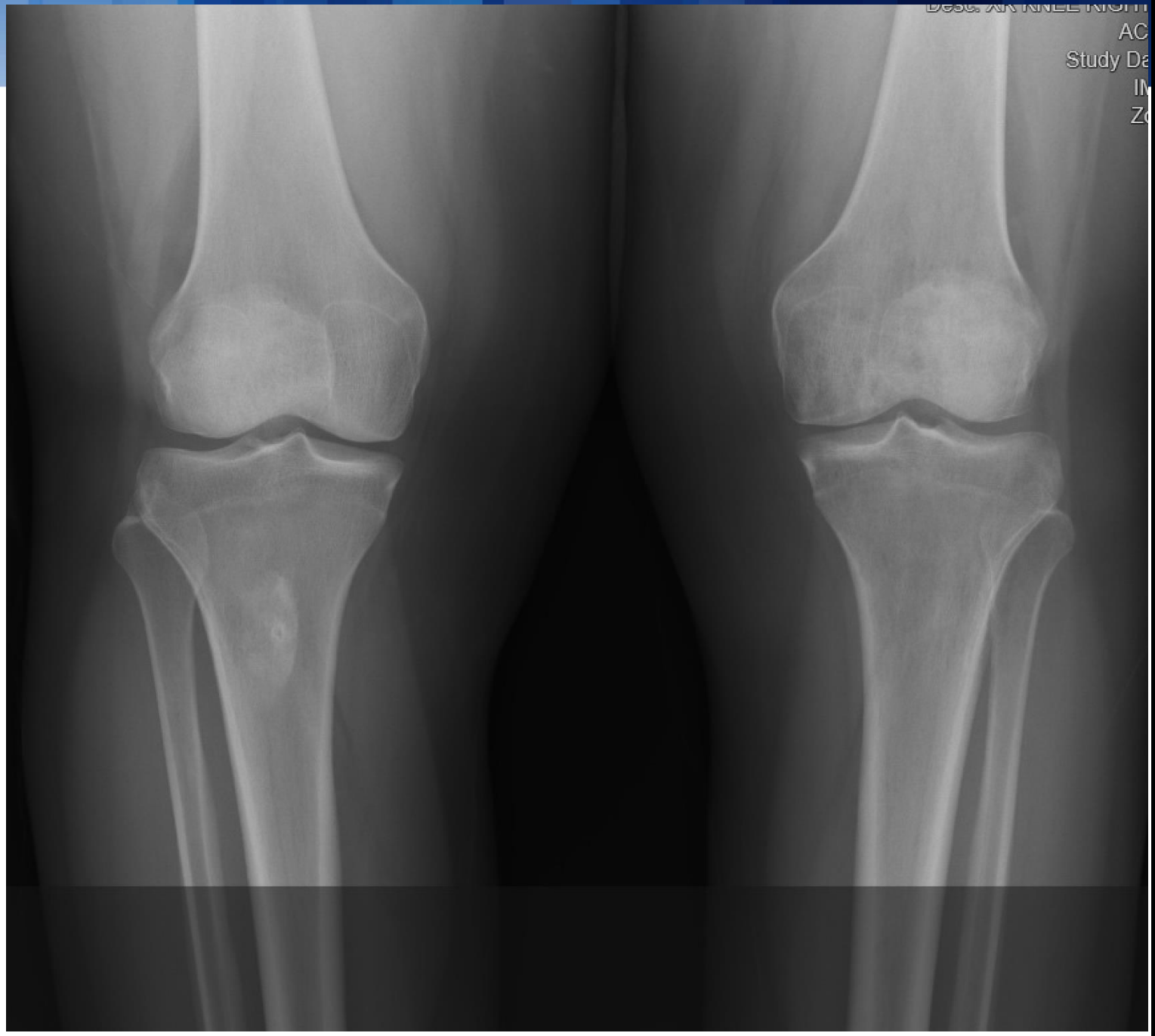
'could not recommend for or against PRP in the treatment of symptomatic knee osteoarthritis."

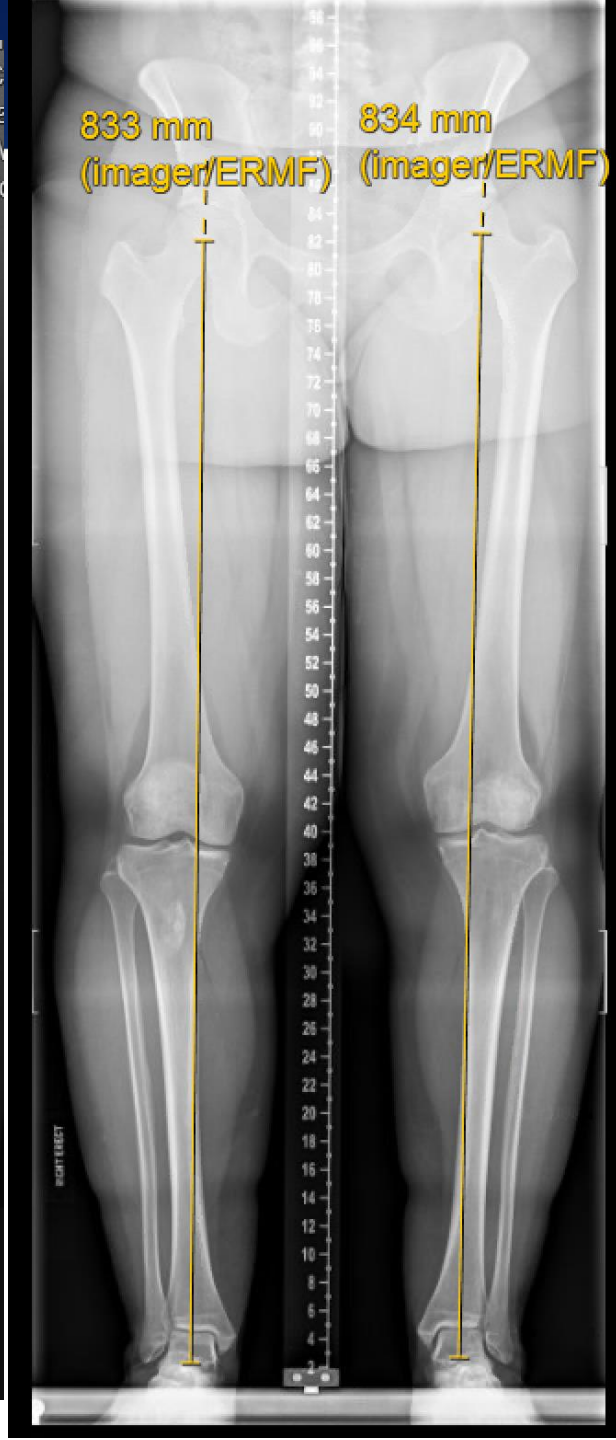
22(p1886)

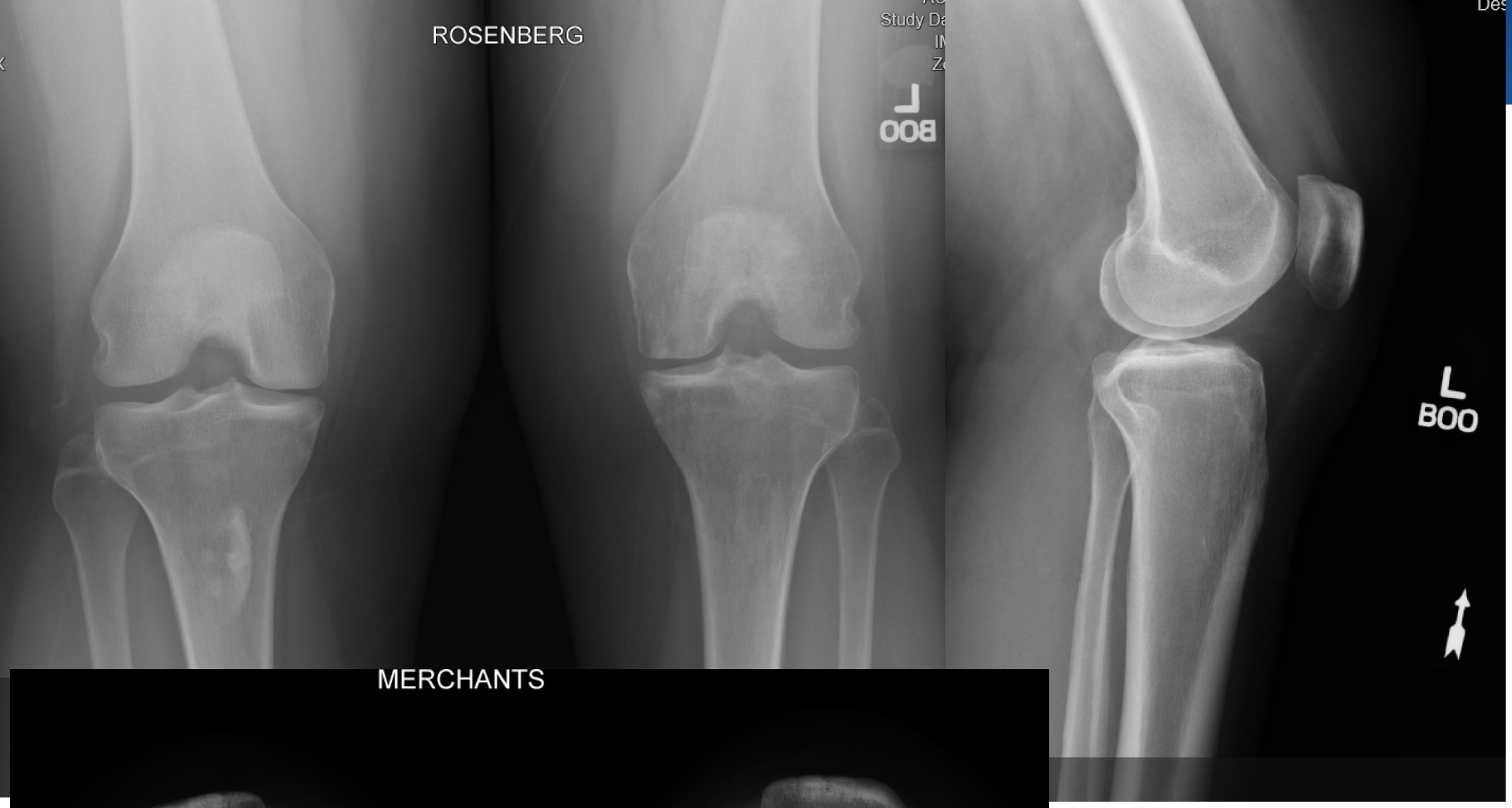
Case No 1

- 32 yo female , very active, left knee
- MACI medial femoral condyle lesion 14 mos ago
- Continued medial pain , intermittent swelling
- Exam
  - MJL tender, Full ROM , minimal swelling , stable
  - Bilateral mild varus knees


Before initial surgery




833 mm
(imager/ERMF)
834 mm
(imager/ERMF)


ROSENBERG
L
BOO
L
BOO
MERCHANTS

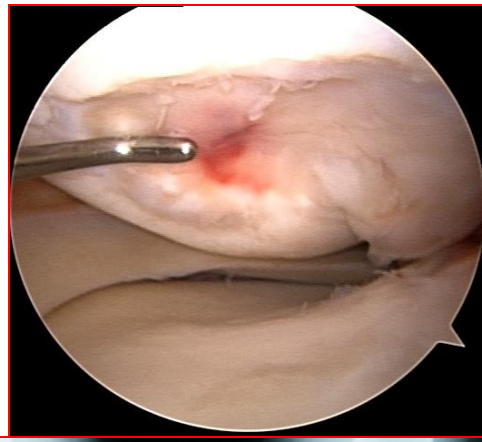
Case 1

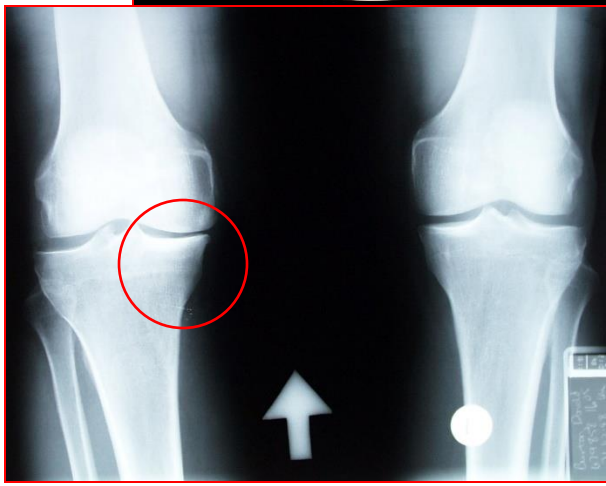
- Considerations :
  - Active 32 YO ; continuing pain
  - Failed MACI
  - Varus alignment

The “Boomer” Knee : surgical considerations

Questions to address

- Is this a Focal articular defect or is it early OA of the knee
- is this unicompartmental OA ?
- Is there mechanical overload ?

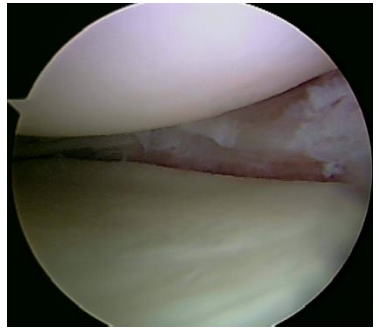




The Unicompartmental OA knee

- Mechanical alignment/overload
- Meniscal transplantation
- Articular cartilage resurfacing
- Osteotomy
- Unicompartmental replacement
- TKA

Knee OSTEOTOMY: Indications

Malalignment + Arthrosis	Malalignment + Instability	Malalignment + Arthrosis + Instability	Malalignment + Meniscal Transplantation + Cartilage Resurfacing
			

Outcome Studies

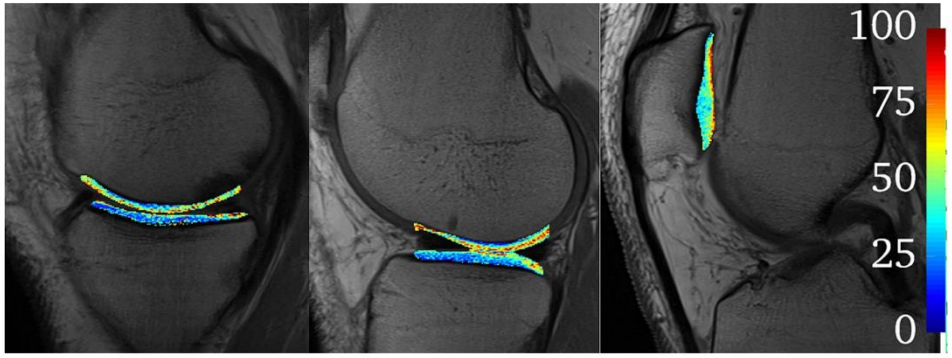
Knee Surgery, Sports Traumatology, Arthroscopy
https://doi.org/10.1007/s00167-021-06516-9

KNEE

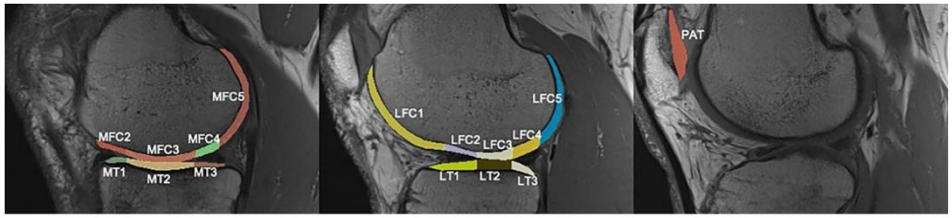
2021

High tibial osteotomy to neutral alignment improves medial knee articular cartilage composition

Hayden F. Atkinson[1,2] · Trevor B. Birmingham[2,3] · Jenna M. Schulz[2,3] · Codie A. Primeau[2,3] · Kristyn M. Leitch[2] · Stephany L. Pritchett[4] · D. W. Holdsworth[1,4] · J. R. Giffin[2,4]



2 Example of a preoperative T2 map demonstrating (from left ght) T2 relaxation time of articular cartilage of the medial com- ment, lateral compartment, and patella, with longer T2 relaxa- tion being represented in red and shorter T2 relaxation represented blue, as per the scale on the right



- 34 patients OWO
- 3T MRI pre/post 1 yr

Osteotomy technique

Knee Surg Sports Traumatol Arthrosc (2017) 25:895–901
DOI 10.1007/s00167-015-3644-2

KNEE

Adverse events and survival after closing- and opening-wedge high tibial osteotomy: a comparative study of 412 patients

T. Duivenvoorden[1] · P. van Diggele[1] · M. Reijman[1] · P. K. Bos[1] · J. van Egmond[1] · S. M. A. Bierma-Zeinstra[1,2] · J. A. N. Verhaar[1]

- Retrospective review 1993-2012
- 80/466 (17% adverse events)
- CWO: 14 (4%) had Peroneal N injury
- OWO: 11 (9.8%) iliac crest pain
- Hardware removal common in both groups
  - (48% CW, 71% OW)

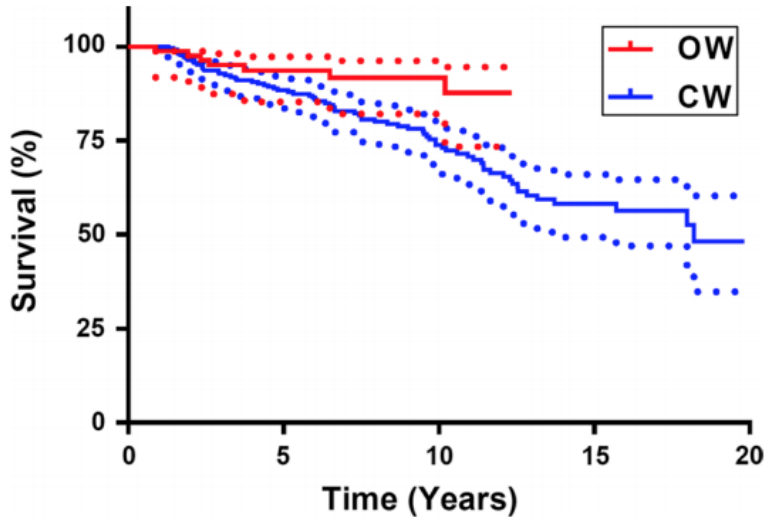


Fig. 2 Survival curve of closing- and opening-wedge osteotomy. Survival considered with conversion to UKA or TKA as end-point

Outcome Studies

Original Article

Comparison between Closing-Wedge and Opening-Wedge High Tibial Osteotomy in Patients with Medial Knee Osteoarthritis: A Systematic Review and Meta-analysis

Hao Sun, MD[1] Lin Zhou, MD[2] Fengsheng Li, MD[1] Jun Duan, MD[1]

2017

- Similar outcomes
- OWO higher accuracy but increases posterior tibial slope and decreases patellar height

Case 4

- 51 yo neurology professor
- Avid soccer player
- Numerous opinions
- Bilateral med comp OA

Case 4

Case 4

Case 4

- Bilat HTO
  - 2008
- Doing well in 2018

Case 4 bilat HTO at 10 yrs

From: "[redacted]
Date: Saturday, June 23, 2018 at 1:51 PM
To: Ned Amendola <ned.amendola@duke.edu>
Subject: Thanks for an active life

Dear Ned,
it was almost to the day 10 years ago that you straightened me out, first the left knee, then the right 3 months later. My goal initially was just to make it to the 3-year mark, then to 5 years, and I did not think I would ever make it to 10 years without revision (not to talk about still being chair, but that is another story).

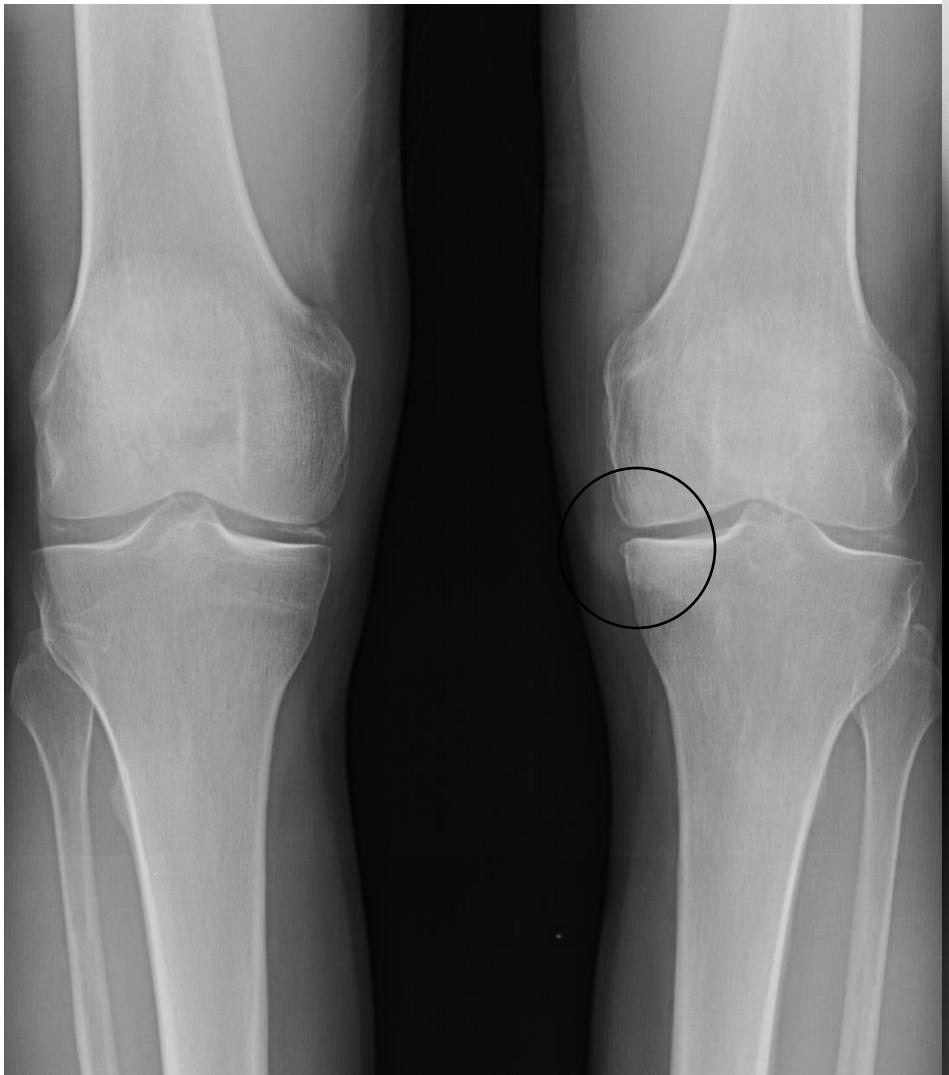
Your judgement regarding the extent of realignment and the technical execution were impeccable. I am so grateful to you as you have given me a decade of very active life. I hiked up Kilimanjaro in 2014, still play soccer every Sunday and have run a 5K twice at the AAN meeting.

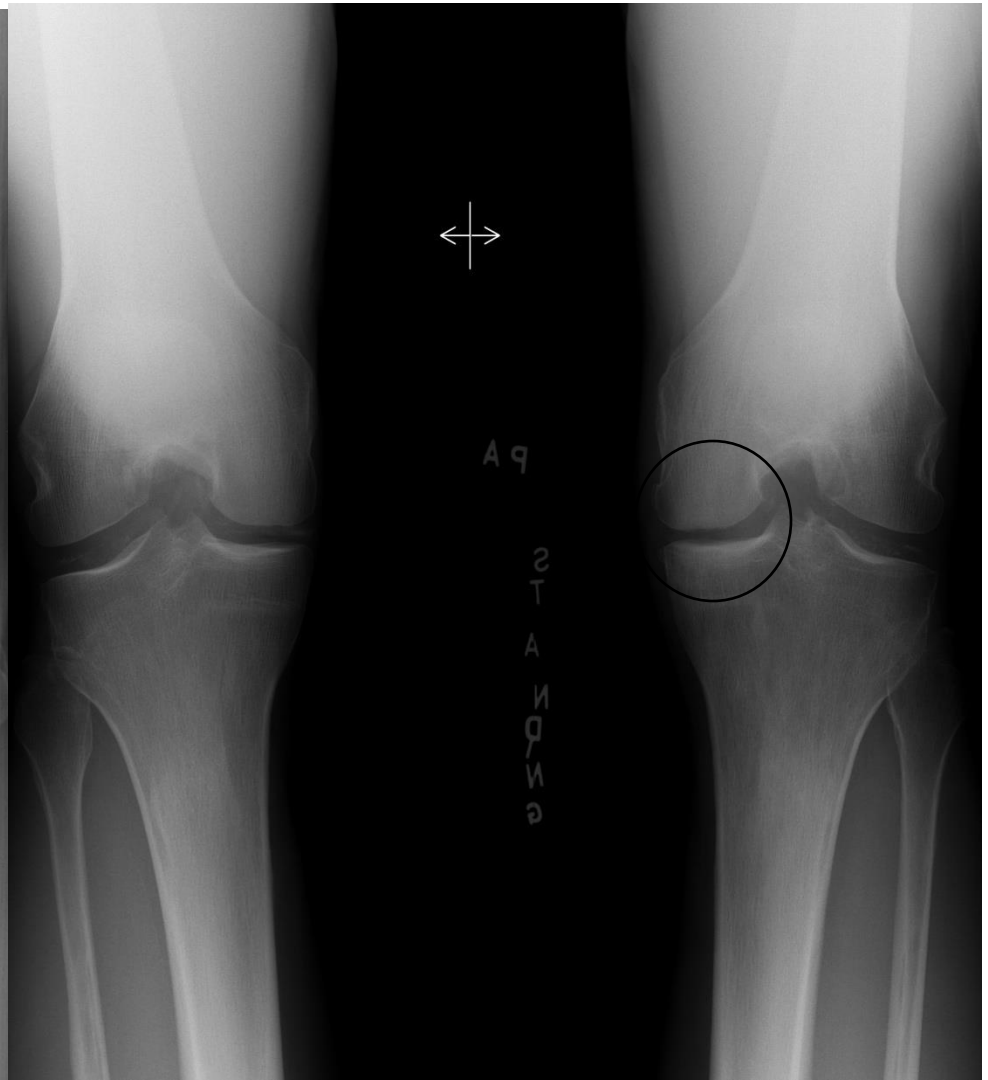
Although the cartilage is wearing thin and is probably down to non existent, the next life goal is playing soccer with grandchildren. The knees, however, are not the problem, but professionally minded children that are in residency.

Please give me a call when you are in SLC.

Best regards
Stefan and Julie

Case: 55 yo avid runner





case

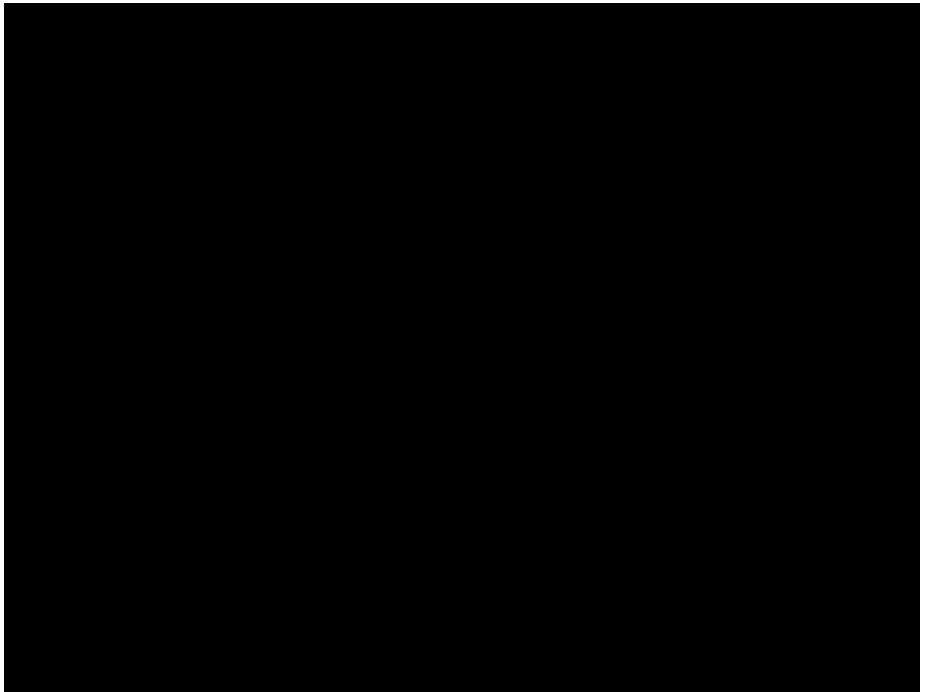
- Professor
- marathoner
- Went to Boston for another opinion
- VERY educated

50 yo avid runner

OW HTO 2005

12 years after HTO

- Gave up running
- Many 200/300 km bike races
- Annual miles logged has risen each year, from 4,513 in 2006 to 6,599 in 2012…and a total of 44,567 miles.
- Recent email



Ned,

Good morning. I know that this is an especially busy time of the year for you, but I thought I'd share with you a photo (attached) taken during my 8 day tour of the French Alps this summer. I rode the Route des Grandes Alpes (route attached), from Thonon-les-Bains (on the southern shore of Lake Geneva) to Menton (on the Mediterranean): ~700 km over 21 peaks in the Alps, including some famous from the Tour de France, such as the attached…summiting Galibier.

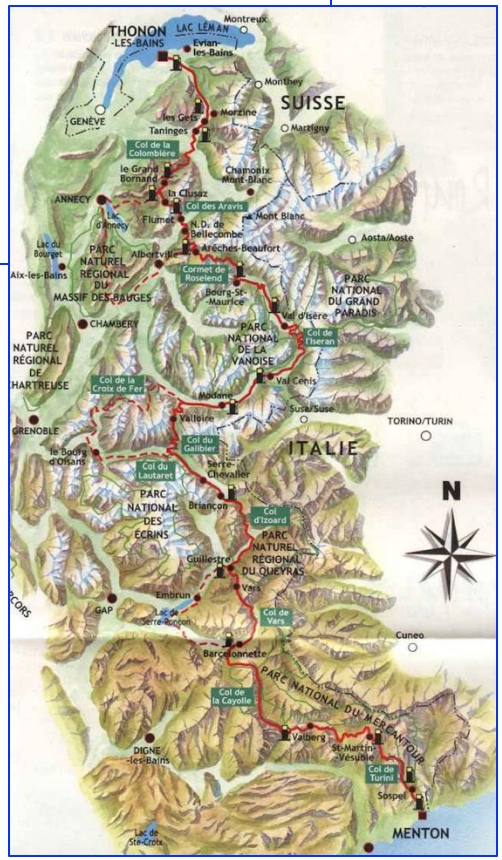
I share this with you because it's further testament to surgical prowess & great post op care. I'm still thanking you 12 years later.

I hope that you're thriving, and still cycling!

Cheers

bill

[redacted]
Director, Inflammation Program
Department of Medicine
Roy J. and Lucille A. Carver College of Medicine
University of Iowa



Opening Wedge Osteotomy

Avoid Complications

1. Under / overcorrection coronal alignment
2. Alteration of tibial slope (sagittal)
3. Patella baja

Fixation techniques

Knee Surgery, Sports Traumatology, Arthroscopy
https://doi.org/10.1007/s00167-020-06199-8

KNEE

2020

Low rates of serious complications but high rates of hardware removal after high tibial osteotomy with Tomofix locking plate

Rajeshwar Sidhu[1] · Gilbert Moatshe[1,2] · Andrew Firth[1] · Robert Litchfield[1] · Alan Getgood[1]

52 % required hardware removal

Table 2 Adverse events in medial opening wedge high tibial osteotomy classified according to severity as described by Martin et al. [12]

	Rate of adverse events %	No. of patients
Class 1: no additional treatment required		
(1) Lateral hinge fracture	8.5	17
(2) Serous discharge	3	6
(3) Delayed wound healing	2	4
Total	13.5	27
Class 2: short-term nonoperative treatment required		
(1) Postoperative stiffness	1	2
(2) Delayed union	5.4	11
(3) Infection	1.5	3
(4) Deep vein thrombosis	0.5	1
(5) Pulmonary embolism	0.5	1
Total	9	18
Class 3: additional surgery or long term nonoperative treatment required		
(1) Deep infection	2	4
(2) Aseptic nonunion	2.5	5
(3) Limited hardware failure-screw breakage	1	2
(4) Post-operative stiffness	1	2
(5) Cardiac complication	0	0
(6) Neurovascular injury	0	0
Total	6.5	13
Total adverse events	29	58/200

Evolving Techniques

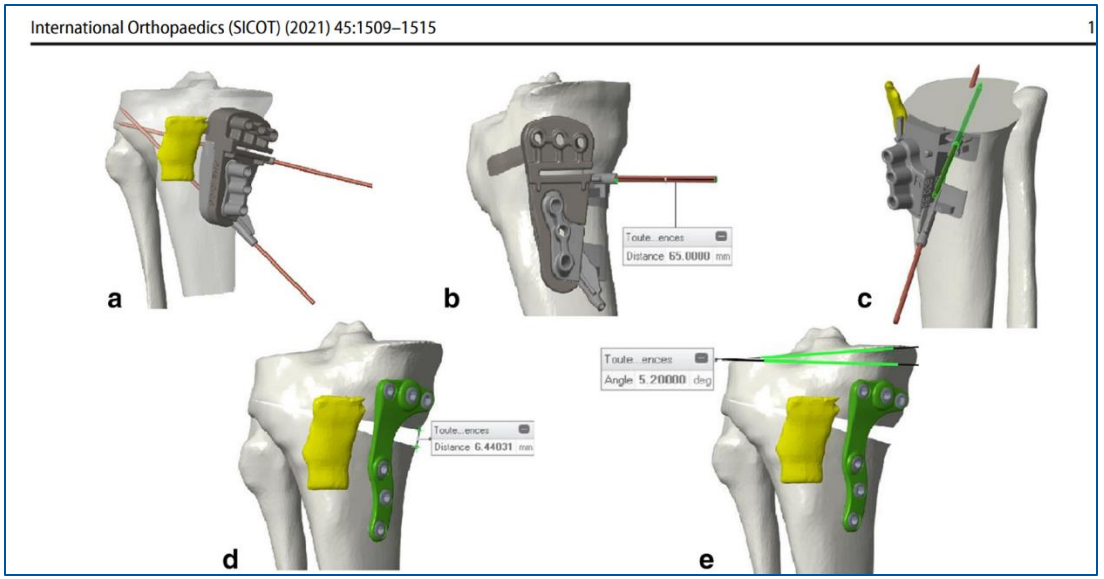
International Orthopaedics (2021) 45:1509–1515
https://doi.org/10.1007/s00264-021-04964-z

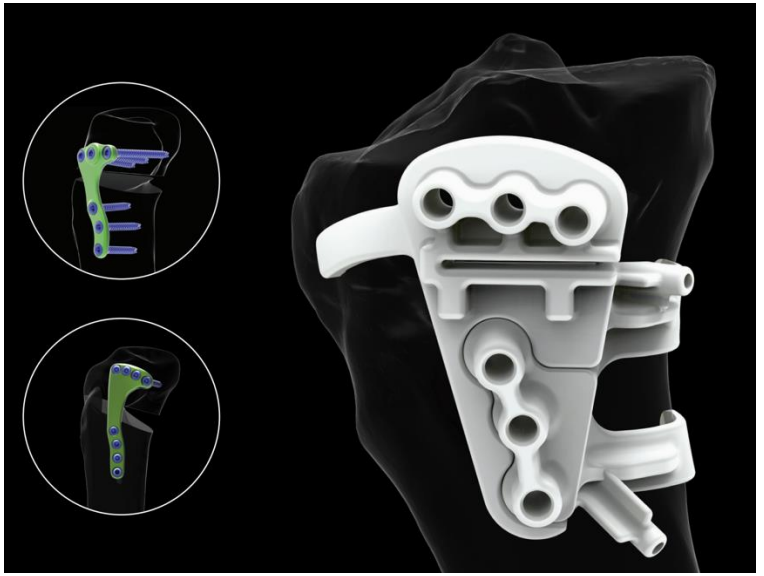
ORIGINAL PAPER

Check for updates

Early experience using patient-specific instrumentation in opening wedge high tibial osteotomy

Vlad Predescu [1,2] · Alina-Maria Grosu [2] · Iulian Gherman [2] · Catalin Prescura [2] · Valentin Hiohi [2] · Bogdan Deleanu [3]





Return to Activity

Clinical Sports Medicine Update

Return to Physical Activity After High Tibial Osteotomy or Unicompartmental Knee Arthroplasty

A Systematic Review and Pooling Data Analysis

James Belsey,*† MA, Sam K. Yasen,‡ MBBS, FRCS, MSc, Simon Jobson,† PhD, James Faulkner,† PhD, and Adrian J. Wilson,§ FRCS, MBBS, BSc
Investigation performed at Department of Sport, Exercise and Health, University of Winchester, Winchester, UK

2020

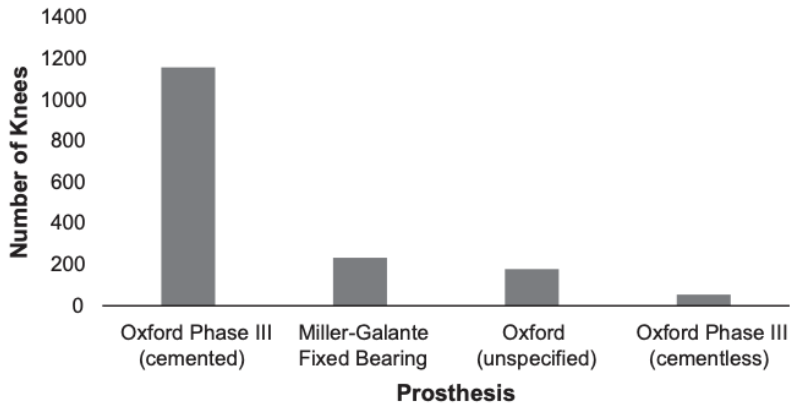


Figure 3. Total number and type of unicompartmental knee arthroplasty prostheses used in the included studies.

- Return to activity post HTO > UNI
- More variability in HTO techniques

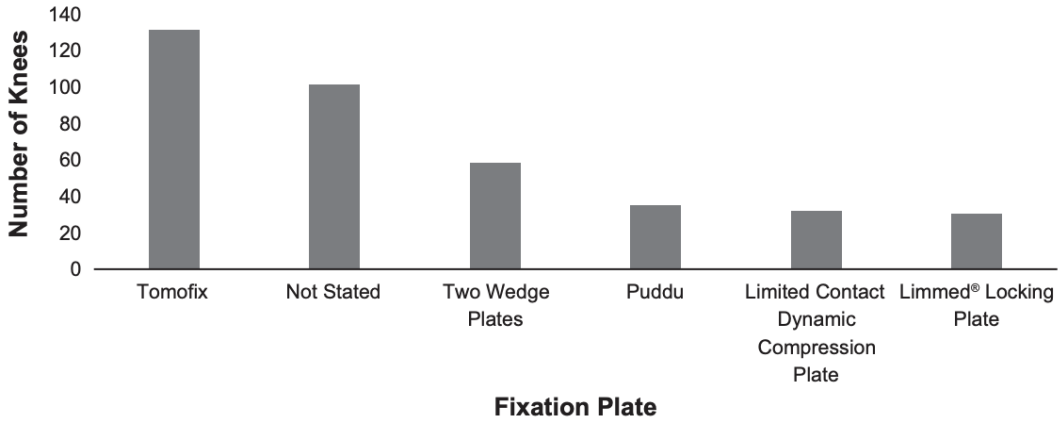


Figure 2. Total number and type of medial opening wedge high tibial osteotomy internal fixation plates used in the included studies.

Return to Activity

Knee Surgery, Sports Traumatology, Arthroscopy (2020) 28:3849–3857
https://doi.org/10.1007/s00167-020-05857-1

KNEE

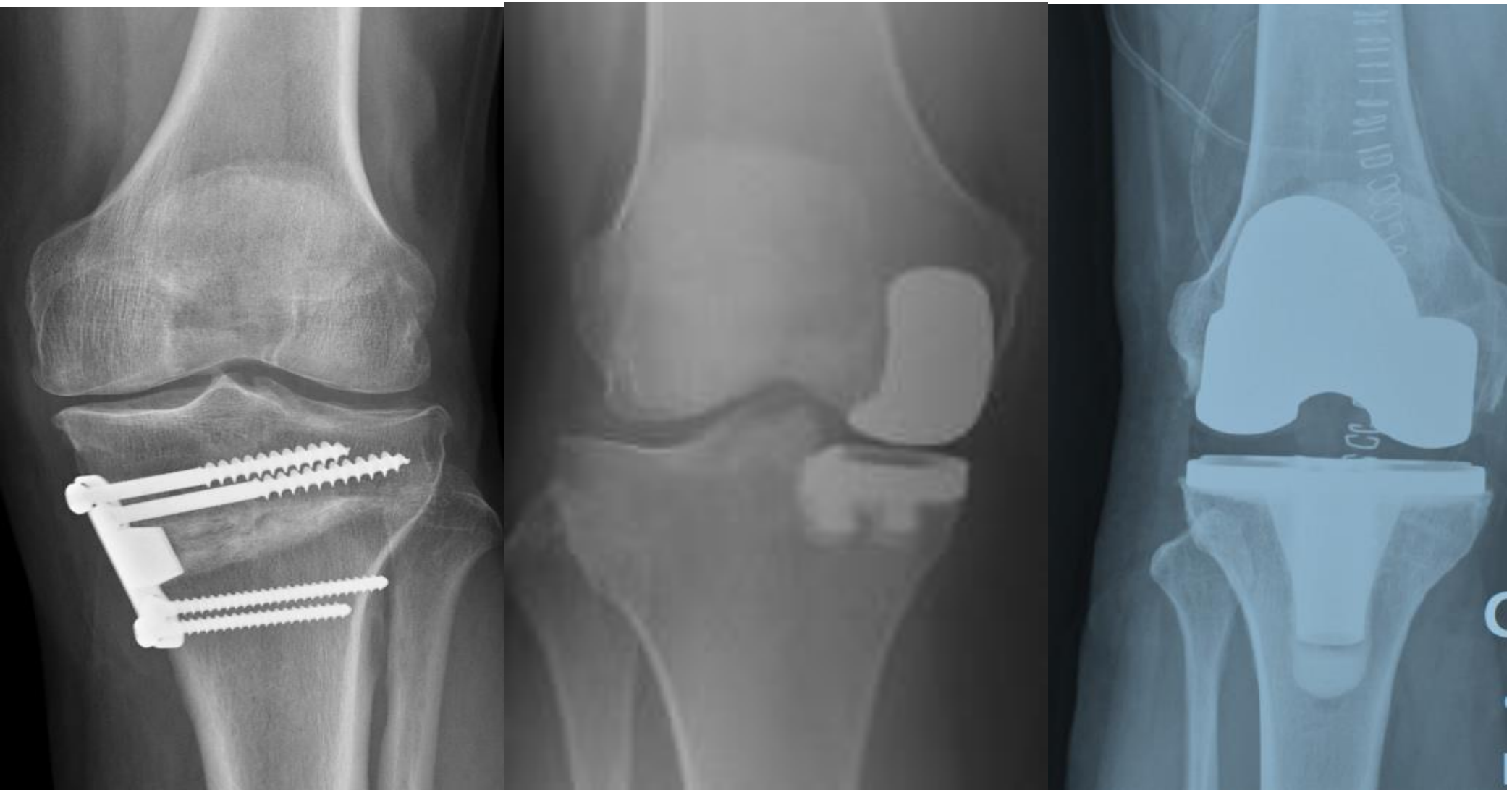
Opening wedge high tibial osteotomy allows better outcomes than unicompartmental knee arthroplasty in patients expecting to return to impact sports

Christophe Jacquet[1] · Firat Gulagaci[1] · Axel Schmidt[1] · Aniruddha Pendse[1] · Sebastien Parratte[2] · Jean-Noel Argenson[1] · Matthieu Ollivier[1]

Table 3 Patients' postoperative sports and functional outcomes

Parameters	HTO ± SD [range]	UKA ± SD [range]	*p* value
Mean time to return to previous professional occupation (months)	3 ± 3.0 [2–7]	4 ± 3.0 [2–13]	0.006*
Mean time to return to sport activities (months)	4.9 ± 2.2 [2–9]	5.8 ± 4.2 [2–13]	0.006*
Mean postoperative UCLA score	8.4 ± 1.6 [6–10]	6.5 ± 2 [3–10]	< 0.0001*°
Mean KSS symptom at 24 months	19 ± 5.4 [4–25]	20 ± 6.8 [4–25]	0.3
Mean KSS satisfaction at 24 months	33 ± 6 [10–40]	30 ± 8 [2–40]	0.04*
Mean KSS expectation at 24 months	8 ± 1.7 [3–14]	9 ± 2.4 [3–14]	0.3
Mean KSS activity at 24 months	84 ± 8 [62–100]	75 ± 9 [46–96]	0.006*°
Mean KSS subtotal at 24 months	61 ± 7 [44–78]	60 ± 9 [40–78]	0.6

Osteotomy vs UNI vs TKA ?



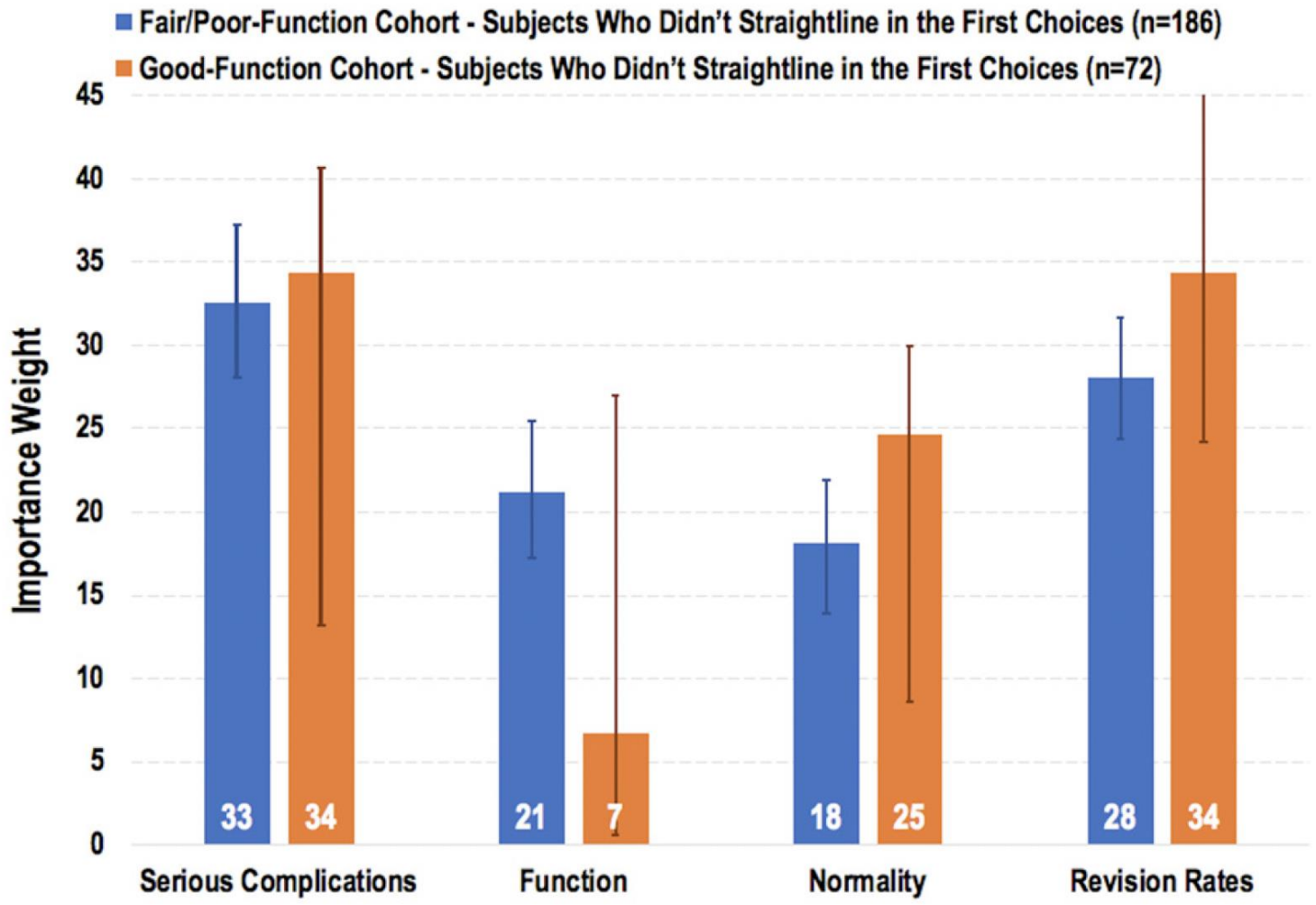
Patient preferences

Patient Preferences for Surgical Treatment of Knee Osteoarthritis

A Discrete-Choice Experiment Evaluating Total and Unicompartmental Knee Arthroplasty

Carolyn A. Hutyra, MMCi, Juan Marcos Gonzalez, PhD, Jui-Chen Yang, MEM, F. Reed Johnson, PhD, Shelby D. Reed, PhD, Annunziato Amendola, MD, Michael P. Bolognesi, MD, Keith R. Berend, MD, Michael E. Berend, MD, Steven J. MacDonald, MD, and Richard C. Mather III, MD, MBA

Patient preferences

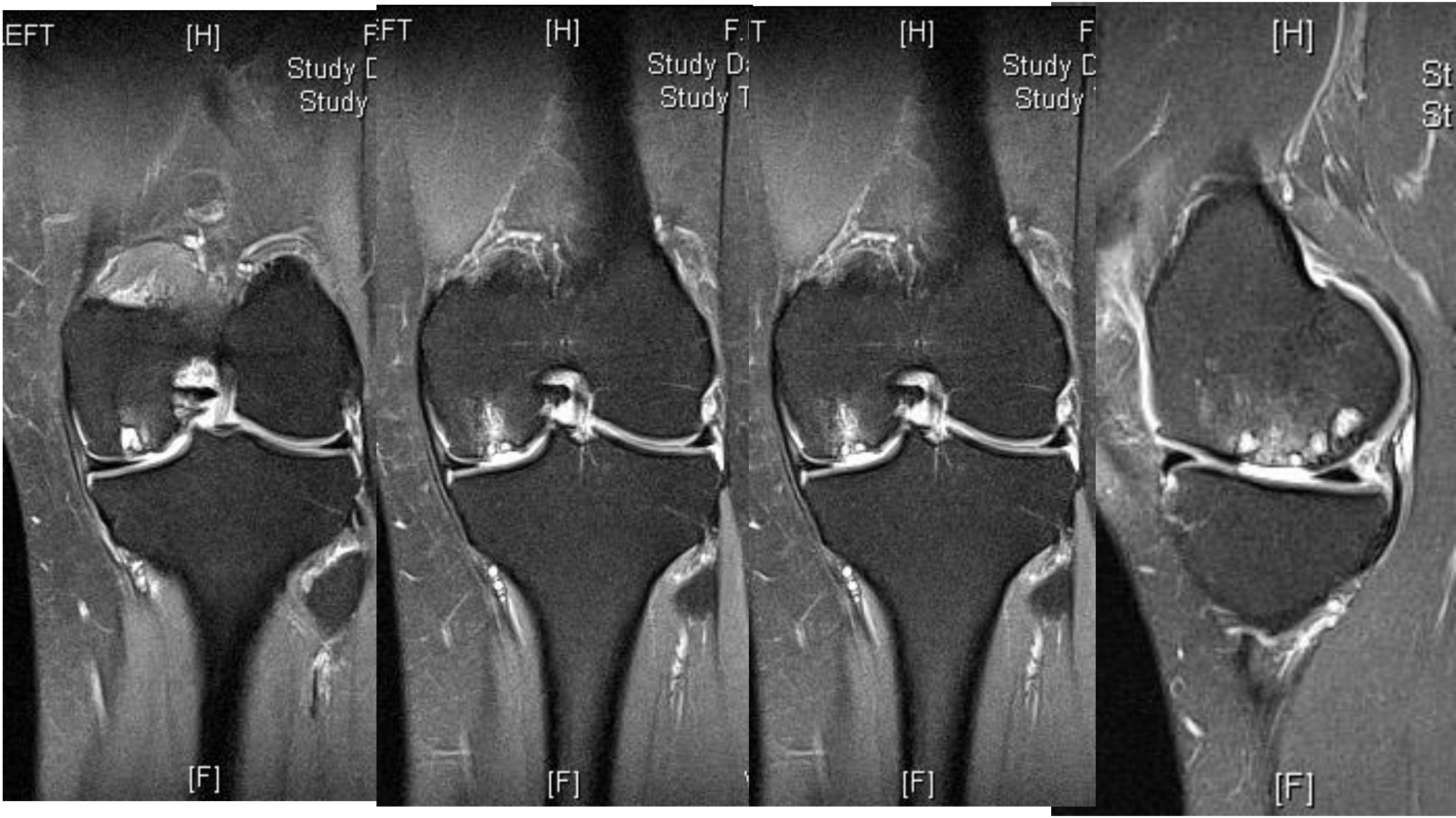


History

- 49 yo F, healthy active
- 5 yr history of progressive medial knee pain
- No instability
- No previous surgery
- Treated with multiple injections, unloader brace

- ***ON Exam :***
  - Symmetrical neutral knee alignment
  - ROM 0-135 bilateral
  - Tender medial joint line
  - Stable

Imaging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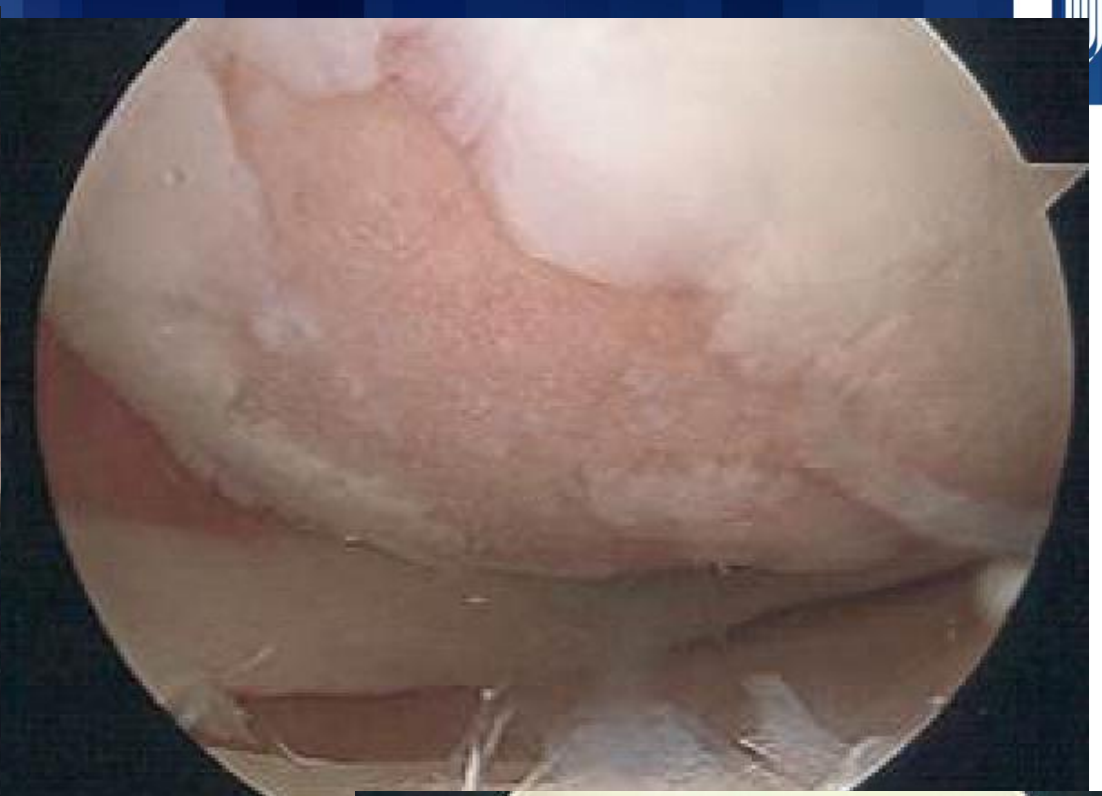
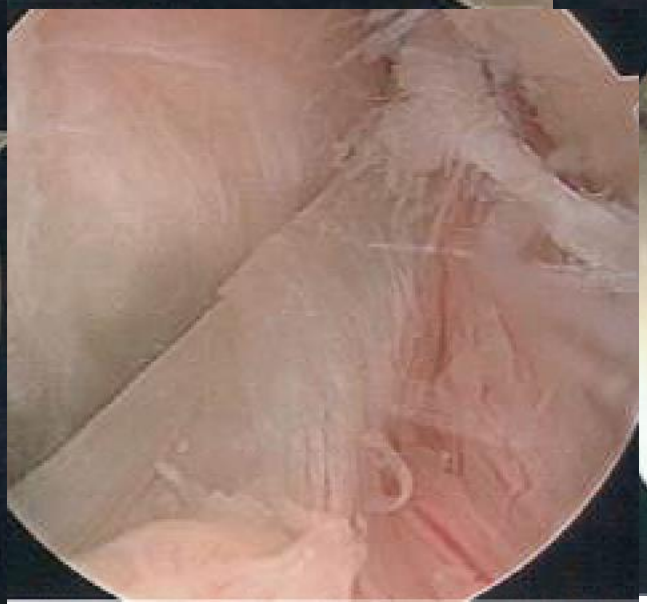
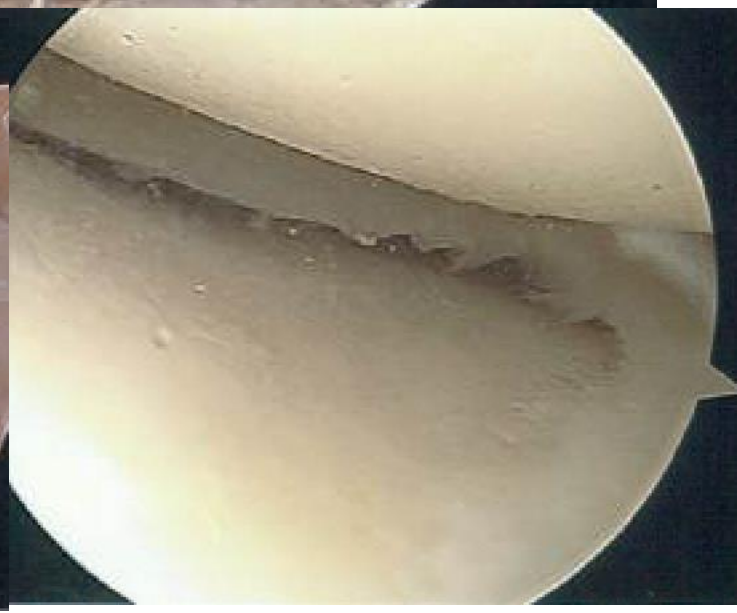


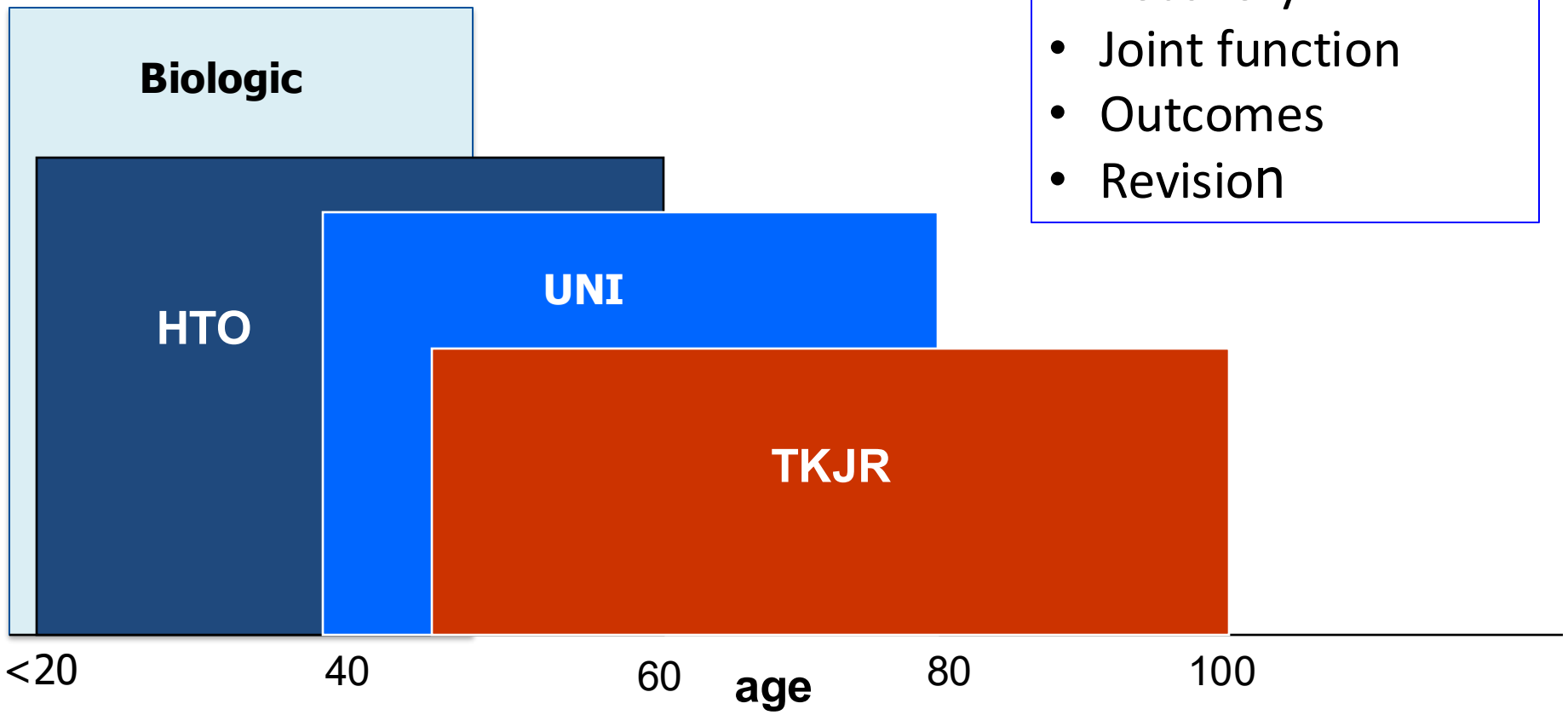
Pre operative planning: what to do ?

- HTO (? normal alignment)
- UNI
- TKA
- **Biologic Resurfacing**
  - **If so what?**

Indications

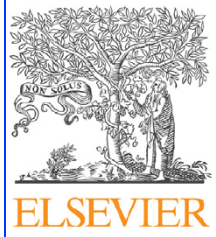
- It is a difficult decision ?

- Indications overlap
- Recovery
- Joint function
- Outcomes
- Revision



HTO vs UNI

Literature review



Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Review

Unicompartmental Knee Arthroplasty vs High Tibial Osteotomy for Knee Osteoarthritis: A Systematic Review and Meta-Analysis

ZhenWu Cao, MM [a], XiuJun Mai, MM [b], Jun Wang, MM [a], EnHui Feng, MM [b], YongMing Huang, MD [b,*]

- 10 studies (2001-2017) out of **3200** were comparisons between HTO and UNI
- Blinding was difficult in almost all studies

Literature review , Cao con't

- Both HTO and UNI had comparable postoperative outcomes
- UNI had less complications, less postoperative pain, less revision to TKA
- HTO had better postoperative ROM, function
- **Conclusion:**
  - **HTO may be more suitable for higher demand patients**

Osteotomy vs UNI ?

Unicompartmental Knee Arthroplasty Provides Higher Activity and Durability Than Valgus-Producing Proximal Tibial Osteotomy at 5 to 7 Years

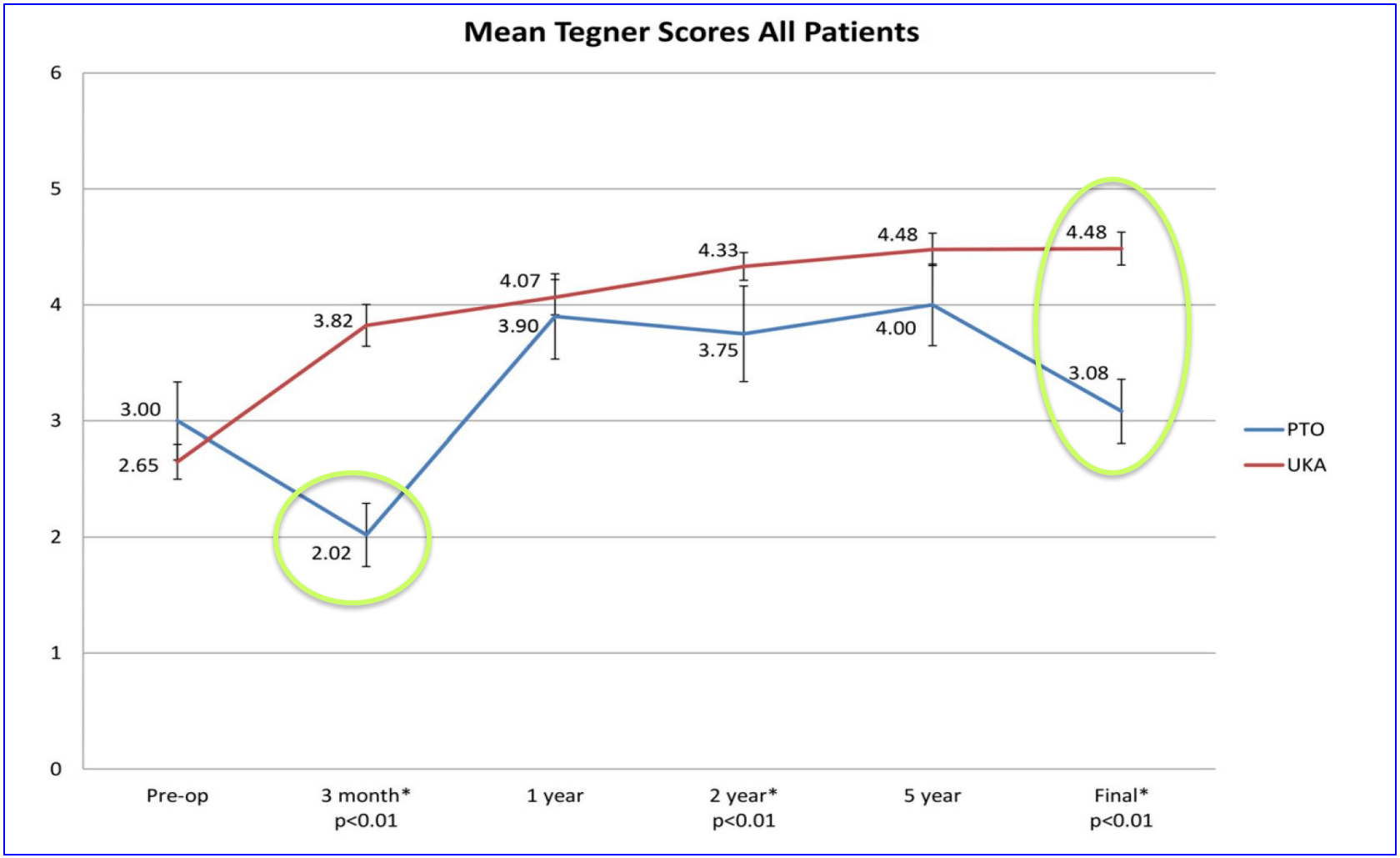
Aaron J. Krych, MD, Patrick Reardon, MD, Paul Sousa, MD, Ayoosh Pareek, BS, Michael Stuart, MD, and Mark Pagnano, MD

Investigation performed at the Department of Orthopedic Surgery and Sports Medicine, Mayo Clinic, Rochester, Minnesota

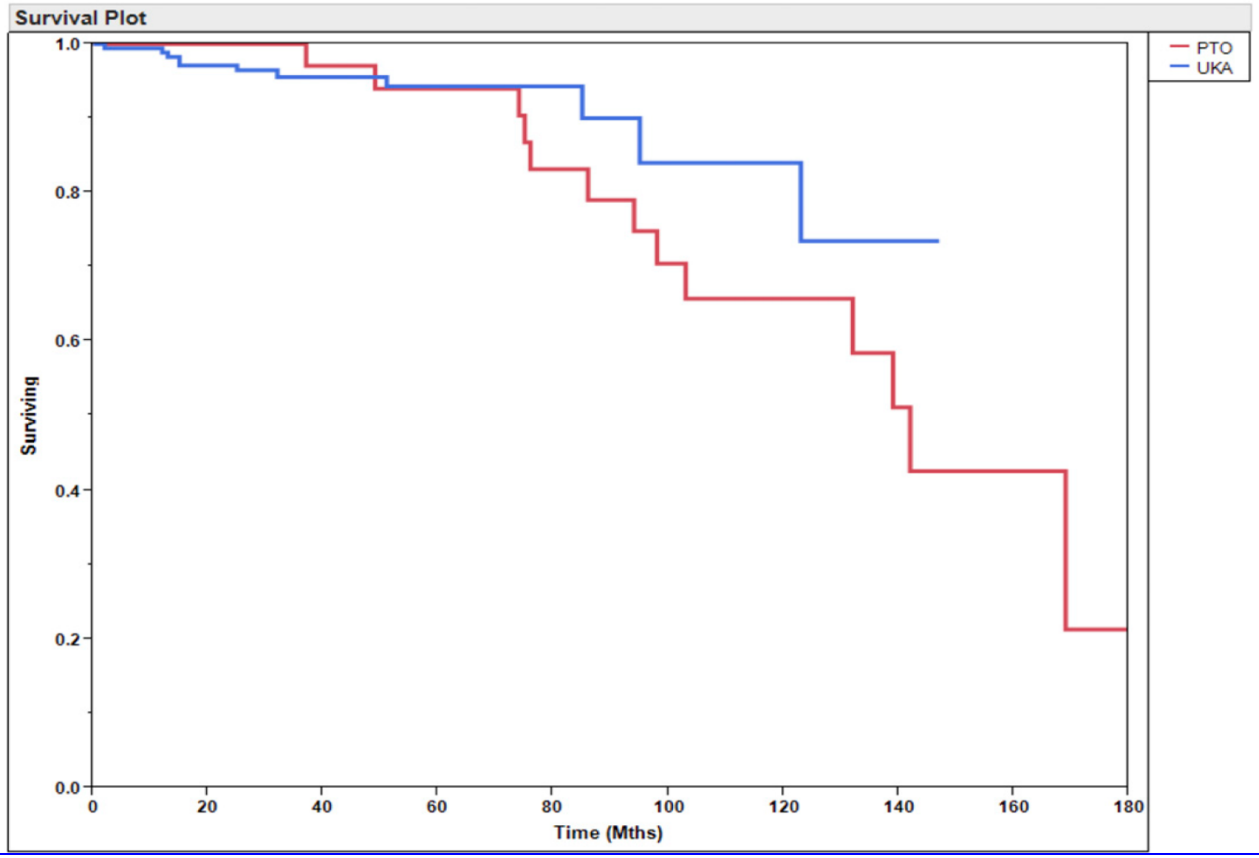
TABLE I Comparison of Baseline Characteristics of Patients Who Were ≤55 Years Old with Documented Follow-up and Those Lost to Follow-up Who Underwent PTO or UKA at a Single Institution Between 1998 and 2013*

	No. of Patients			Age		BMI		Sex		Preop. Tegner Score	
	Total	PTO Group	UKA Group	Mean *(yr)*	P Value†	Mean *(kg/m²)*	P Value†	Ratio (M:F)	P Value‡	Mean	P Value†
All patients					<0.01		NS		<0.01		NS
PTO	57			43		31.8		2.57		3.0	
UKA	183			49		32.4		0.82		2.6	
3-mo Tegner					0.03		NS		NS		0.03
Documented	193	52	141	47		32.5		1.08		2.8	
Lost to follow-up	47	5	42	49		31.2		0.96		2.4	

Krych et al con't



Krych et al con't



Radiographic Evaluation

- mean Kellgren-Lawrence score was 2 for the PTO group compared with 3 for the UKA group ($p < 0.01$).
- **Mean alignment (and standard deviation) following correction for patients undergoing PTO was 1.3 ± 2.4 of valgus (**
  (3-5 deg valgus in MA , or 8-10 deg anatomic valgus)

Table 1. Results of TKA Following HTO

Author	Year	Follow-up (Years)	TKA (No.)	Results
Katz	1987	2.9	21	Results worse than primary TKA
Staheli	1987	3.7	35	Results similar to primary TKA
Windsor	1988	4.6	45	80% had patella baja, results similar to revision TKA
Scuderi	1989	N/A	66	89% had patella baja
Amendola	1989	3.1	42	Knee scores similar, but less ROM in the HTO group
Jackson	1994		20	Worse results after HTO compared to UKR, because of complications
Mont	1994	6.1	73	Worse knee scores in HTO group
Gill	1995	3.8	30	Better results after HTO than after UKR
Bergenudd	1997	4-9	14	No difference in knee scores, more complications in HTO group
Toksvig	1998	10	40	knee scores same , RSA tibial movement same
Walther	2000		35	Worse knee scores in HTO group
Meding	2000	7.5	39	No difference in knee scores when compared with TKA in opposite knee

Koval, KJ (ed): *Orthopaedic Knowledge Update 7.* Rosemont, IL. American Academy of Orthopaedic Surgeons. 2002 Ch. 44,

Opening vs Closing Wedge ?

OWO vs CWO to TKR?

Clin Orthop Relat Res
DOI 10.1007/s11999-013-3040-5

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

SYMPOSIUM: 2013 KNEE SOCIETY PROCEEDINGS

Total Knee Arthroplasty After High Tibial Osteotomy

No Differences Between Medial and Lateral Osteotomy Approaches

Stephen Preston MDCM, James Howard MD, FRCSC,
Douglas Naudie MD, FRCSC, Lyndsay Somerville PhD,
James McAuley MD, FRCSC

HTO Complications: Is there a concern revising an HTO to TKA?

International Orthopaedics (SICOT) (2013) 37:427–431
DOI 10.1007/s00264-012-1765-5

ORIGINA

Total k
a comp

Ricardo Ba
Victoria Du
José Maur

Table 2 Intra-operative comparison of the opening and closing wedge groups

	Opening (n=24)	Closing (n=117)	Significance
Tourniquet Time (minutes)	86.2±20.4	84.0±20.0	p=0.63
Additional Exposure Performed	2 (8.3 %)	29 (24.8 %)	p=0.08
Tibial tubercle osteotomy	2 (8.3 %)	26 (22.2 %)	
Quadriceps Snip	0 (0 %)	3 (2.6 %)	
Femoral Valgus Cut (degrees)	6.6±0.9	6.3±1.0	p=0.17
Thickness of Tibial Cut (mm)	8.7±1.3	6.9±1.5	p=0.0001
Medial Release Performed	22 (91.7 %)	65 (55.5 %)	p<0.0001
Capsule only	13 (54.2 %)	48 (41 %)	
Capsule + semimembranosus	0 (0 %)	6 (5.1 %)	
Capsule + semimembranosus + MCL	9 (37.5 %)	11 (9.4 %)	
Lateral Release Performed	11 (46.0 %)	67 (57.2 %)	p=0.32
Capsule only	10 (41.7 %)	28 (23.9 %)	
Capsule + IT band	1 (4.2 %)	25 (21.0 %)	
Lateral Collateral Ligament	0 (0 %)	6 (5.1 %)	
Popliteus	0 (0 %)	6 (5.1 %)	
Lateral Epicondyle Osteotomy	0 (0 %)	2 (1.7 %)	
Intra-operative complications	1 (4.2 %)	3 (2.6 %)	p=0.33

IT Iliotibial, MCl medial collateral ligament

HTO : How I Decide when to do Osteotomy ?

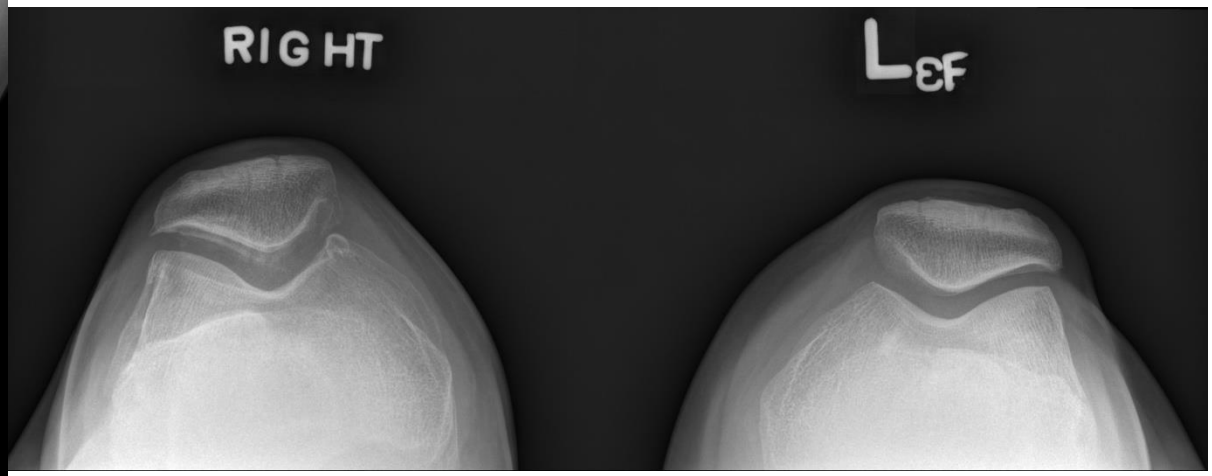
- **Choose the right patients!!**
  - **VERY educated**
  - **Healthy**
  - **Mild to Moderate severity**
  - **Desire to remain active**

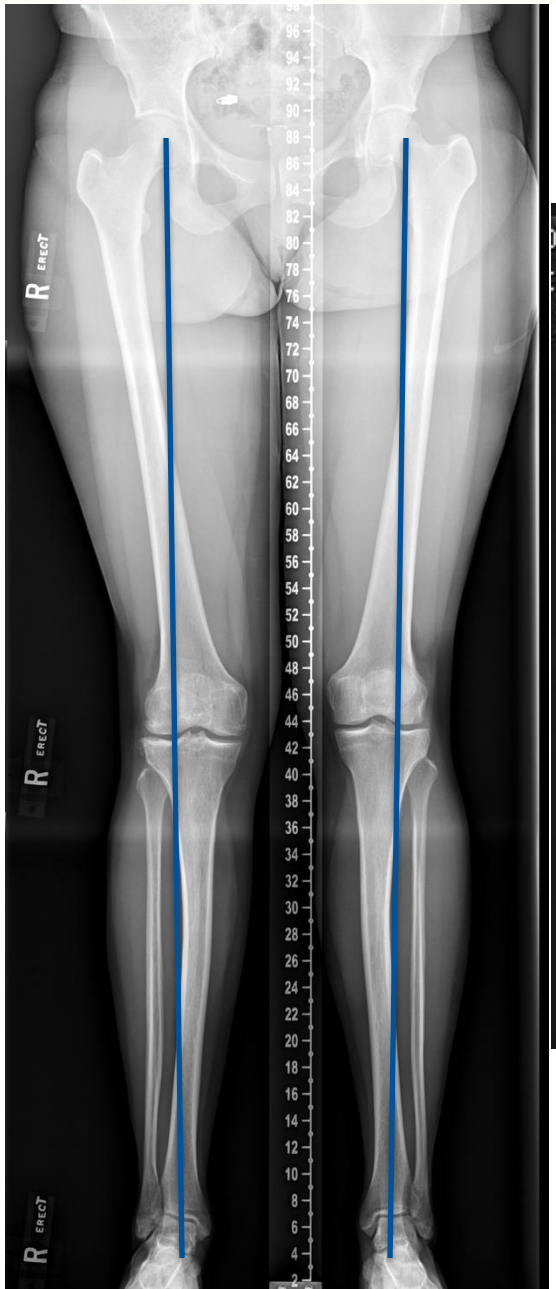
Summary : UNI vs HTO vs TKA

How I Decide?

- Articular cartilage resurfacing and/or meniscal transplantation and/or ACLR with compartment overload , by definition needs an Osteotomy
- Any patient who desires to go back to unlimited activity , ie sports, farming, outdoor activites, laboring work, High BMI , I recommend an osteotomy
- Women > men >50 who have bilateral disease, prefer to recommend UNI (simultaneous)
- Low demand > 50 bone on bone disease recommend UNI
- Lateral compartment changes, advanced PF changes >50 consider TKA

Case : 35 yo F coach , R knee valgus deformity, meniscal deficiency, cartilage loss



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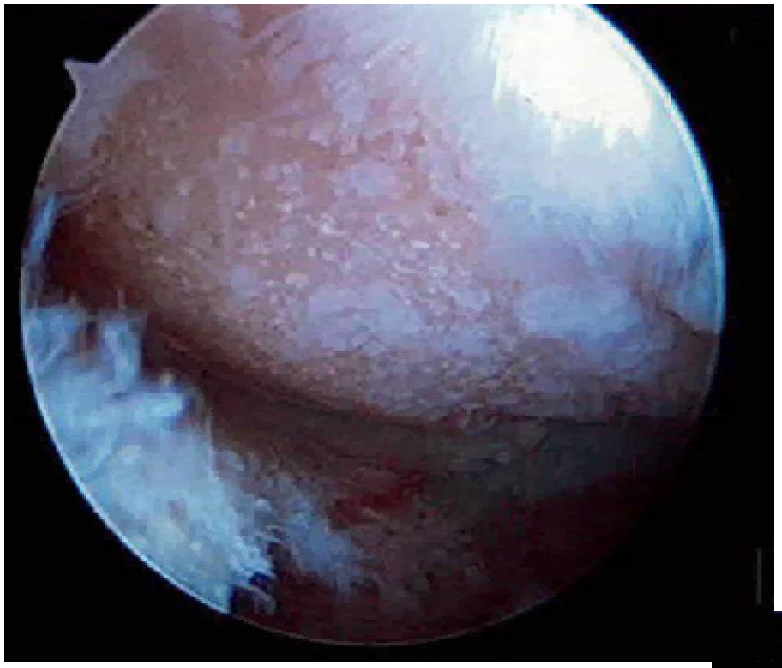

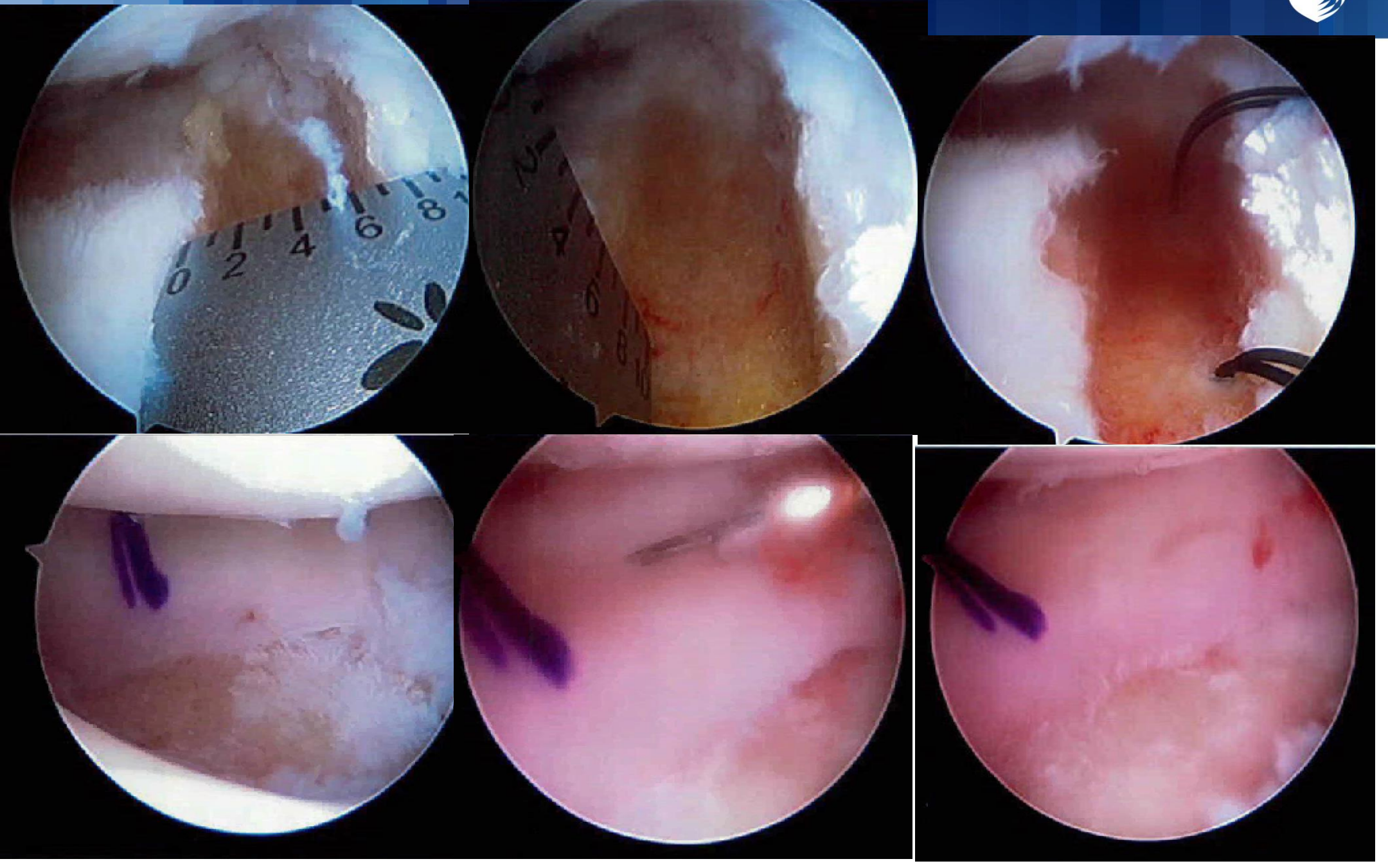

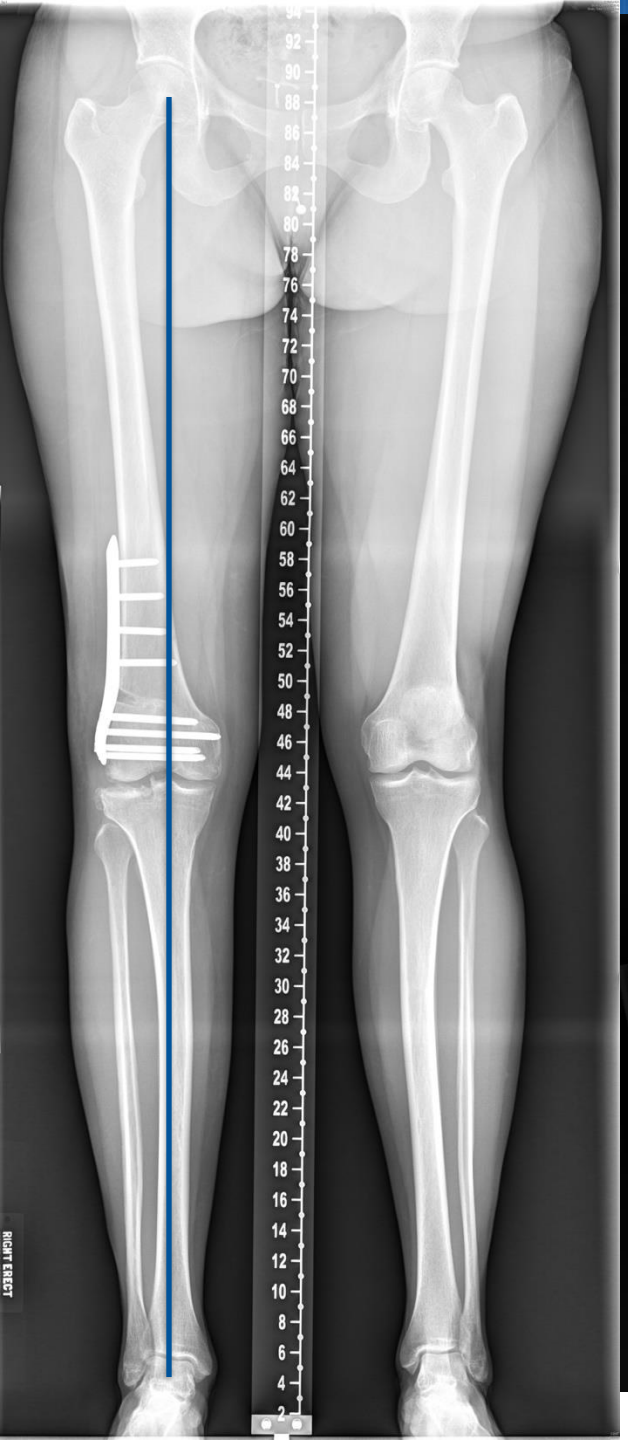
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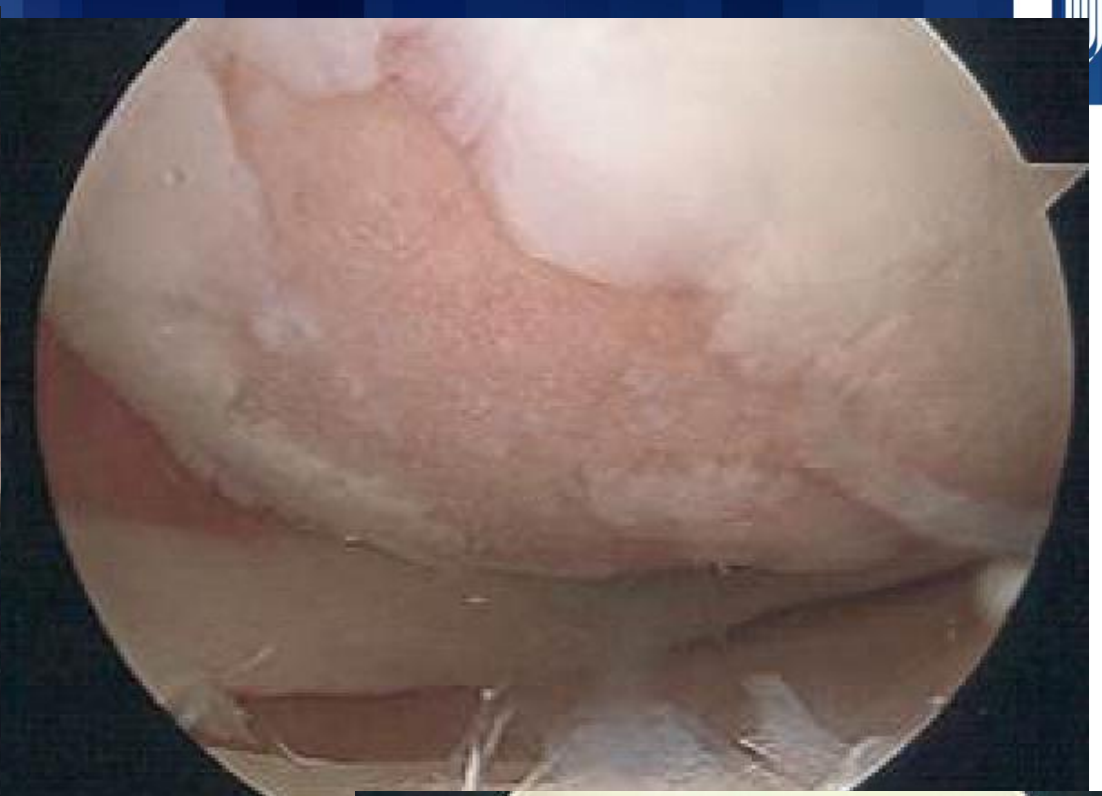

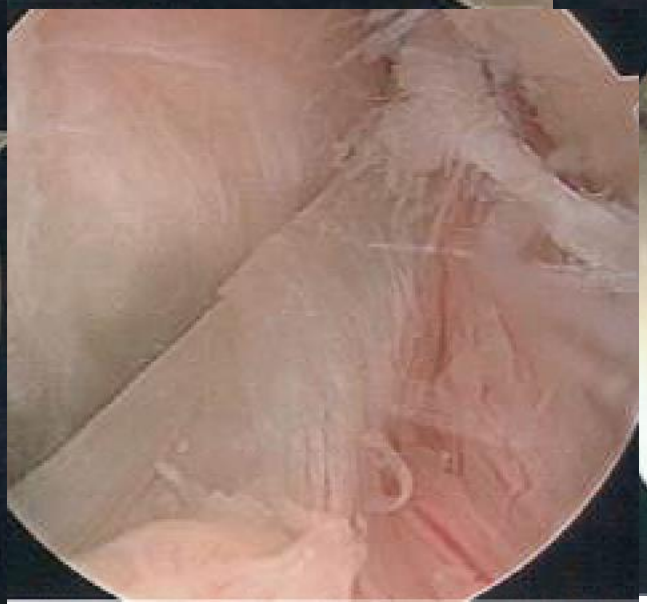
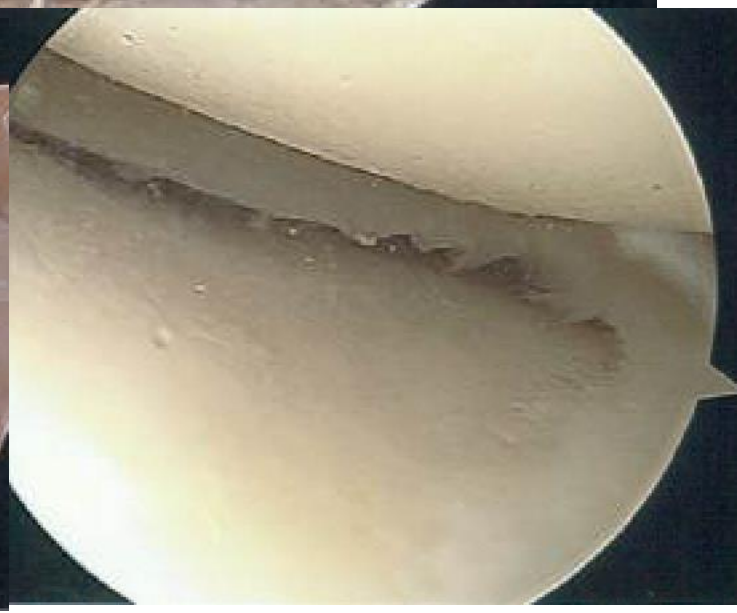

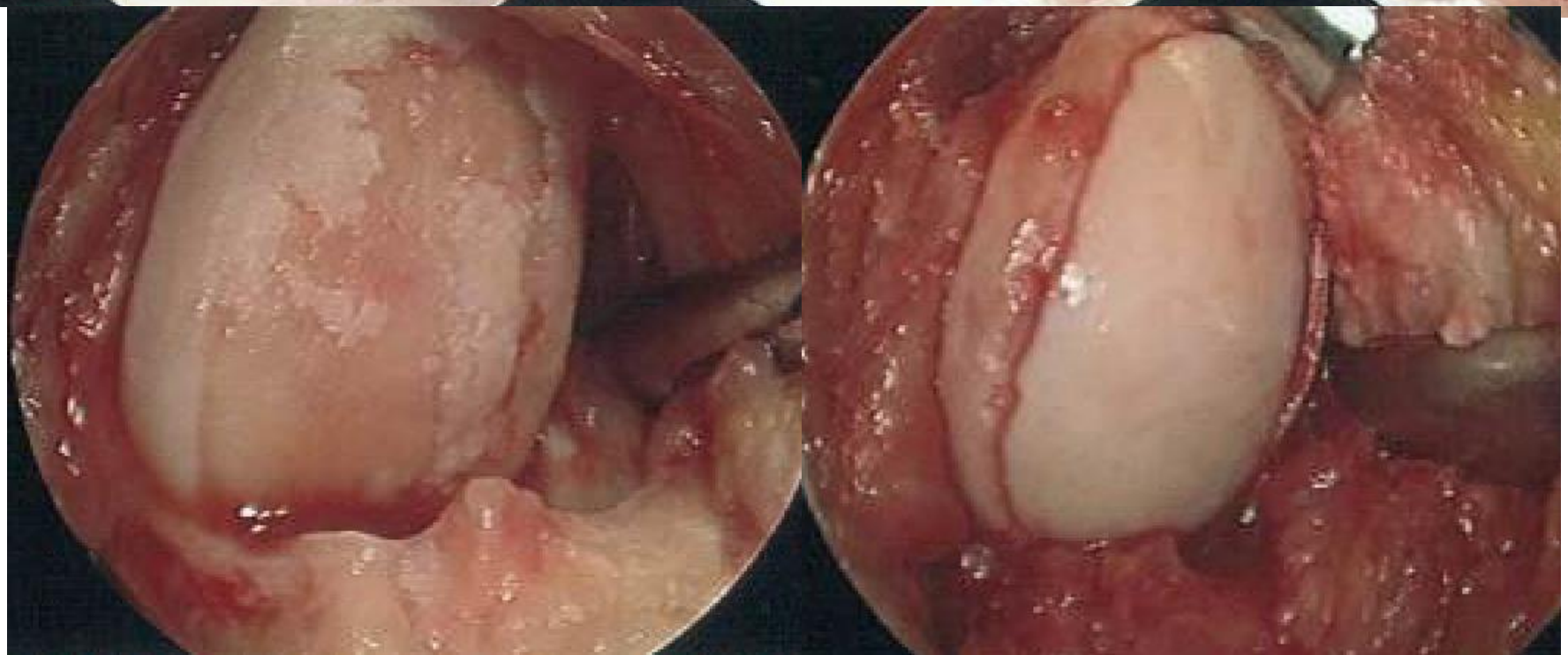

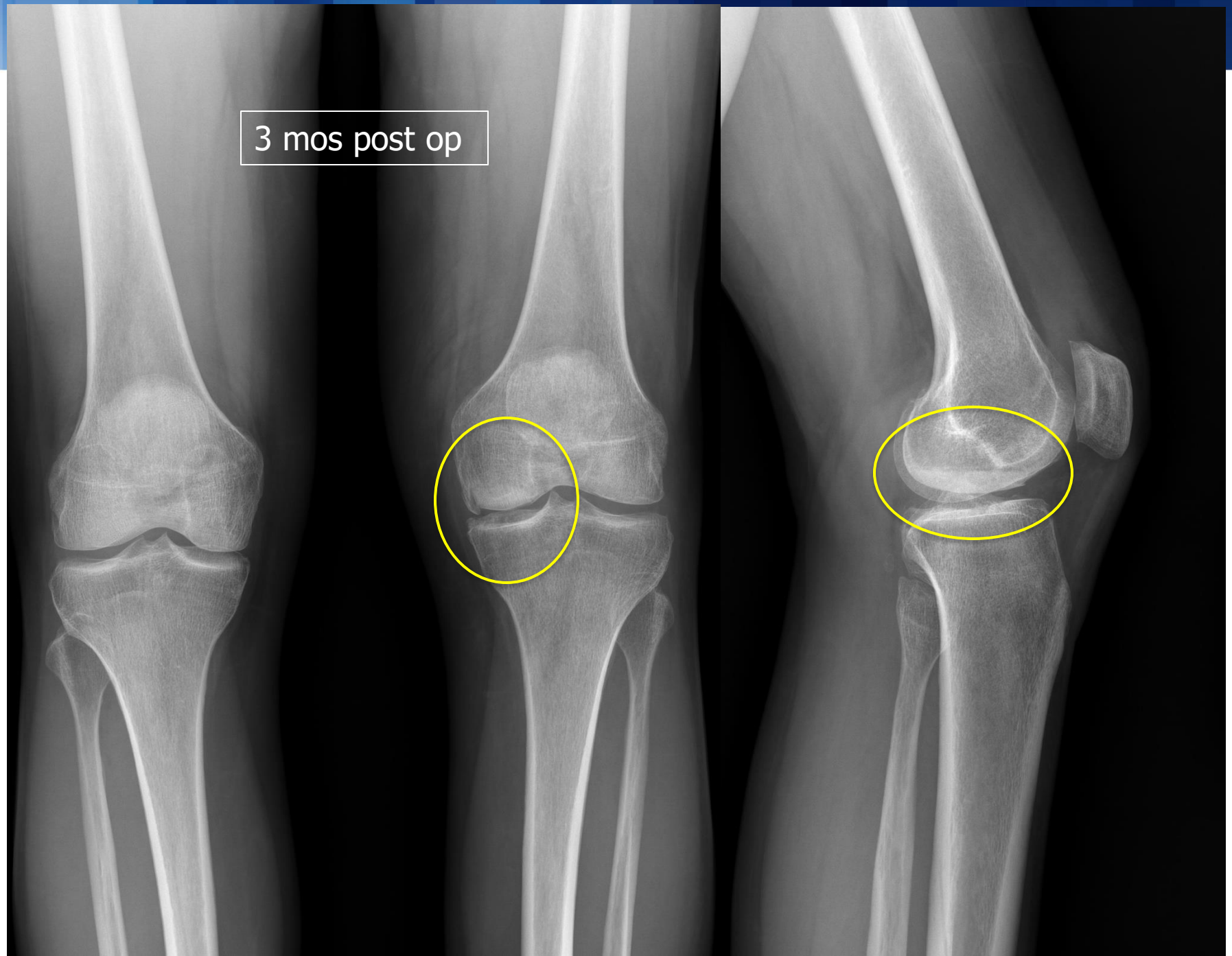
3 mos post op

3 months post op

Case Continued

- 2 year follow up
  - Doing very well with ADL's
  - No running or impact activity
  - Unlimited walking, hiking and biking

Unicompartmental OA in the young patient ("Boomer Knee")

Conclusions

- **Non-Operative Rx**
- **Biologic Reconstruction**
  - ***Optimal Biomechanical environment***
  - Alignment
  - Stability
  - Meniscal status
  - Cartilage
- **HTO/UNI/TKR : Individualize indications**


Thank you