

Val d'Isère 2022



Trochlear analysis

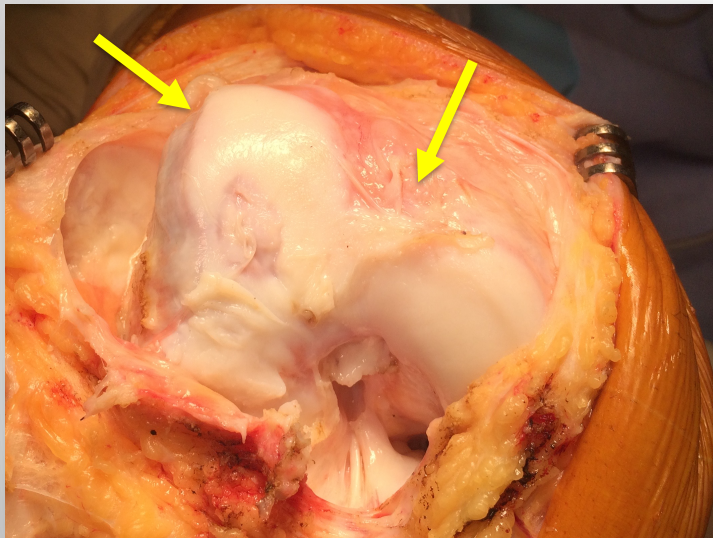
David DEJOUR



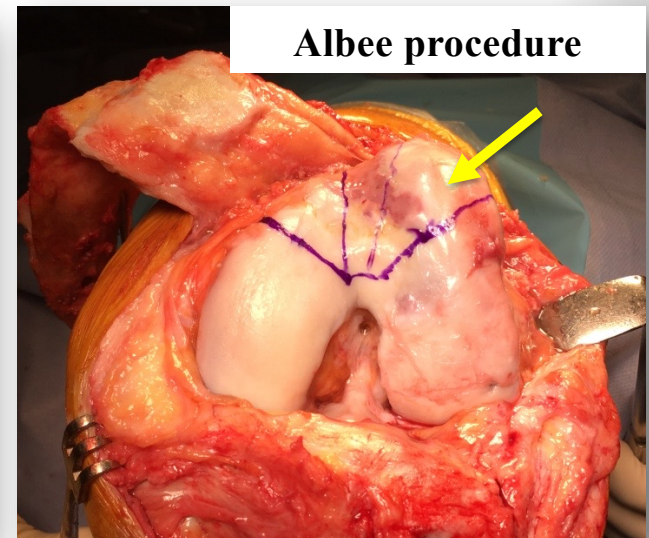
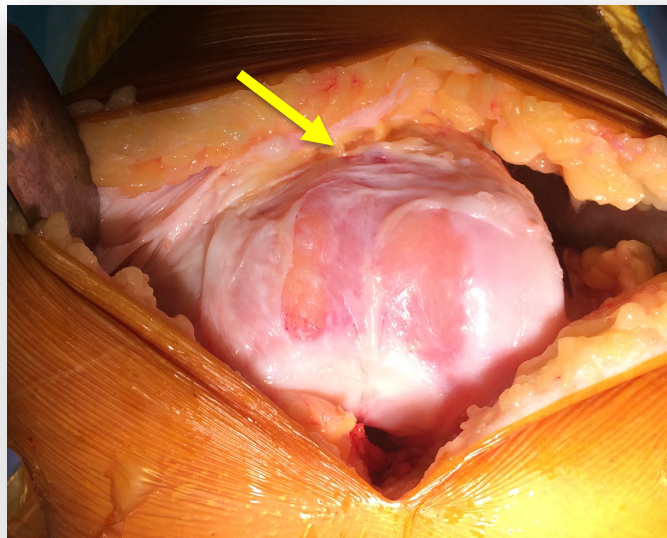
LYON **ORTHO** CLINIC



Dislocation is Always related to Anatomy !

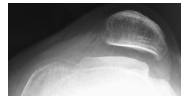


Native anatomy



**Iatrogenic
anatomy**

... 1964

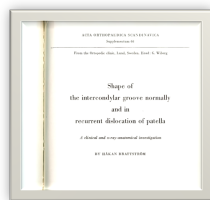


H. Brattström, a paediatric orthopaedist
Österliden in Sweden

First study on trochlear dysplasia with axial knee x-rays at 30° of flexion

“The trochlea is a flattening of the trochlear groove”

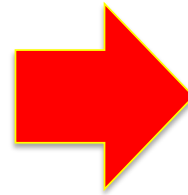
X-Rays starts to be used for patient screening



100 ♂ } 142° +/- 0.5
100 ♀ }

Brattström H. Shape of the intercondylar groove normally and in recurrent dislocation of patella. A clinical and x-ray anatomical investigation. Acta Orthop Scand. 1964(68(Suppl)):1-147.

Courtesy E Arendt & Andrea Chatfield



... 1964



H. Brattström

“Classification” or Description



Fig. 26. This shows how the same changes in L, M, C₁, L, and L-M can arise, either by an actual lowering of the height of the condyles above the sulcus bottom (B) or by raising the sulcus bottom (C). A = normal conditions.

A/ Hypoplasia of the medial femoral condyle
“most common”

B/ Aplasia of the medial condyle

C/ Global dysplasia both condyles

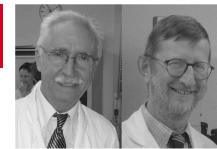
Flat or Convex distal femoral trochlea.



... 1985



Belgians radiologists
B. Maldague and J. Malghem.



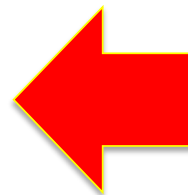
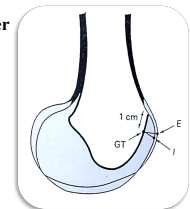
B. Maldague 25.04.1941 J. Malghem 14.02.1945

Study of trochlea ‘and its dysplasias’ in lateral x-rays

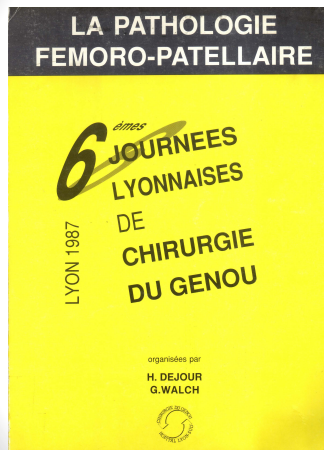
Conclusion: “increased sulcus angle of more than 145° with trochlear dysplasia”

Proximal **Trochlear Depth** 1 cm below the upper limit of the trochlear groove in lateral x-rays

Average 2.7 mm in Dislocation group
Average 5.9 mm asymptomatic group.

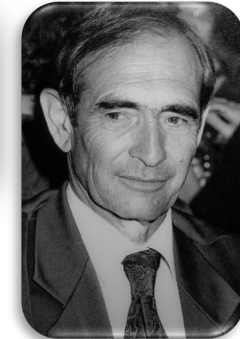
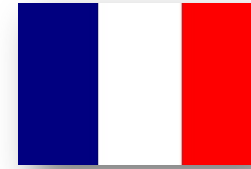


La PATELLA Lyon 2012 “ALRM”



1987

... 1987



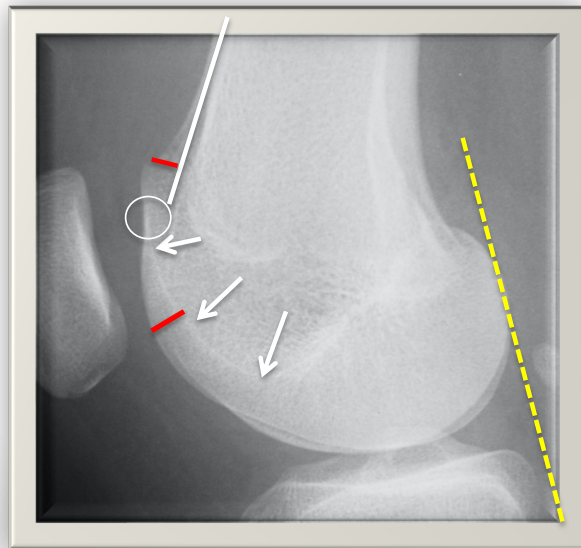
Henri Dejour



Gilles Walch

Lyon's group ALRM
Henri Dejour & Gilles Walch.

Systematic use of true lateral view



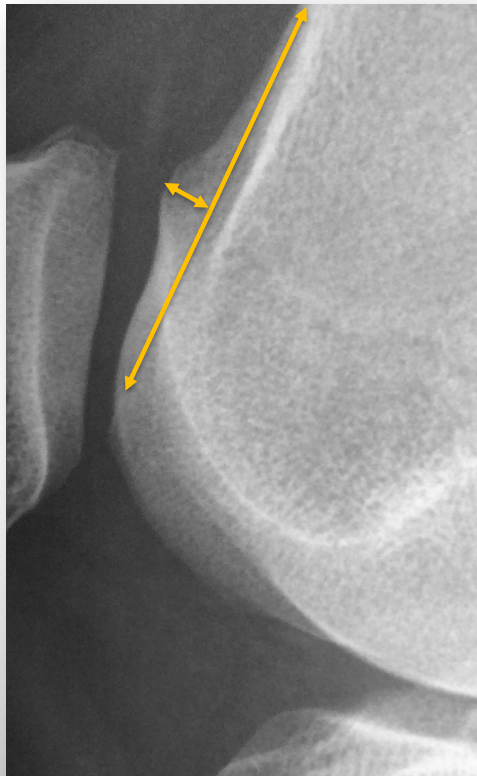
- The Crossing Sign
- The Trochlear depth
- The Bump : “la saillie”



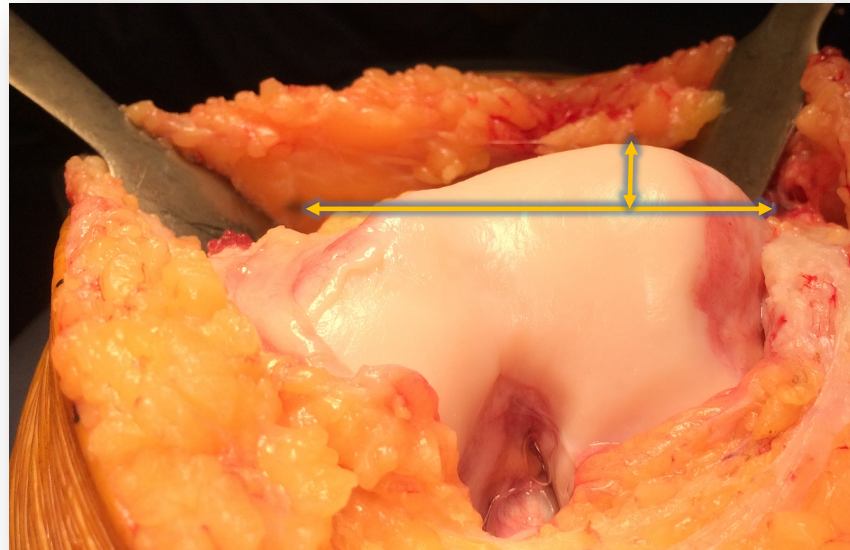
... 1987

The Bump : “La saillie” : The Supra Trochlear Spur (1998)

Trochlear prominence



Objective Patellar Instability : 3.1 to 4.7 mm
Control : 0.1 mm



... 1998

David Dejour
Bertrand Le Coultre

M&H

MISE AU POINT

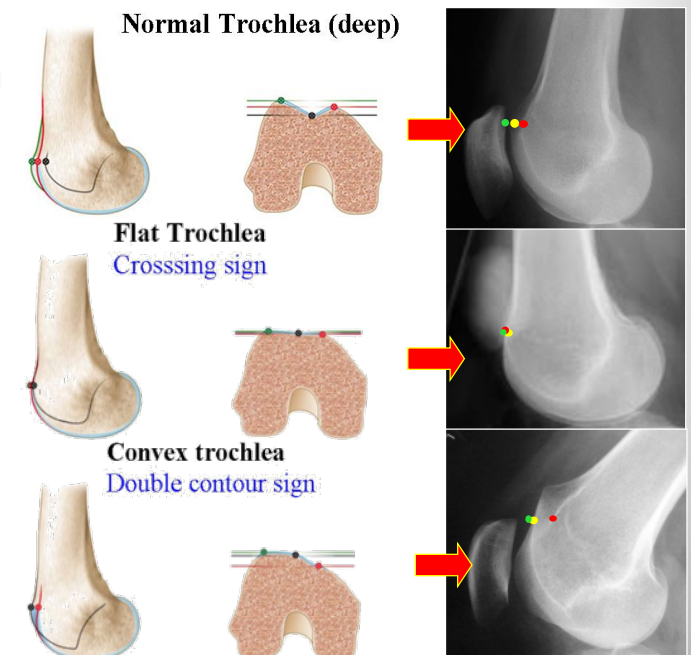
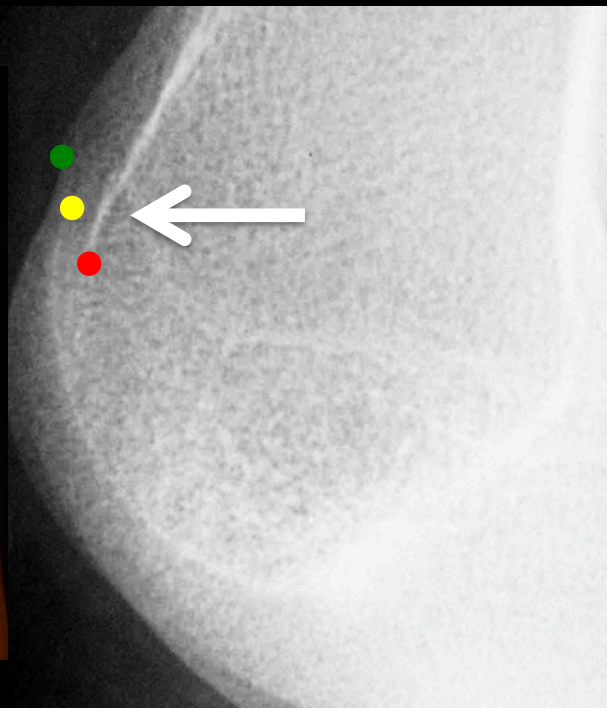
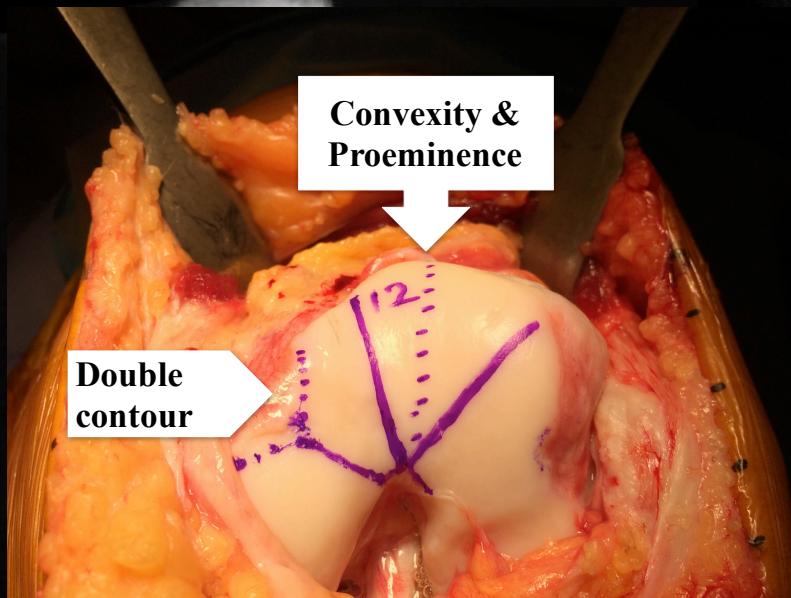
586 ANNÉE • 30 JUILLET 1998

D. Dejour, P. Reynaud et
B. Lecolre

DOULEURS ET INSTABILITÉ ROTULIENNE.
ESSAI DE CLASSIFICATION

3 D Analysis on 177 Objective Patellar Dislocation Based on :

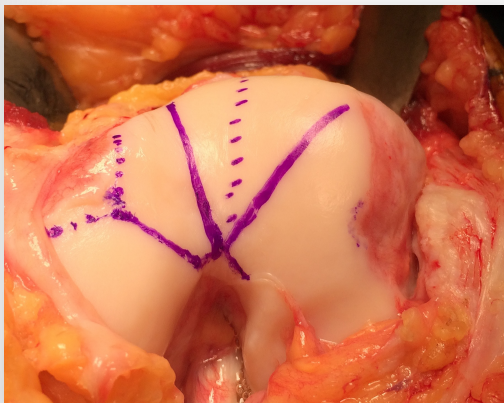
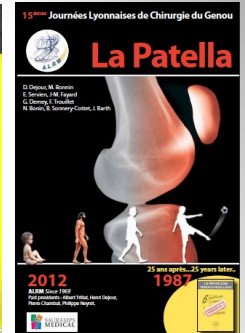
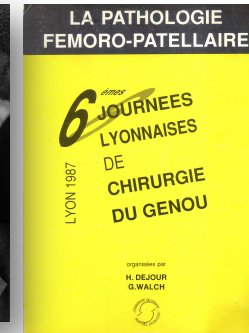
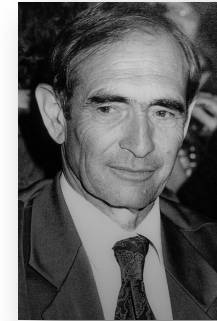
Slice Imaging + X-Rays



Anatomical study 1987-2012

Control (n= 190) / **Dislocation** (n= 147)

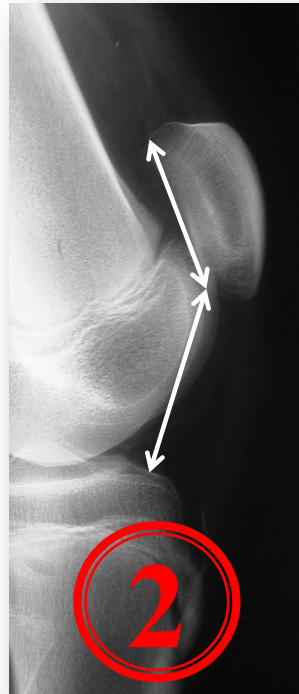
Statistical differences 3 factors (H. Dejour – G. Walch)



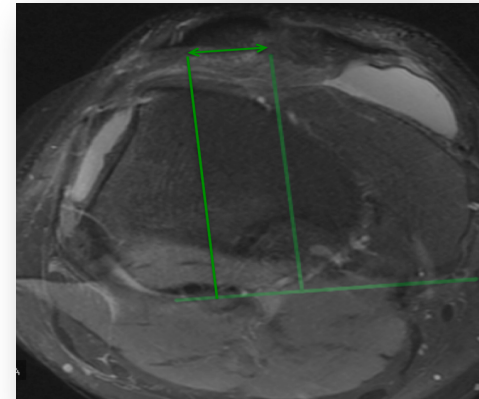
Trochlear dysplasia

①

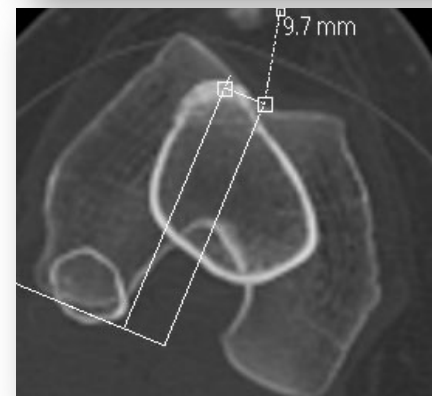
French J. Orthop. 1990
Knee Surg. Trauma 1994



Patella Alta > 1.2



TT- TG > 13 mm MRI



③
TT- TG > 20 mm CT

Morphology and Anatomic Patellar Instability Risk Factors in First Time Traumatic Lateral Patellar Dislocation

Marie Askenberger,^{1,2} MD, Per-Mats Janarv,¹ MD, PhD, Thorsten Finnbergsson,³ MD, PhD, and Elizabeth A. Arendt,⁴ MD
Investigation performed at Karolinska Children's Hospital, Karolinska University Hospital in Solna, Stockholm, Sweden

A Prospective Magnetic Resonance Imaging Study in Skeletally Immature Children

	Dislocation	Control
APIF	79 % 2 to 4	7%
Trochlear depth	2.3 mm	4.5 mm
Patella height	1.33	1.1
TT-TG	14	10
Tilt	21°	8.5°

- The main divergent APIF was trochlear dysplasia (defined as trochlear depth <3 mm) 74%
- Elevated TT-TG distance as a single APIF was never present in the LPD group
- The most common APIF in the control group was patella alta (36%)

Lyon's factors



Trochlear Dysplasia Patella Alta TT-TG

Predictors of Recurrent Instability After Acute Patellofemoral Dislocation in Pediatric and Adolescent Patients

Laura W. Lewallen,* MD, Amy L. McIntosh,*† MD, and Diane L. Dahm,* MD
Investigation performed at the Department of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota

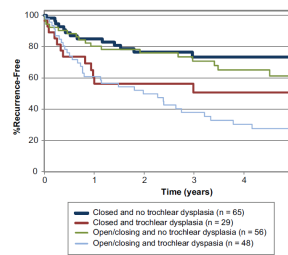
AJSM 2013

Recurrent instability



Trochlear Dysplasia

- 58.3% => Trochlear dysplasia.



Knee Surg Sports Traumatol Arthrosc
DOI 10.1007/s00167-016-4117-y



An analysis of knee anatomic imaging factors associated with primary lateral patellar dislocations

Elizabeth A. Arendt¹ · Kristin England¹ · Julie Agel¹ · Marc A. Tompkins^{1,2}

157 knees
(79 M/78 F)

More anatomic risk factors in primary lateral patellar dislocations population than historical controls

Patella height and trochlear dysplasia are the most common 'dysplastic' anatomic factors in this population

There were differences based on sex for some patella height measurements and for TT-TG

Table 2 Anatomic risk factor measurement data for population of primary lateral patellar dislocations. This table is generously provided by authors as property of the University of Minnesota

Measurement	Mean	SD	Minimum	Maximum
IS	1.33	0.23	0.70	2.00
CD	1.23	0.17	0.80	1.80
PTI	0.55	0.15	0.04	0.85
Til (°)	17	6.1	3	35
TT-TG (mm)	15.1	4.6	1.9	26.6
SA (°)	158	12	132	199
TD (mm)	2.7	1.5	-1.4	10.9
TFA	0.47	0.13	0.15	0.89
TCA	104.4	4.0	96.6	13.7
LITA (°)	13	5.4	-2	29

IS Insall-Salvati, CD Caton-Deschamps, PTI Patellar Trochlear Index, TT-TG tibial tubercle-trochlear groove distance, SA sulcus angle, TD trochlear depth, TFA trochlear facet asymmetry, TCA condyle asymmetry, LITA lateral trochlear inclination angle

Table 3 Anatomic risk factor measurements based on sex and skeletal maturity. This table is generously provided by authors as property of the University of Minnesota

Measurement	Females (n = 76)	Males (n = 79)	P value	Skeletally immature (n = 50)	Skeletally mature (n = 107)	P value
IS	1.38	1.28	<0.01**	1.40	1.31	0.20
CD	1.27	1.19	<0.01**	1.26	1.24	0.21
PTI	0.50	0.52	0.37	0.53	0.50	0.29
Til (°)	17	17	0.95	17	17	0.80
TT-TG (mm)	14.3	16.0	0.02*	15.9	14.4	0.18
SA (°)	159	156	0.20	159	157	0.29
TD (mm)	2.5	2.9	0.1	2.5	2.8	0.22
TFA	0.45	0.48	0.12	0.45	0.48	0.27
TCA	104.9	103.9	0.11	104.1	104.5	0.49
LITA (°)	13	13	0.60	13	13.0	0.56

IS Insall-Salvati, CD Caton-Deschamps, PTI Patellar Trochlear Index, TT-TG tibial tubercle-trochlear groove distance, SA sulcus angle, TD trochlear depth, TFA trochlear facet asymmetry, TCA trochlear condyle asymmetry, LITA lateral trochlear inclination angle

* Analysis is significant at the 0.05 level (2-tailed)

** Analysis is significant at the 0.01 level (2-tailed)

First time Lateral patella dislocation More anatomical abnormalities / control population

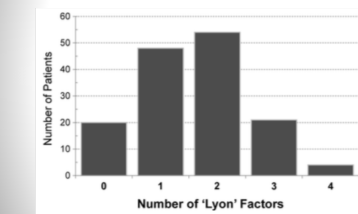


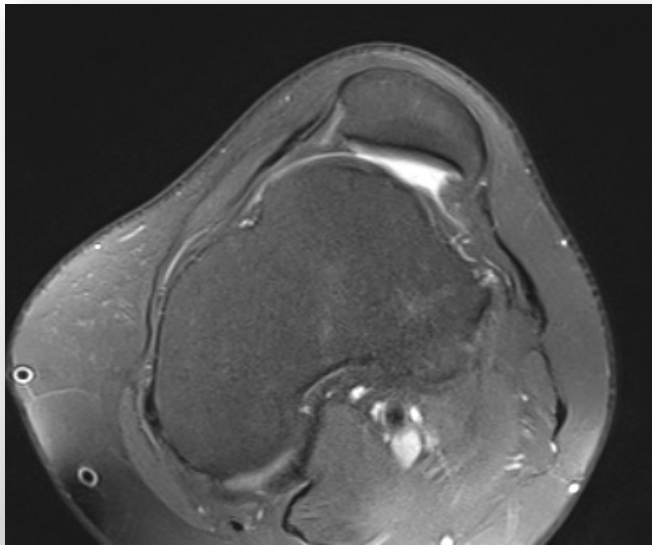
Fig. 5 Number of measurements that were excessive (CD > 1.2, trochlear depth < 3 mm, TT-TG > 20 mm, tilt > 20°) within each individual of our primary LPD patients. This figure is generously provided by the authors as property of the University of Minnesota

Risk factors for recurrent patellar dislocation

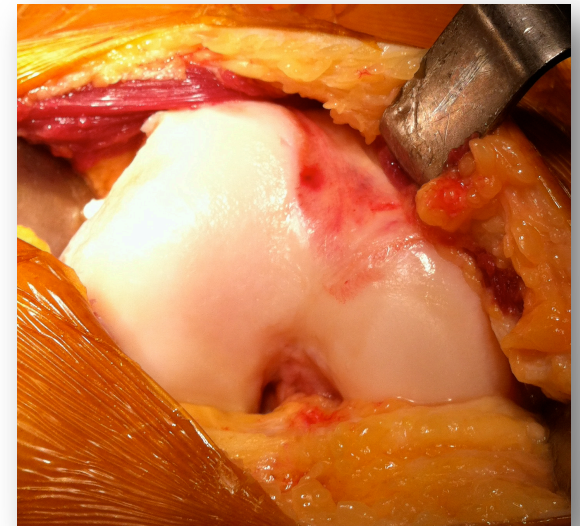
The **Trochlear Dysplasia**

The first Instability factors

Some tricks to classify ...

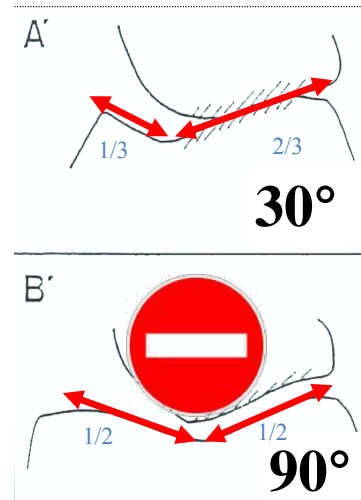
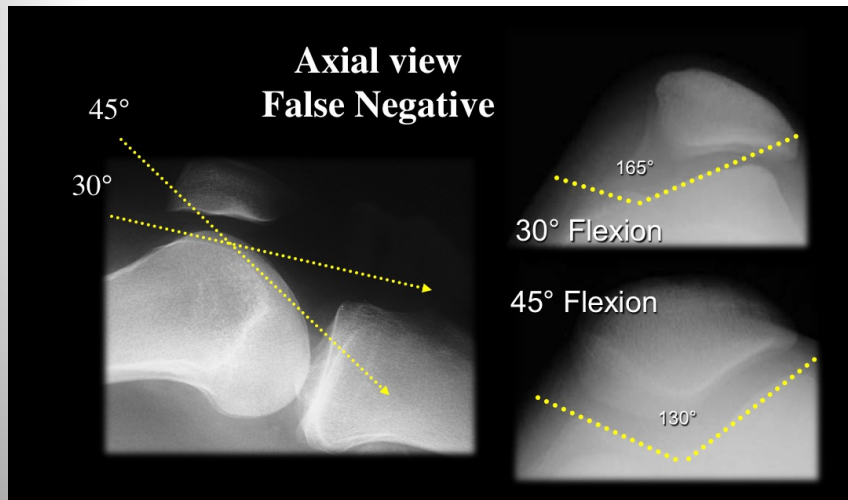
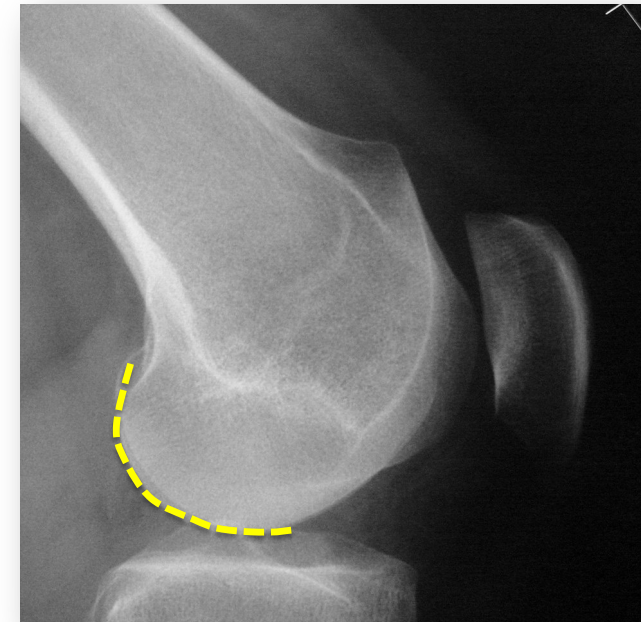


No Groove



Criteria for standard X-Rays

True lateral View

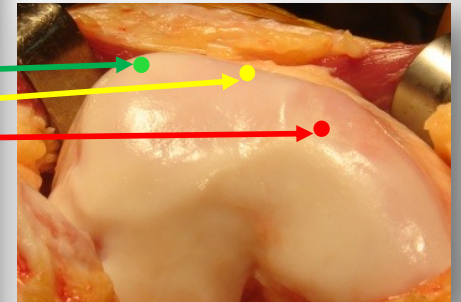
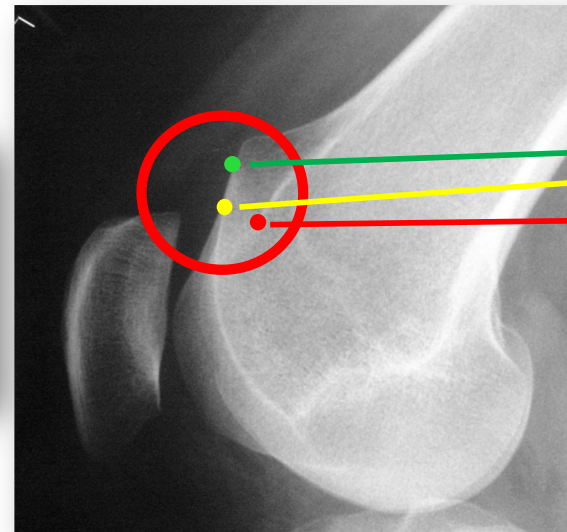
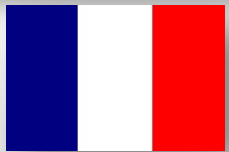
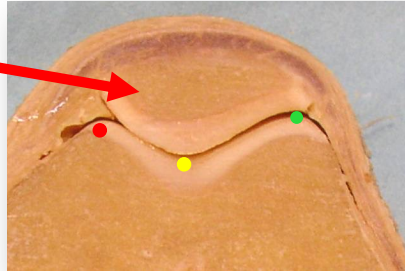
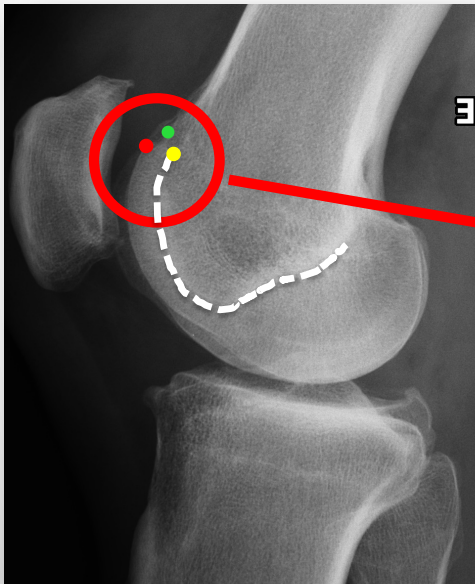


Axial view
Angle of Beam or Knee Flexion

Trochlear dysplasia

96 % Dislocation population / Control 3 % $P = 0,001$

Crossing Sign (H. Dejour) 1987



Trochlear classification

Ski Jump

Crossing Sign
91 %



**Supra trochlear
Spur +++**

**Double Contour
(Medial facet)**

The 3 pillars of trochlear dysplasia

D. Dejour and coll French J.Orthop. 2000 J Radiol 2001, KSSTA 2006, Sports Med Arthrosc 2007 ...

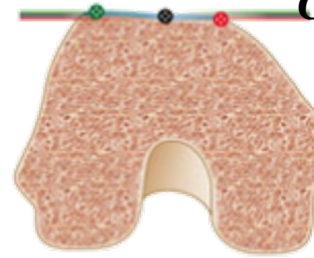
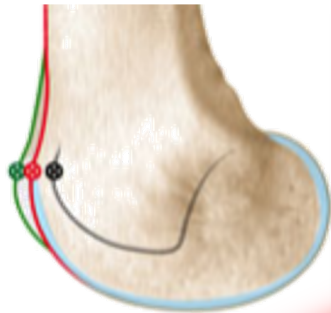
X-Rays

Trochlear Classification

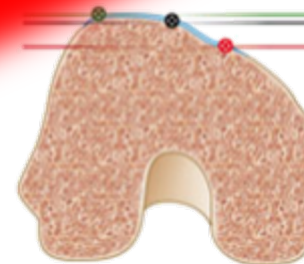
Slice Imaging



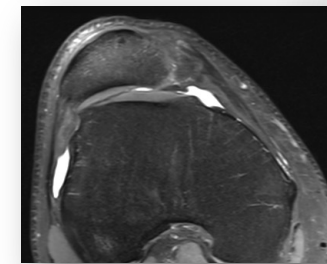
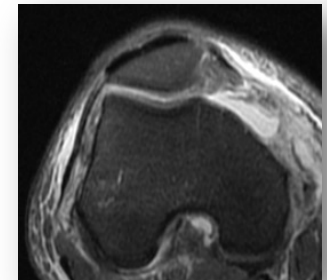
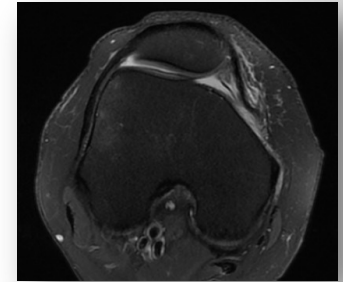
Bump



The shape



CT scan or MRI



MRI Does NOT provide good information about the Supra trochlear Spur

Some critics about classification...

Observer Agreement on the Dejour Trochlear Dysplasia Classification

A Comparison of True Lateral Radiographs and Axial Magnetic Resonance Images

Sabine Lippacher,^{*,†} MD, David Dejour,[†] MD, Mohammed Elsharkawi,[†] MD, Daniel Dornacher,[†] MD, Christina Ring,[§] MD, Jens Dreyhaupt,[§] MD, Heiko Reichel,[†] MD, Prof., and Manfred Nelitz,[†] MD
Investigation performed at Department of Orthopaedics, University of Ulm, German.

Knee Surg Sports Traumatol Arthrosc
DOI 10.1007/s00167-012-2321-y

KNEE

Evaluation of trochlear dysplasia using MRI: correlation between the classification system of Dejour and objective parameters of trochlear dysplasia

M. Nelitz · S. Lippacher · H. Reichel ·
D. Dornacher

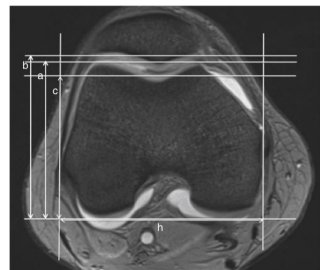


Fig. 1 Height of the medial (a) and lateral condyle (b) as well as the lowest point of the trochlea (c) were measured. These distances were related to the total width of the distal femur (h). Depth of trochlear groove: maximal anteroposterior distance of the medial (a) and lateral femoral (b) condyle and the minimal anteroposterior distance between the deepest point of the trochlear groove and the line paralleling the posterior outlines of the femoral condyles (c)

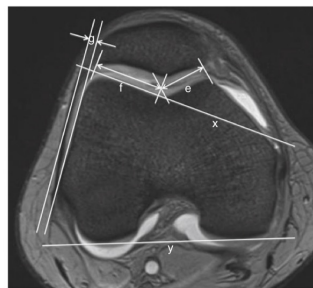


Fig. 2 Inclination angle of the lateral trochlear facet (lines x and y). Trochlear facet asymmetry (relation of the length of the medial facet (e) to the lateral facet (f)). Lateralization of the patella (distance of the line paralleling the lateral margin of the lateral condyle to the most lateral point of the patella (distance g))

1. The 4-grade analysis shows fair intraobserver and interobserver agreements, while the 2-grade analysis shows good to excellent agreement.
2. The best overall agreement was found for the 2-grade analysis on MRI scans.
3. The lateral radiograph tends to underestimate the severity of trochlear dysplasia compared with axial MRI.



■ KNEE

The Oswestry-Bristol Classification

A NEW CLASSIFICATION SYSTEM FOR TROCHLEAR DYSPLASIA

Aims

Trochlear dysplasia is a significant risk factor for patellofemoral instability. The Dejour classification is currently considered the standard for classifying trochlear dysplasia, but numerous studies have reported poor reliability on both plain radiography and MRI. The severity of trochlear dysplasia is important to establish in order to guide surgical management. We have developed an MRI-specific classification system to assess the severity of trochlear dysplasia, the Oswestry-Bristol Classification (OBC). This is a four-part classification system comprising normal, mild, moderate, and severe to represent a normal, shallow, flat, and convex trochlea, respectively. The purpose of this study was to assess the inter- and intraobserver reliability of the OBC and compare it with that of the Dejour classification.

N. Sharma,
A. Brown,
T. Bouras,
J. H. Kuiper,
J. Eldridge,
A. Barnett

From The Robert
Jones and Agnes Hunt

THE OSWESTRY-BRISTOL CLASSIFICATION

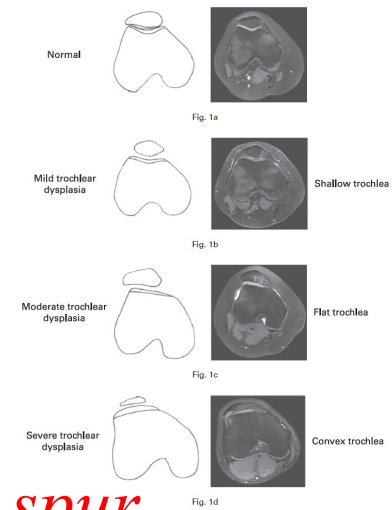


Fig. 1 Oswestry-Bristol Classification (OBC) drawings and MRI.

Don't look about the prominence and supra trochlear spur

Some critics about classification...



■ KNEE

The Oswestry-Bristol Classification

A NEW CLASSIFICATION SYSTEM FOR TROCHLEAR DYSPLASIA

N. Sharma,
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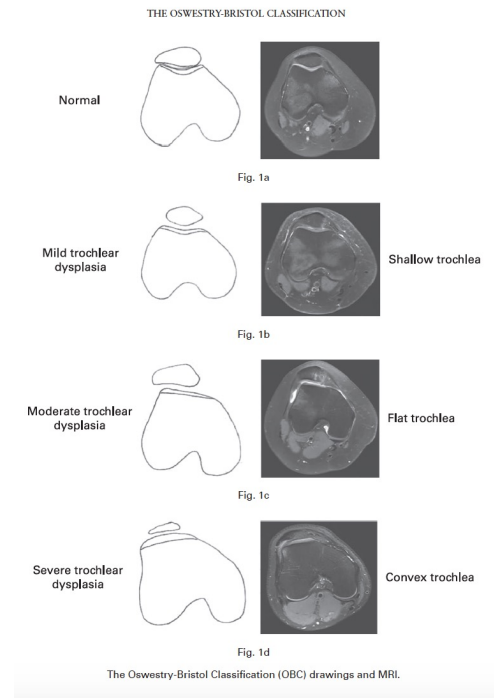


JBJS !!!

28 patients !!!

2020 !!!

Don't look about the prominence and supra trochlear spur



... 1964

H. Brattström



“Classification” or Description

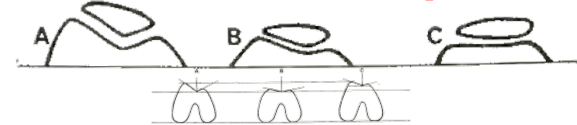


Fig. 26. This shows how the same changes in L, M, C₁, L₁, and L₁-M can arise, either by an actual lowering of the height of the condyles above the sulcus bottom (B) or by raising the sulcus bottom (C). A = normal condition.

A/ Hypoplasia of the medial femoral condyle
“most common”

B/ Aplasia of the medial condyle

C/ Global dysplasia both condyles

Flat or Convex distal femoral trochlea.

Same classification
56 years ago !!!!



Lateral inclinaison of the trochlea

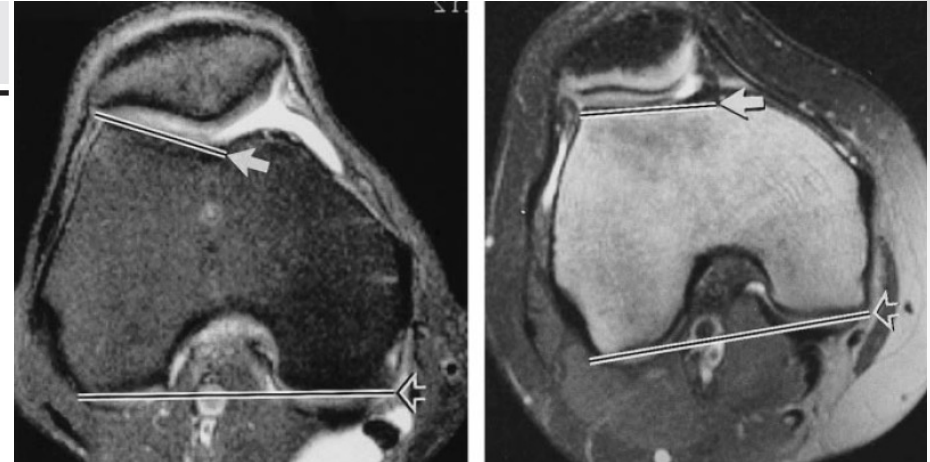
Technical Developments

Yannick Carrillon, MD
Hassane Abidi, PhD
David Dejour, MD
Olivier Fantino, MD
Bernard Moyen, MD
Van A. Tran-Minh, MD

Index terms:
Joints, abnormalities, 452.42
Magnetic resonance imaging, 452.42

Patellar Instability: Assessment on MR Images by Measuring the Lateral Trochlear Inclination— Initial Experience¹

Radiology 2000



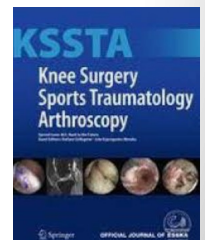
KNEE

Quality assessment of radiological measurements of trochlear dysplasia; a literature review

Mathias Paiva¹ · Lars Blønd² · Per Hölmich¹ · Robert N. Steensen³ · Gerd Diederichs⁴ · Julian A. Feller⁵ · Kristoffer Weisskirchner Barfod¹

2016

*Lateral Trochlea Inclination as the
highest rated measurement by the expert
panel*



Lateral inclinaison of the trochlea

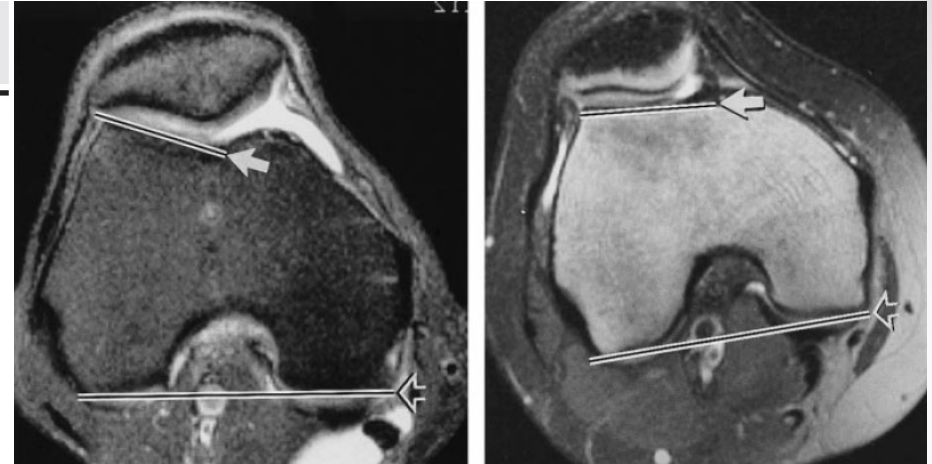
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Bernard Moyon, MD
Van A. Tran-Minh, MD

Index terms:
Joints, abnormalities, 452.42
Knee, abnormalities, 452.42

Patellar Instability: Assessment on MR Images by Measuring the Lateral Trochlear Inclination— Initial Experience¹

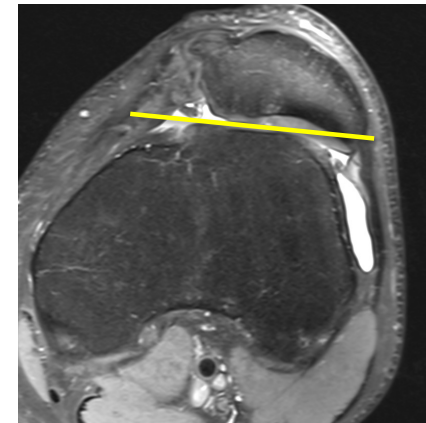
Radiology 2000



Threshold 11°

Perfect for low grade trochlear dysplasia



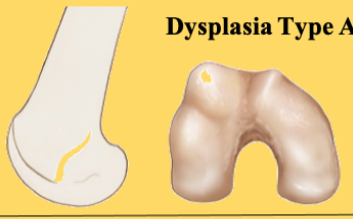
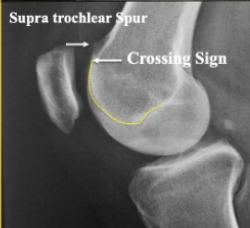
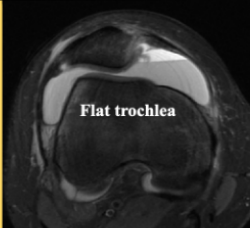

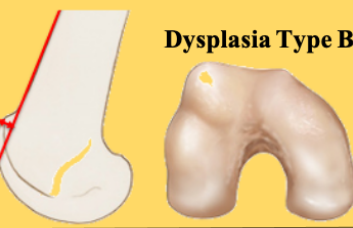
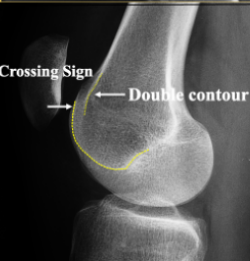
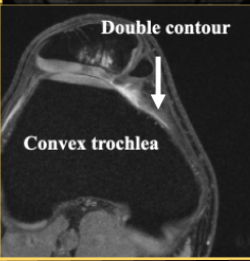
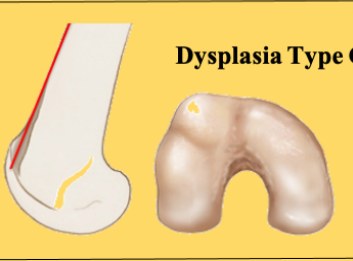
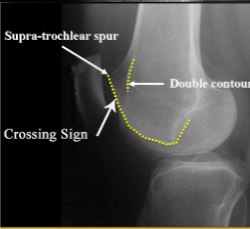


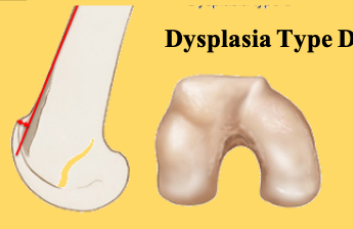
? If convex trochlea ??? Negative angle !!!



Trochlear Classification

(1998)

David Dejour
Bertrand Le Coultre

X-Ray	+	Slice Imaging CT / MRI	=	Dejour's Classification
				 Dysplasia Type A
				 Dysplasia Type B
				 Dysplasia Type C
				 Dysplasia Type D

M&H

MISE AU POINT

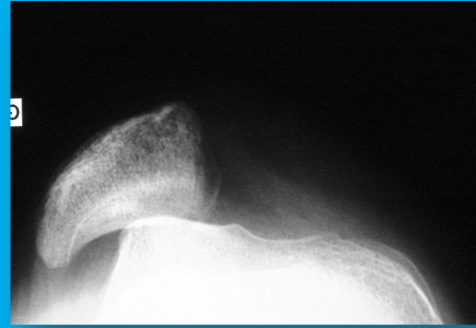
546 ANNÉE • 30 JUILLET 1998

D. Dejour, P. Reynaud et
B. Lecoulre

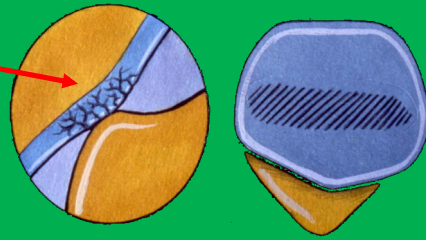
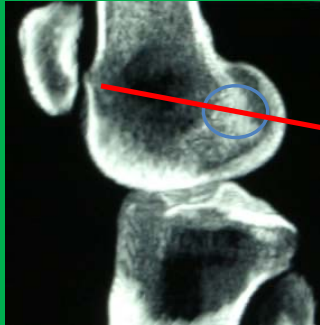
DOULEURS ET INSTABILITÉ ROTULIENNE.
ESSAI DE CLASSIFICATION

High grade Trochlear dysplasia

Maltracking : Horizontal plane



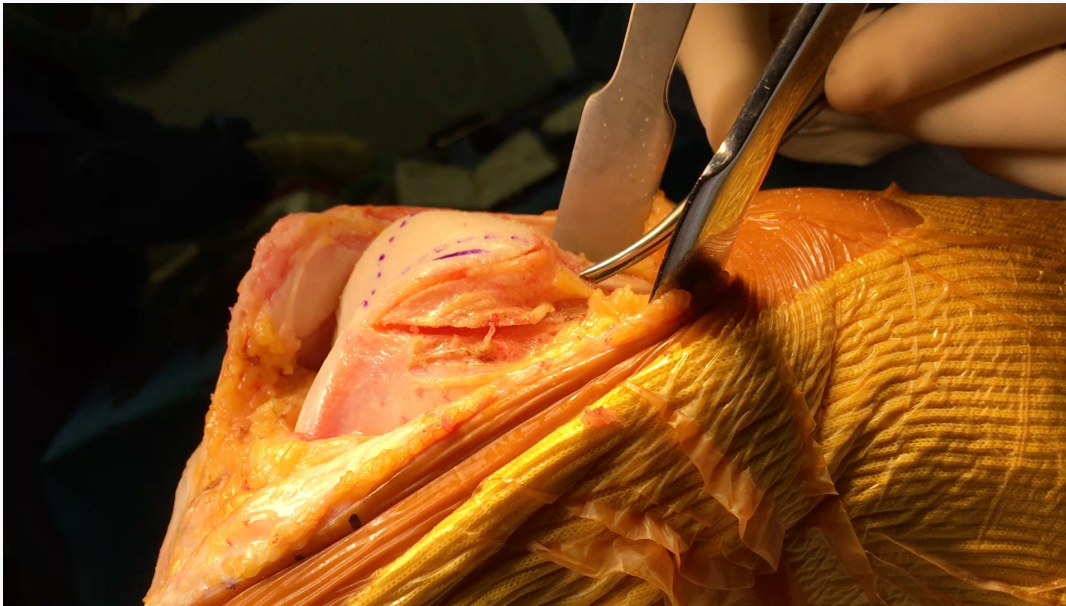
Impingement : Sagittal plane



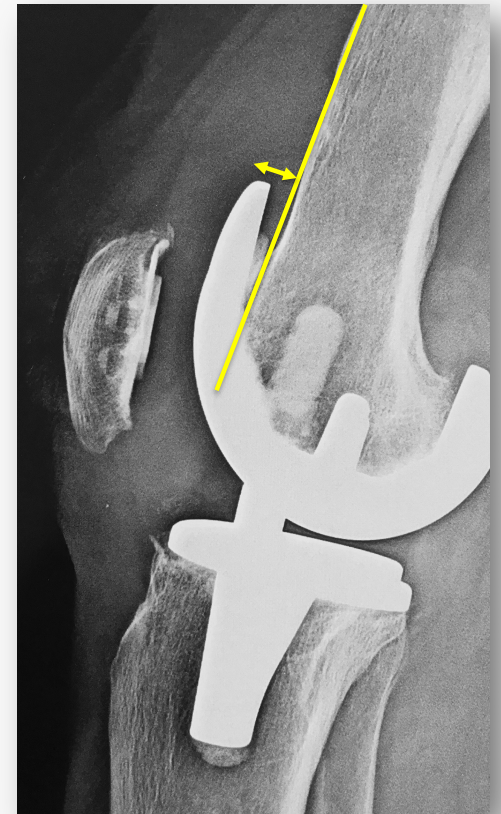
**The supra-structure of the trochlear
IS BEST SEEN ON X-RAYS**

Type D & B

Supra Trochlear Spur



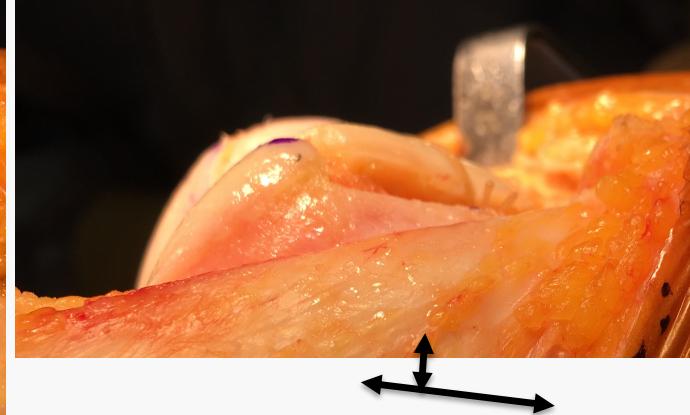
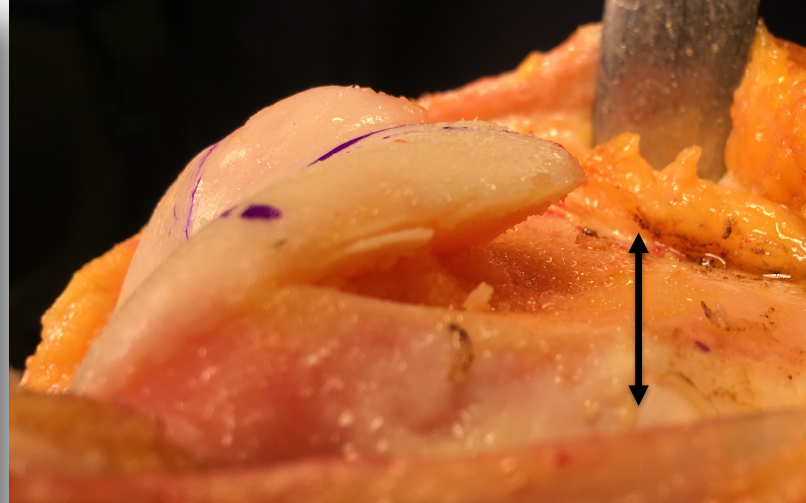
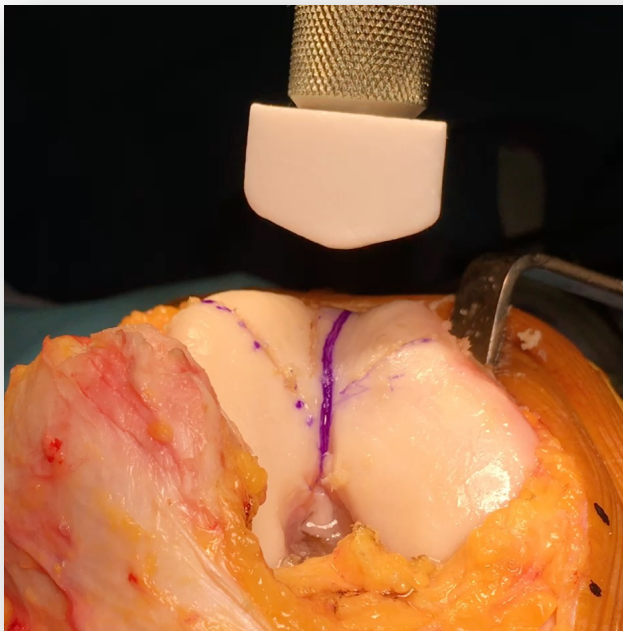
**You will
never
accept
that in a
TKR !!!**



The supra-structure of the dysplasia

Type D Increases the PF pressure

Trochleoplasty is the solution !!!!



Val d'Isère 2022



Conclusion



David DEJOUR

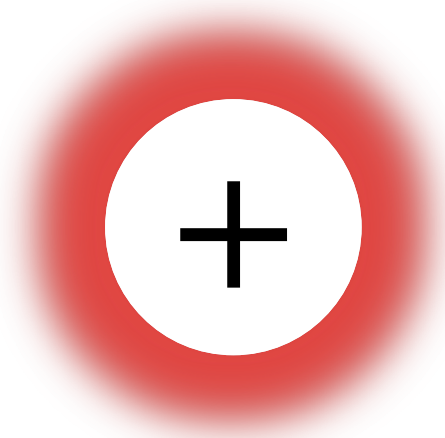
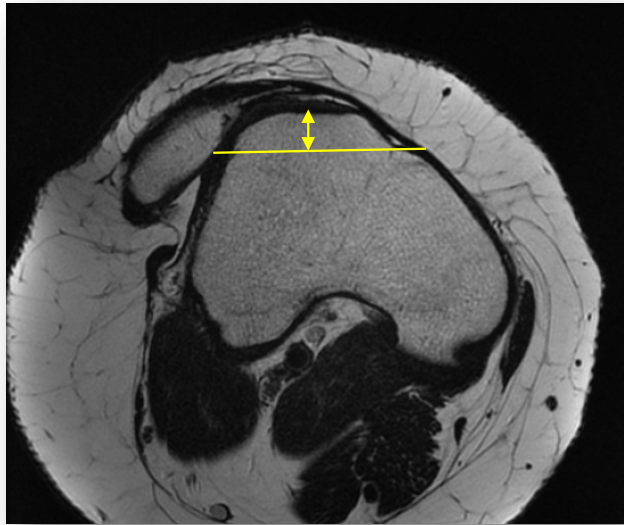


To classify the trochlear Dysplasia

To be good you can use

Slice Imaging

CT scan or MRI



To be EXCELENT

X-Rays

