



# 8th Advanced Course on Knee Surgery

January 23rd to 27th - 2022



## How to deal with Knee Recurvatum

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Chief, Division of Sports Medicine  
Duke University





## Recurvatum : definition

- genu recurvatum Etymology: L, *genu*, knee, *recurvare*, to bend back a deformity in which the lower leg is **hyperextended** at the knee joint





# Hyperextension is a Risk Factor

## Does Severity or Specific Joint Laxity Influence Clinical Outcomes of Anterior Cruciate Ligament Reconstruction?

Sung-Jae Kim MD, Hong-Kyo Moon MD,  
Sul-Gee Kim MD, Yong-Min Chun MD,  
Kyung-Soo Oh MD

CORR 2009

**Table 5.** Comparison of clinical outcomes according to the knee hyperextension

Presence or absence of hyperextension	KT2000 <sup>TM</sup> (mm)*			IKDC (A or B) <sup>†</sup>			Lysholm*		
	BPTB	Hamstring	p value	BPTB	Hamstring	p value	BPTB	Hamstring	p value
Normal knee laxity (n = 204)	2.50 (1.3)	3.53 (1.0)	0.009	110 (78.6%)	53 (79.1%)	0.257	90.2 (8.6)	87.3 (7.9)	0.72
Hyperextension (n = 68)	3.39 (1.2)	4.38 (1.2)	0.012	29 (80.6%)	19 (65.5%)	0.067	90.9 (8.2)	83.0 (7.4)	0.008

\* Data are expressed as means, with standard deviations in parentheses; <sup>†</sup>number of patients scoring IKDC A or B. IKDC = International Knee Documentation Committee; BPTB = bone-patellar tendon-bone.





# Hyperextension is a risk factor

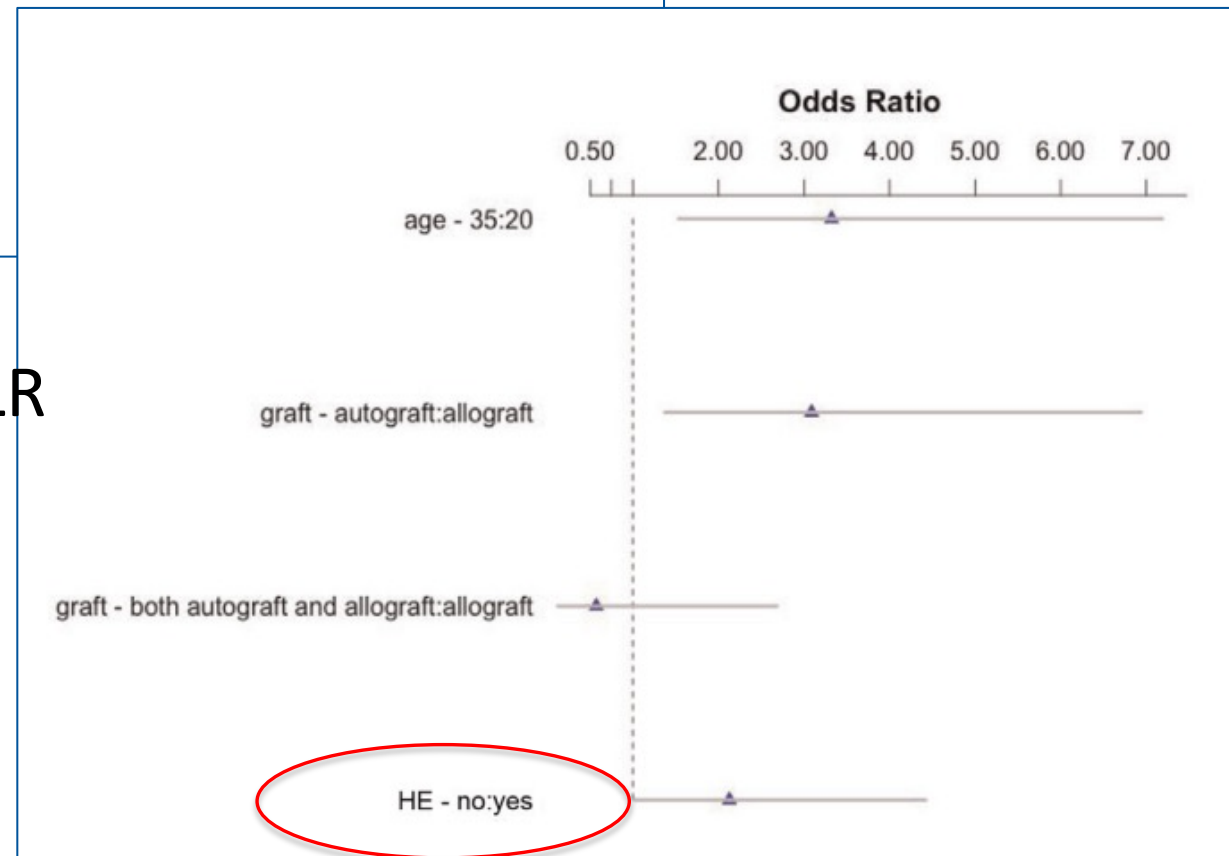
## Physiologic Preoperative Knee Hyperextension Is a Predictor of Failure in an Anterior Cruciate Ligament Revision Cohort

AJSM 20218

### A Report From the MARS Group

The MARS Group\*†

- 1145 patients revision ACLR
- 2 yr follow up

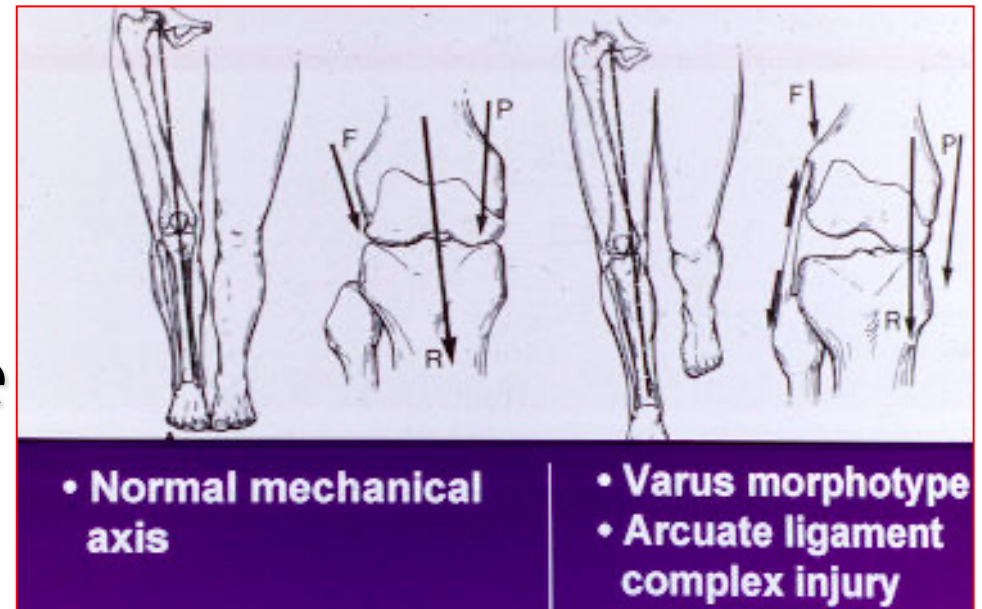






# Varus deformity + ACL deficiency

- Etiology:
  - ◆ Triple varus knee - Noyes
  - ◆ Post meniscectomy
  - ◆ Poor joint control with pre existing varus



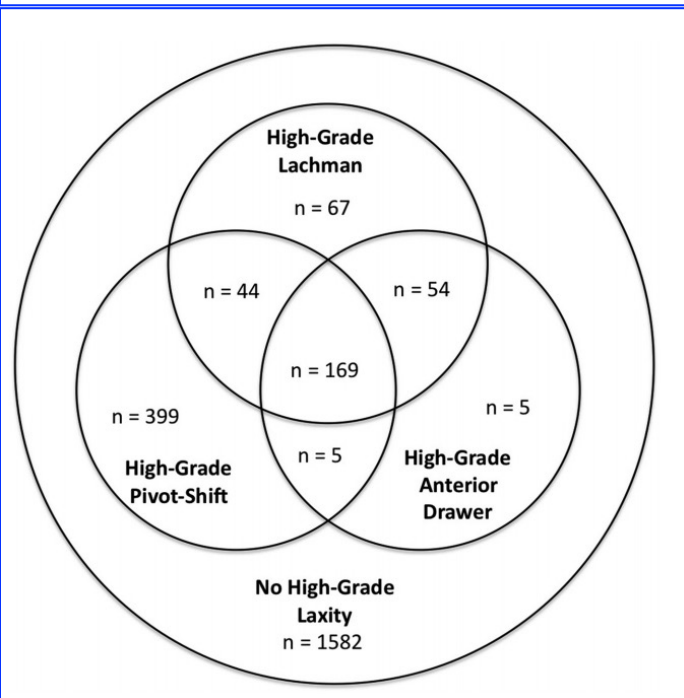
*Jakob,staubli*



## Effect of High-Grade Preoperative Knee Laxity on Anterior Cruciate Ligament Reconstruction Outcomes

AJSM 2016

Robert A. Magnussen,<sup>\*†‡</sup> MD, MPH, Emily K. Reinke,<sup>§</sup> PhD, Laura J. Huston,<sup>§</sup> MS, MOON Group,<sup>\*\*</sup> Timothy E. Hewett,<sup>||¶</sup> PhD, and Kurt P. Spindler,<sup>#</sup> MD  
*Investigation performed by Multicenter Orthopaedic Outcomes Network*



- Higher failure rates with excess laxity on physical examination
- *Need for additional stability?*

# ACLR Failure: Knee laxity



- **Anterolateral augmentation ( LET or ALL ) may be of benefit in conjunction with ACLR**
  - **Hyperlaxity**
  - **ACL revision**
  - **High degree laxity**



## Lateral Augmentation Procedures in Anterior Cruciate Ligament Reconstruction

CME

### Anatomic, Biomechanical, Imaging, and Clinical Evidence

Alexander E. Weber,<sup>\*†</sup> MD, William Zuke,<sup>‡</sup> BA, Erik N. Mayer,<sup>†</sup> BS, Brian Forsythe,<sup>‡</sup> MD, Alan Getgood,<sup>§</sup> MD, Nikhil N. Verma,<sup>‡</sup> MD, Bernard R. Bach,<sup>‡</sup> MD, Asheesh Bedi,<sup>||</sup> MD, and Brian J. Cole,<sup>‡</sup> MD, MBA  
*Investigation performed at Midwest Orthopaedics at Rush, Rush University Medical Center, Chicago, Illinois, USA*

## Clinical Results of Combined ACL and Anterolateral Ligament Reconstruction: A Narrative Review from the SANTI Study Group

Adnan Saithna, MD<sup>1,2,3</sup>  Matt Daggett, MD<sup>1,2</sup> Camilo Partezani Helito, MD, PhD<sup>4,5</sup>  
Eduardo Monaco, MD<sup>6</sup> Florent Franck, MD<sup>7</sup> Thais Dutra Vieira, MD<sup>7,8</sup>  Charles Pioger, MD<sup>7</sup>  
Jin Goo Kim, MD, PhD<sup>9</sup> Bertrand Sonnery-Cottet, MD<sup>7,8</sup>





# ACLR Failure: Knee laxity



- Hamstring ACLR with LET = reduced clinical and graft failure

## Lateral Extra-articular Tenodesis Reduces Failure of Hamstring Tendon Autograft Anterior Cruciate Ligament Reconstruction

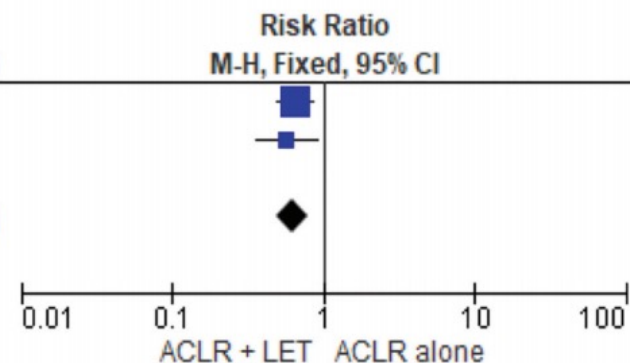


### 2-Year Outcomes From the STABILITY Study Randomized Clinical Trial

Alan M.J. Getgood,\* MD, FRCS(Tr&Orth), Dianne M. Bryant, MSc, PhD, Robert Litchfield, MD, FRCSC, Mark Heard, MD, FRCSC, Robert G. McCormack, MD, FRCSC, Alex Rezansoff, MD, FRCSC, Devin Peterson, MD, FRCSC, Davide Bardana, MD, FRCSC, Peter B. MacDonald, MD, FRCSC, Peter C.M. Verdonk, MD, PhD, Tim Spalding, FRCS, and the STABILITY Study Group  
*Investigation performed at The Fowler Kennedy Sport Medicine Clinic,*

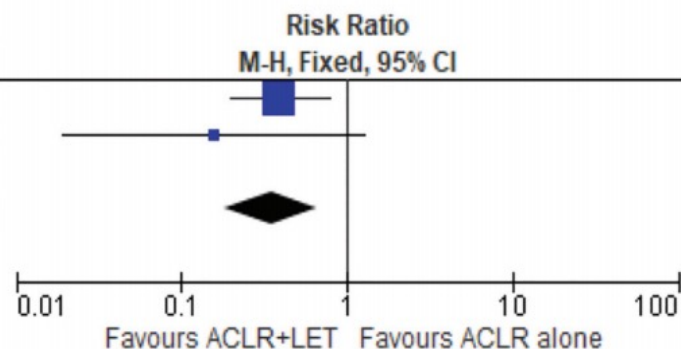
**A**

Study or Subgroup	ACLR + LET		ACLR alone		Weight	Risk Ratio	
	Events	Total	Events	Total		M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
14 to 19 yo	49	171	83	187	68.0%	0.65	[0.49, 0.86]
20 to 25 yo	22	120	36	112	32.0%	0.57	[0.36, 0.91]
<b>Total (95% CI)</b>		<b>291</b>		<b>299</b>	<b>100.0%</b>	<b>0.62</b>	<b>[0.49, 0.79]</b>
Total events	71		119				
Heterogeneity: Chi <sup>2</sup> = 0.20, df = 1 (P = 0.65); I <sup>2</sup> = 0%							
Test for overall effect: Z = 3.82 (P = 0.0001)							



**B**

Study or Subgroup	ACLR + LET		ACLR alone		Weight	Risk Ratio	
	Events	Total	Events	Total		M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
14 to 19 yo	10	171	28	187	81.2%	0.39	[0.20, 0.78]
20 to 25 yo	1	120	6	112	18.8%	0.16	[0.02, 1.27]
<b>Total (95% CI)</b>		<b>291</b>		<b>299</b>	<b>100.0%</b>	<b>0.35</b>	<b>[0.18, 0.67]</b>
Total events	11		34				
Heterogeneity: Chi <sup>2</sup> = 0.67, df = 1 (P = 0.41); I <sup>2</sup> = 0%							
Test for overall effect: Z = 3.19 (P = 0.001)							



# Knee OSTEOTOMY: **Indications**



**Malalignment**

+

**Arthrosis**

**Malalignment**

+

**Instability**



**Malalignment**

+

**Arthrosis /  
Cartilage**

+

**Instability**

**Malalignment**

+

**Meniscal  
Transplantation**



# Limb Alignment and Instability

- Indications
- When should an osteotomy be considered in the **ACL deficient knee** ?
  1. Coronal ( genu varum)
  2. Sagittal ( tibial slope)
  3. **Recurvatum ( combination )**

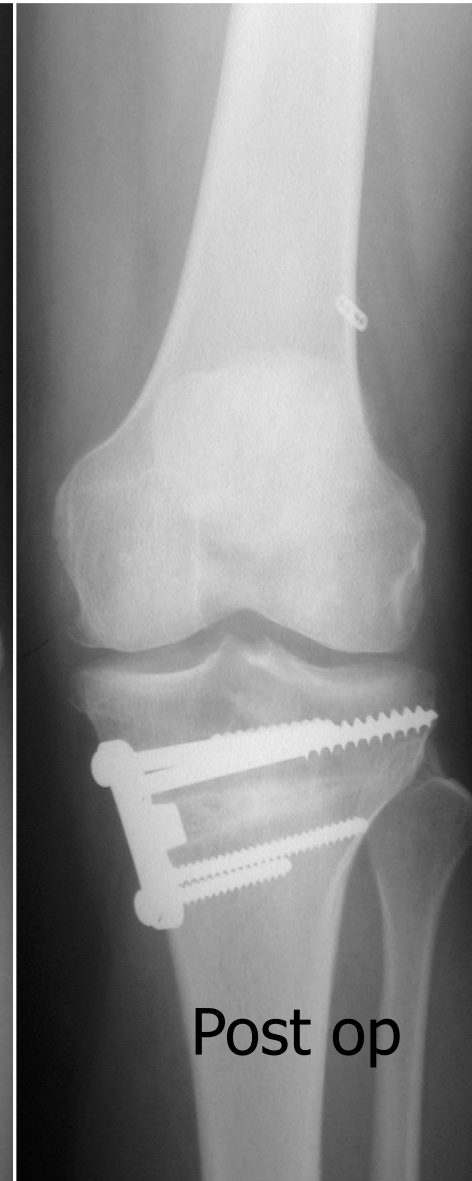
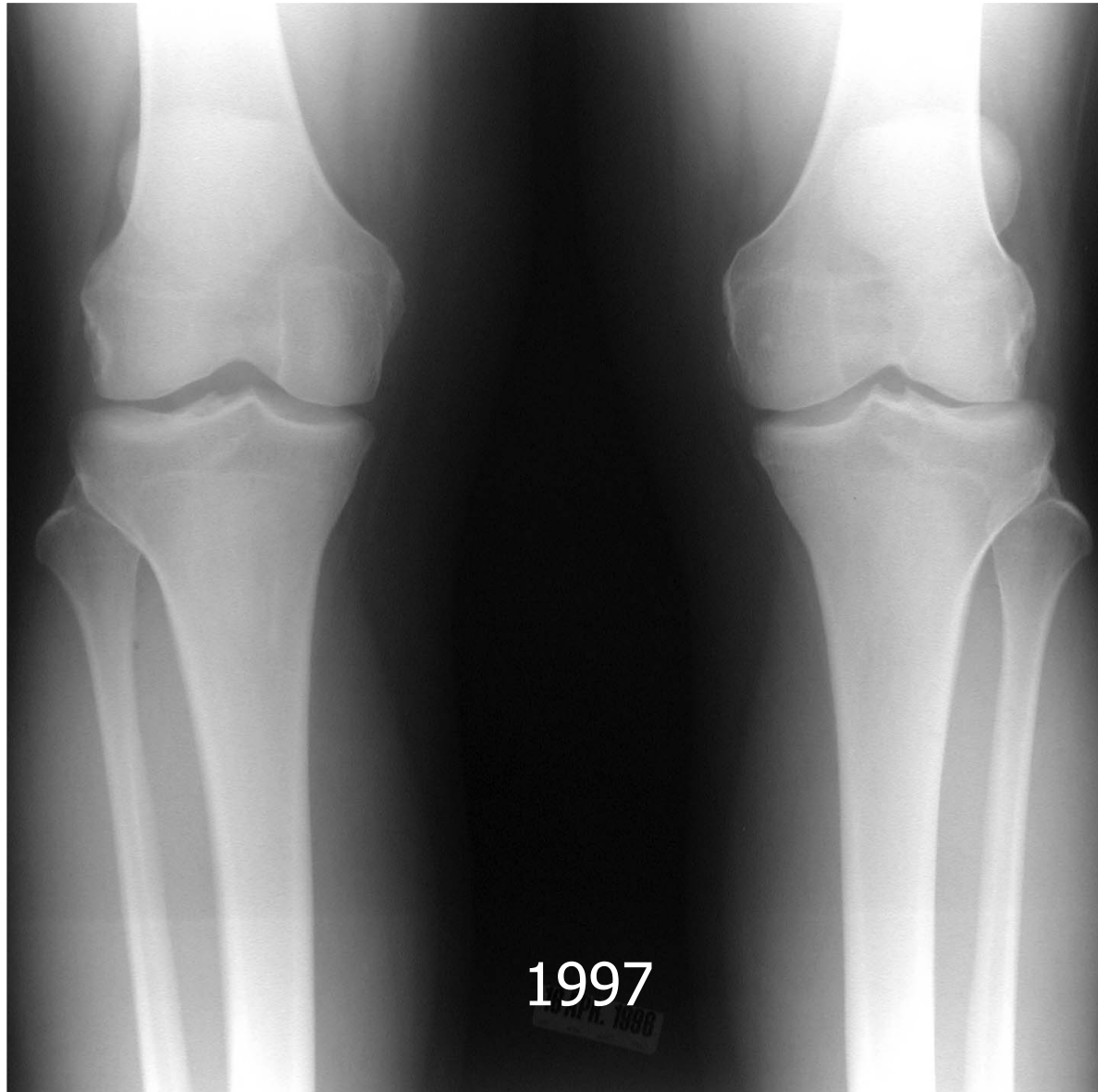


# Biomechanics: Osteotomy for instability

- Osteotomy may be **indicated** with these instabilities :
  - **ACL**
  - **PCL**
  - **posterolateral Instability**
  - Varus /Valgus instability
  - Combined
  - **Physiologic hyperextension ?**

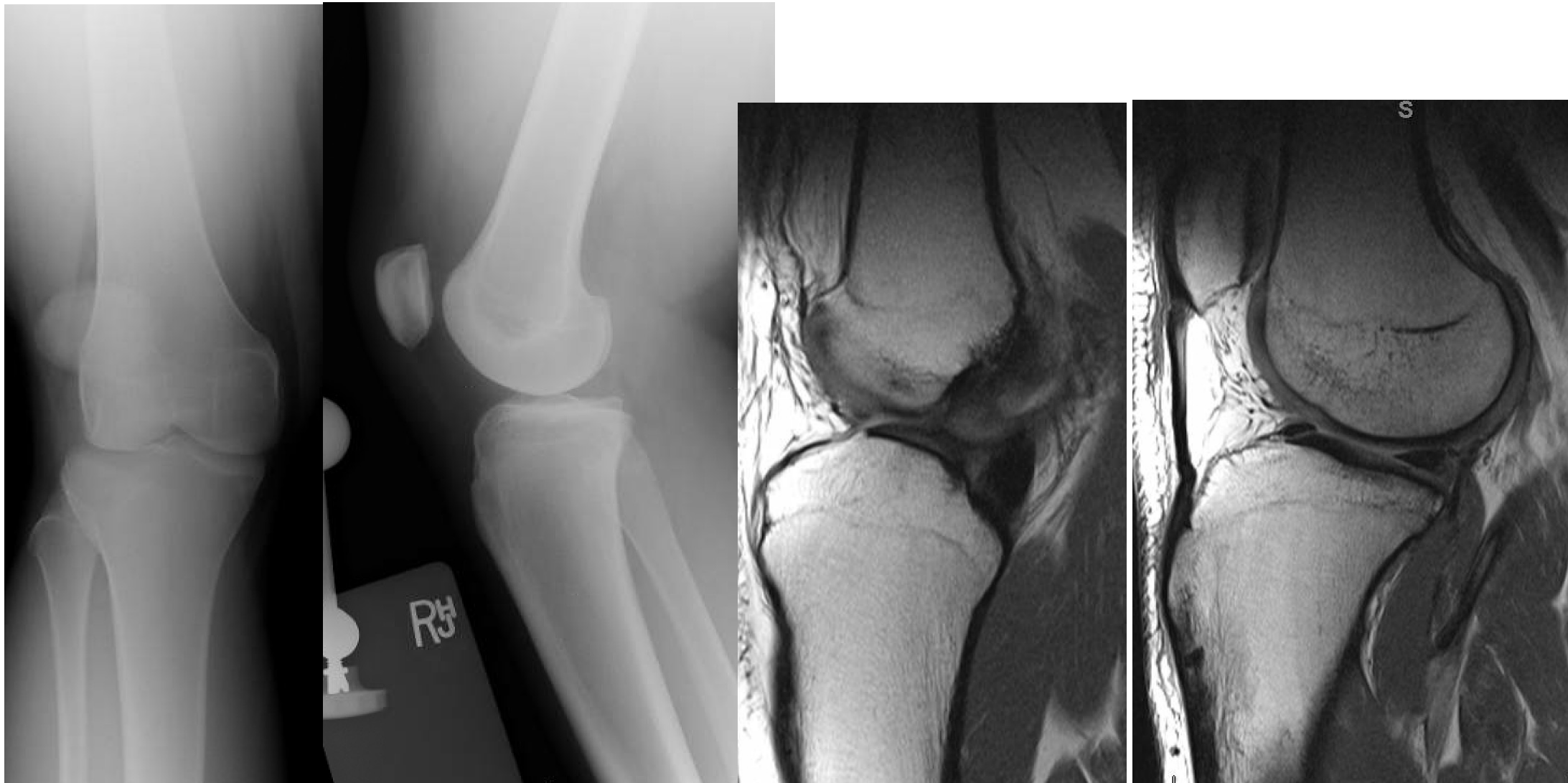


# Case : chronic ACL deficiency/ varus





# 19 YO ACL deficiency and coronal/ sagittal malalignment





# Further Imaging





# Staged surgery

1. DFO
2. Biplanar HTO + ACLR





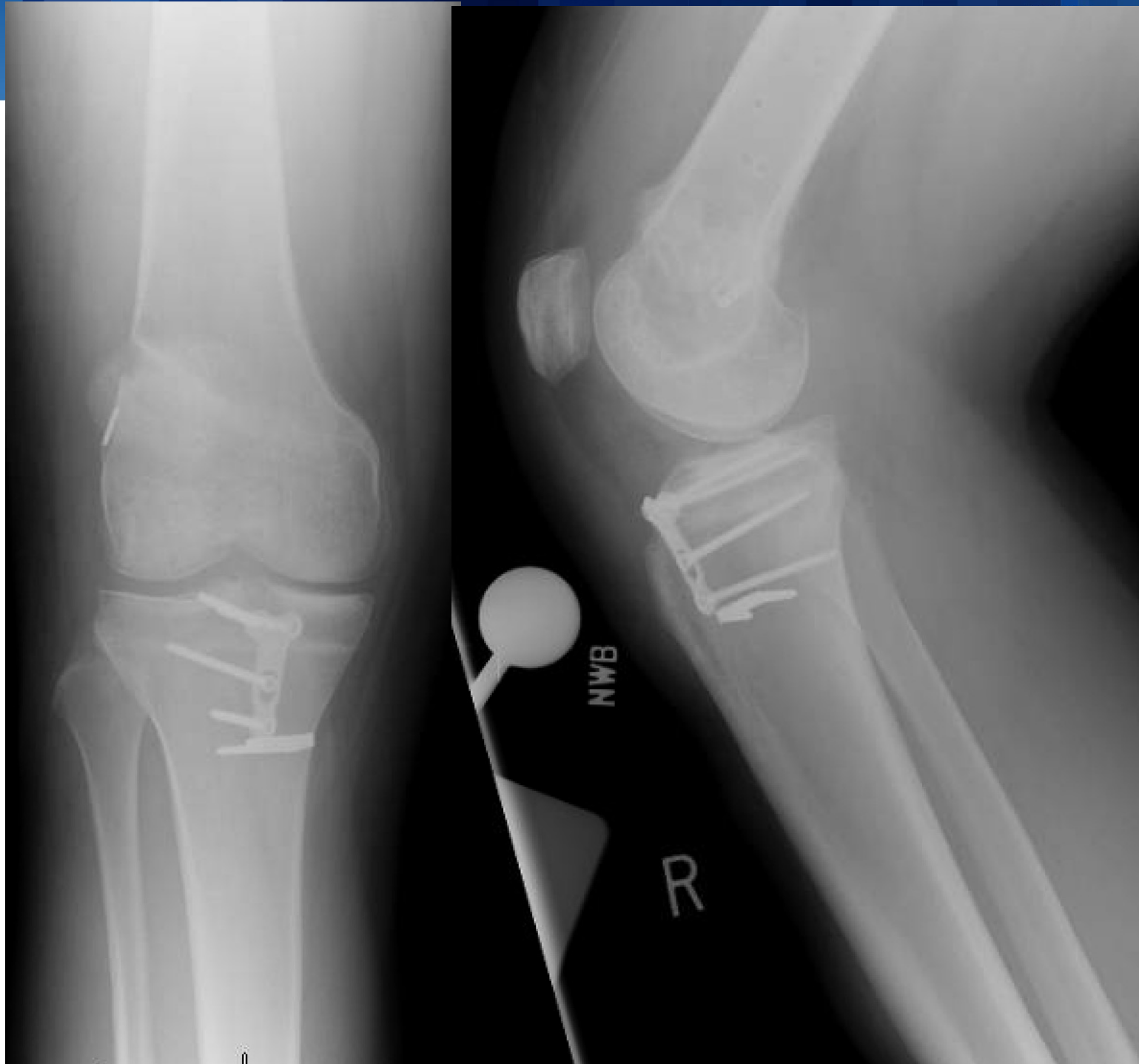


# HTO / ACLR





HTO/ACL



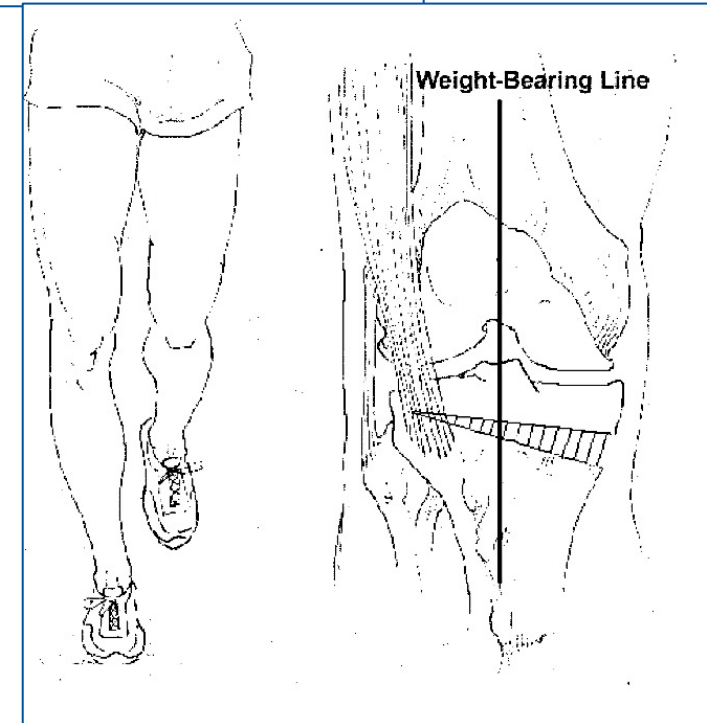
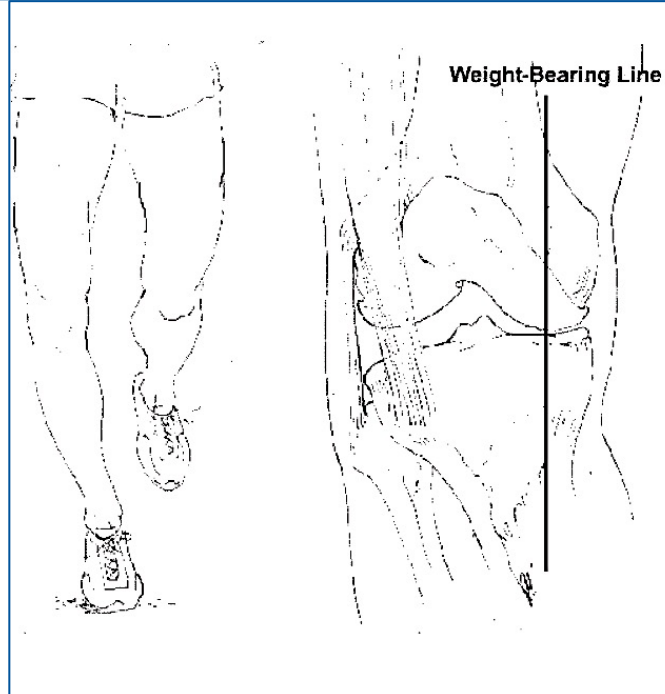
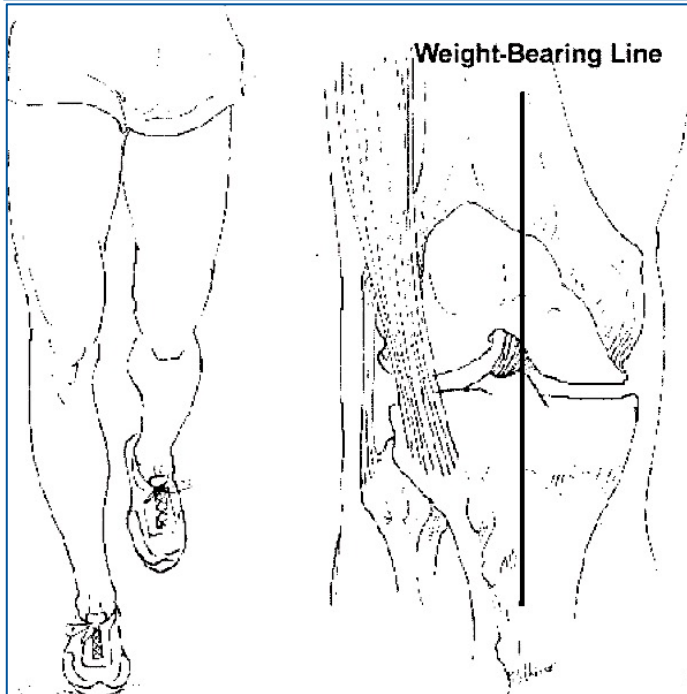
# Osteotomy for Hyperextension / varus



## Opening Wedge High Tibial Osteotomy for Symptomatic Hyperextension-Varus Thrust

Douglas D.R. Naudie,\* MD, FRCSC, Annunziato Amendola, MD, FRCSC,  
and Peter J. Fowler, MD, FRCSC

*From the Division of Orthopaedic Surgery, London Health Sciences Centre, University  
Campus, Fowler Kennedy Sport Medicine Clinic, University of Western Ontario, London,  
Ontario, Canada*



# Osteotomy for Hyperextension /varus





## *Naudie et al, AJSM, 2004 con't*

### Functional Results

- Questionnaire
  - *15/16 improved stability*
    - 9/16 significantly better
    - 6/16 somewhat better
    - 1/16 same
  - *15/16 satisfied*
  - *15/16 would have surgery again*







# Radiographic Results

- Osteoarthritis

No significant changes

- Femorotibial axis alignment

Mean change of 6° valgus

- Posterior tibial slope

Mean increase of 8° inclination

- Ratio of patellar height

Mean decrease 0.17

2 patella infera (< 0.54)



# Osteotomy for PL instability

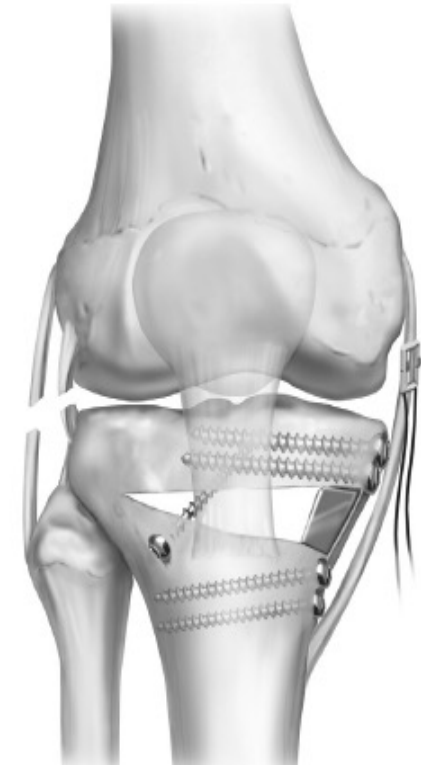
## The Effect of a Proximal Tibial Medial Opening Wedge Osteotomy on Posterolateral Knee Instability

### A Biomechanical Study

Robert F. LaPrade,<sup>\*†</sup> MD, PhD, Lars Engebretsen,<sup>‡</sup> MD, PhD, Steinar Johansen,<sup>‡</sup> MD, Fred A. Wentorf,<sup>†</sup> MS, and Chad Kurtenbach<sup>†</sup>

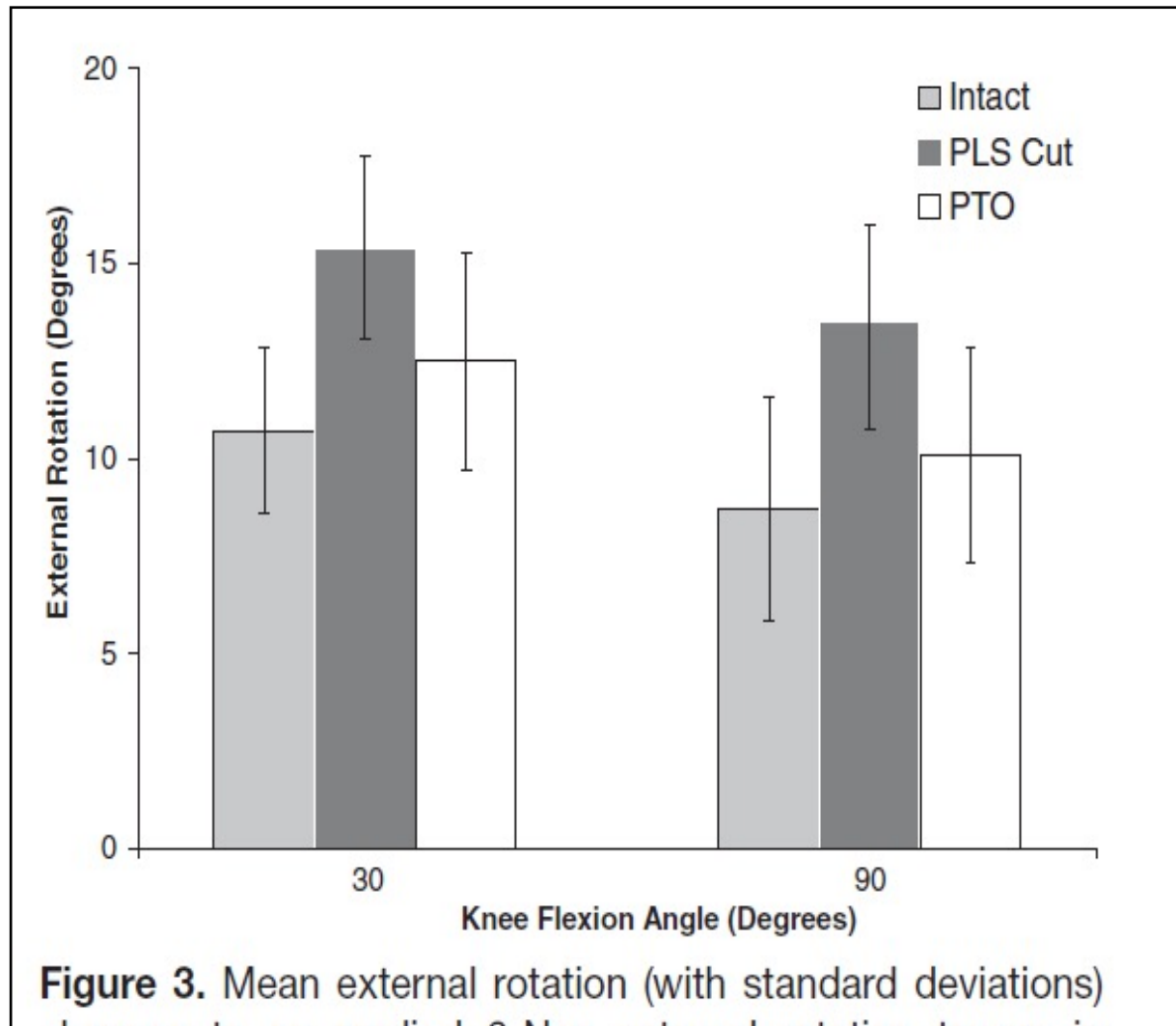
From the <sup>†</sup>Department of Orthopaedic Surgery, University of Minnesota, Minneapolis, Minnesota, and the <sup>‡</sup>Department of Orthopaedic Surgery and Faculty of Medicine, Ullevaal University Hospital, University of Oslo, Oslo, Norway

*LaPrade et al*





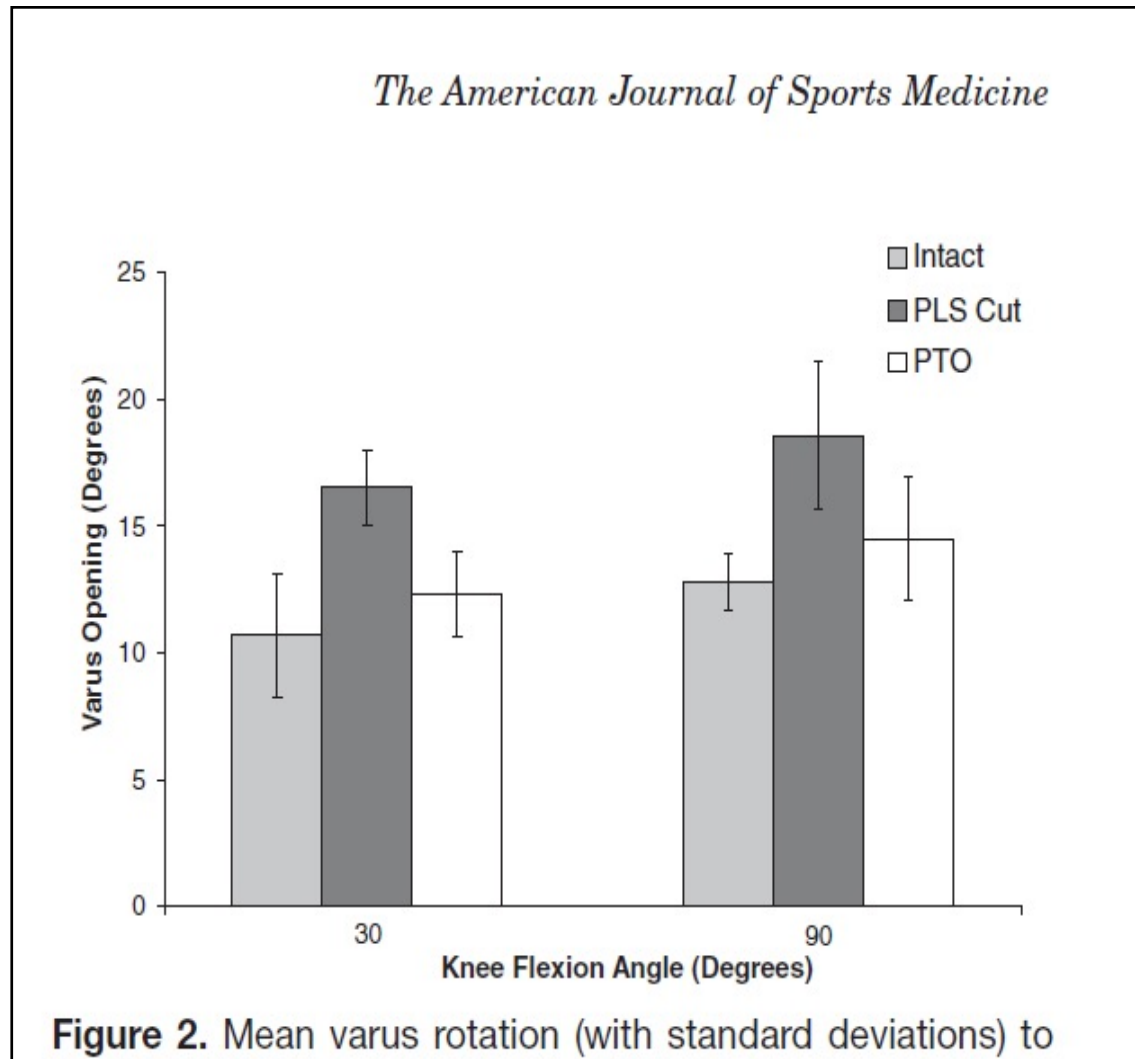
# PL instability: Laprade et al







# PL instability



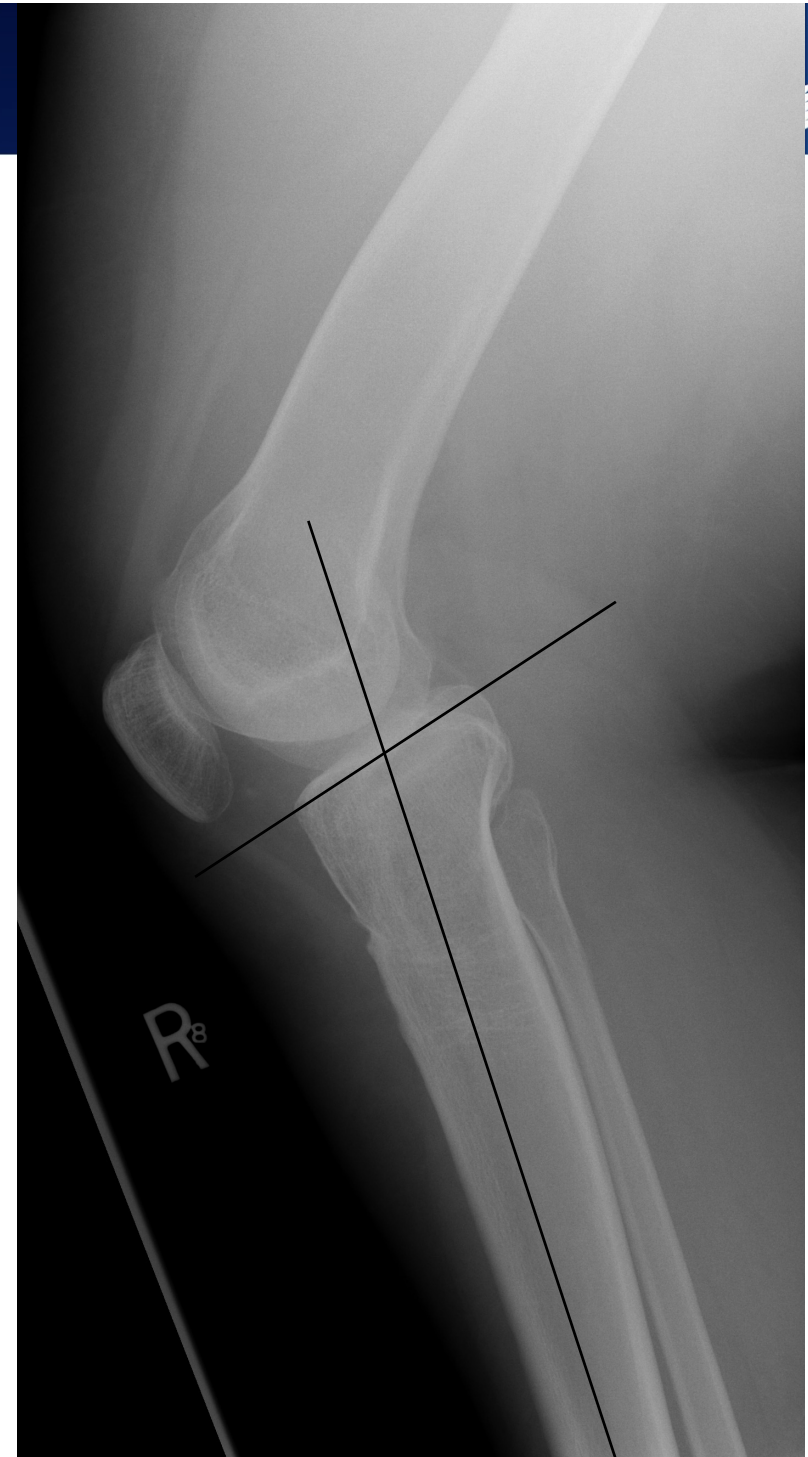
32 yo F

Hyperextension and  
posterior instability  
post physeal injury



32 yo F

Hyperextension and  
posterior instability  
post physeal injury







# Case CS

- 44 yo male very fit
- Chronic ACL deficiency
- ACLR with allograft and medial meniscectomy
- At 2 yrs, no improvement in instability with the surgery

# Case CS





# Case CS

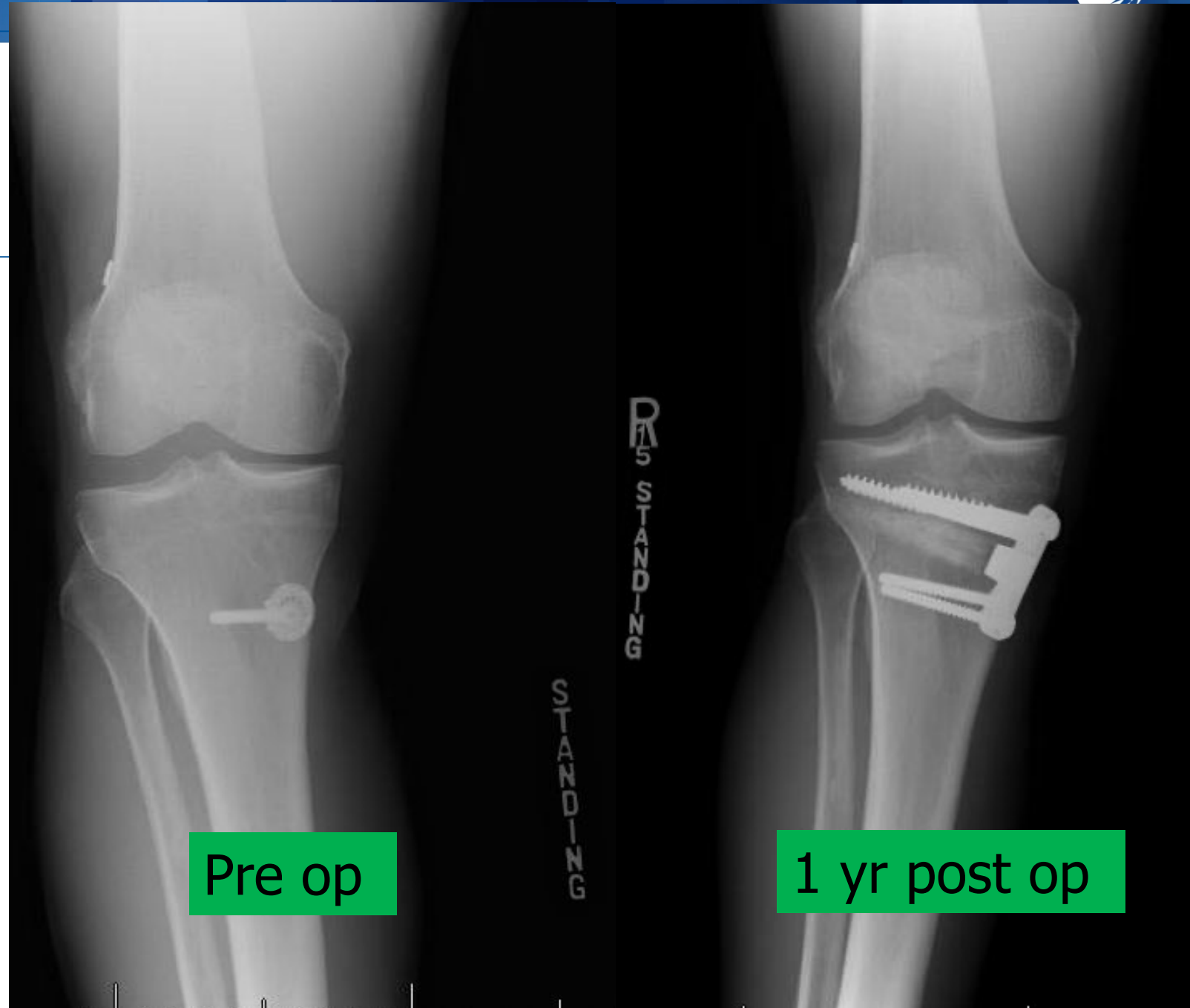
1 yr post op







# Case CS



Pre op

R5 STANDING

1 yr post op



*Closed lateral HTO*

*Open medial HTO*

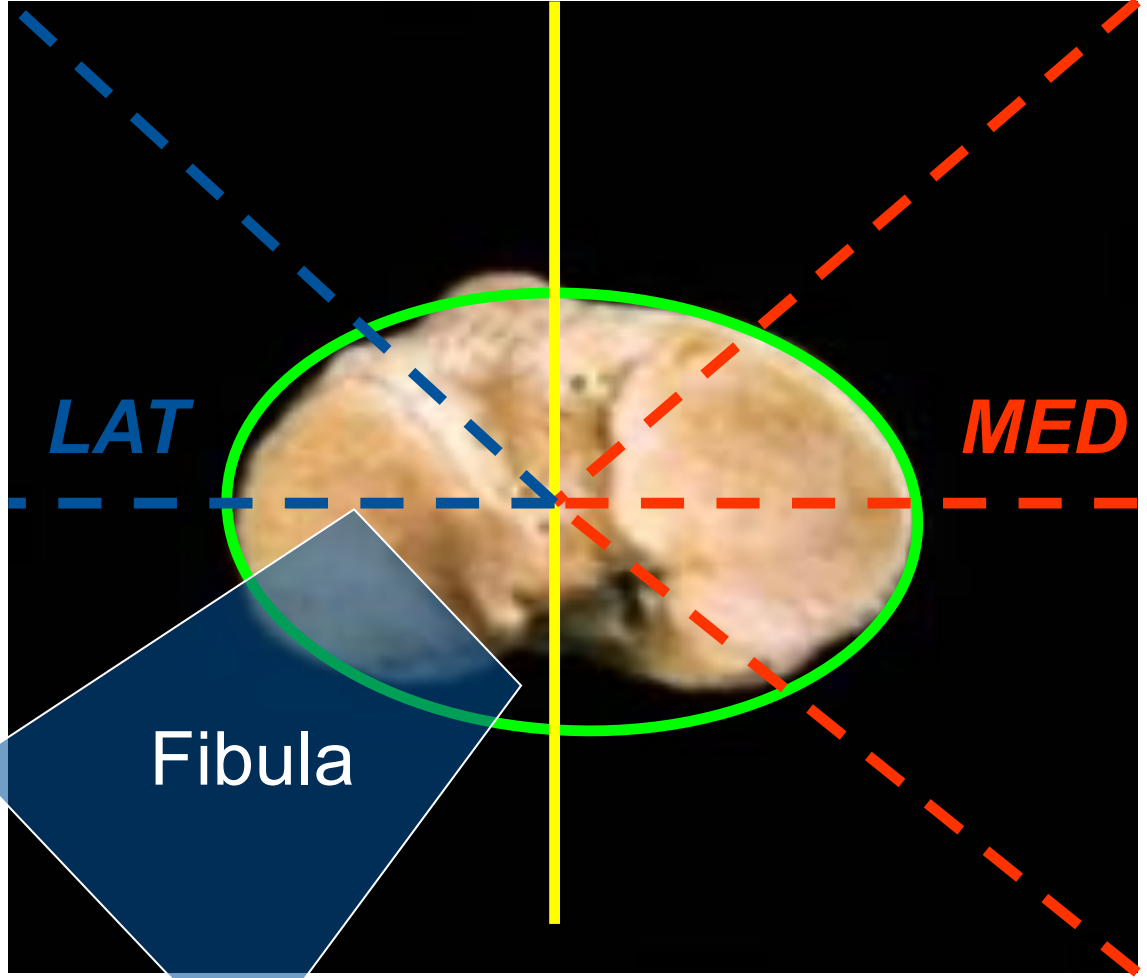
Decrease slope  
↓

Increase slope  
↑↑

**ANT**

Decrease slope  
↓

Increase slope  
↑



**POST**

Unchanged slope



## Case 1 : 47 yo M

- Recurrent failure ACLR

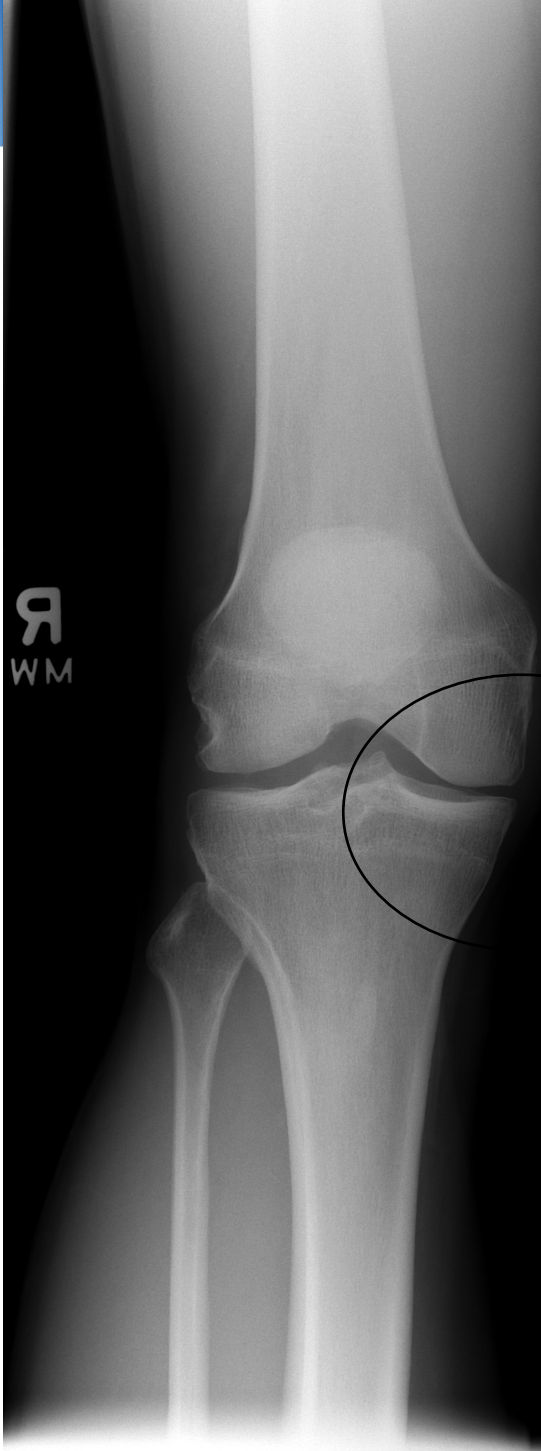
### exam

- ACL laxity 2+ lachman
- MCL pseudolaxity , lateral gapping
- Medial JL tenderness
- Gait lateral thrust ( hyperextension/varus)





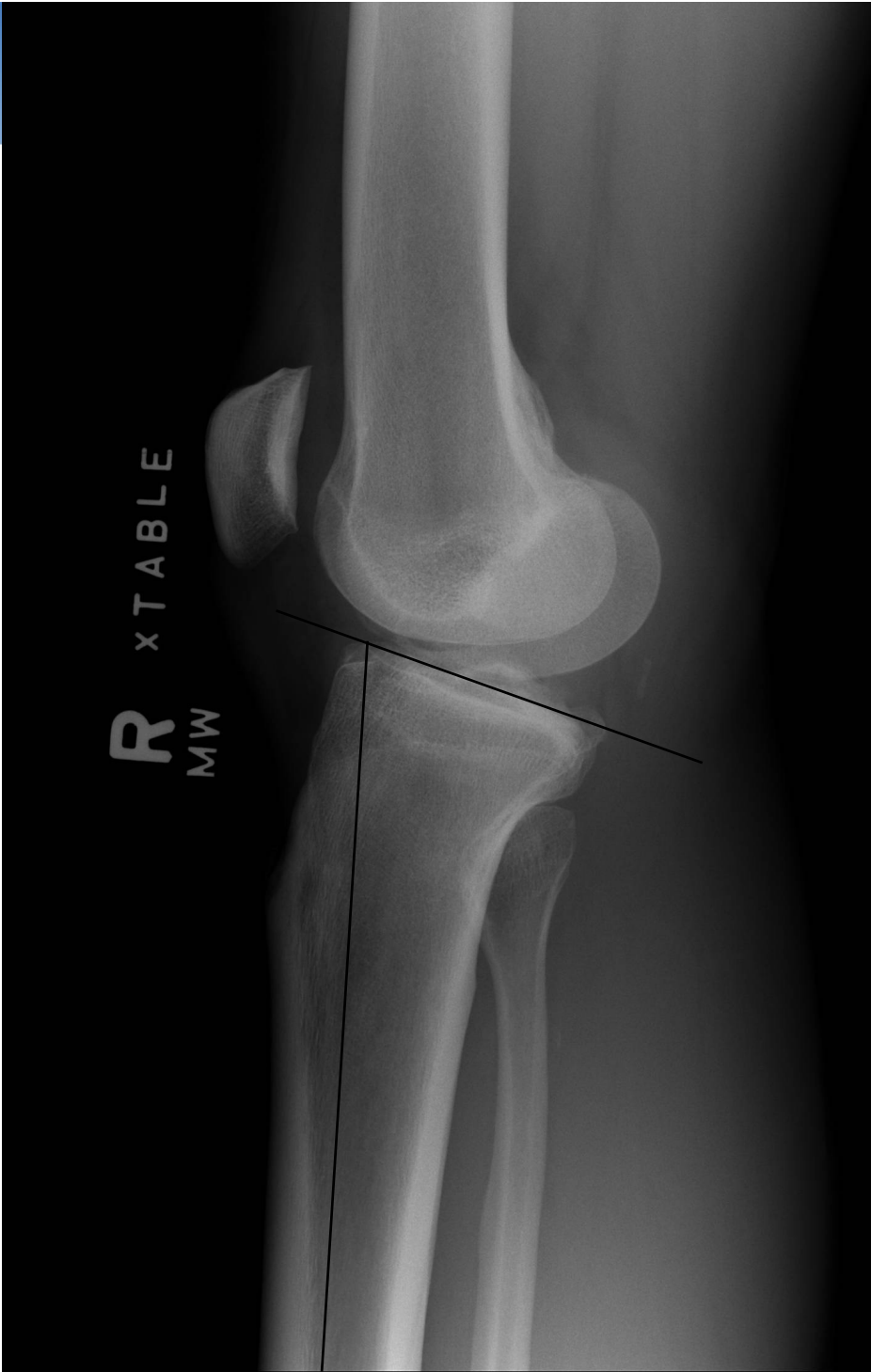
R  
WM



STANDING

L  
WM









# Osteotomies for Knee Instability

## Summary

- ◆ **Assess alignment with any instability**
  - ◆ *Coronal and sagittal*
- ◆ **Indications for osteotomy for Hyperextension instability**
  - ◆ **ACL + recurvatum ( hyperextension)**
  - ◆ **ACL Revision : **consider** slope correction**





Thank you