Service de radiodiagnostic
et radiologie interventionnelle
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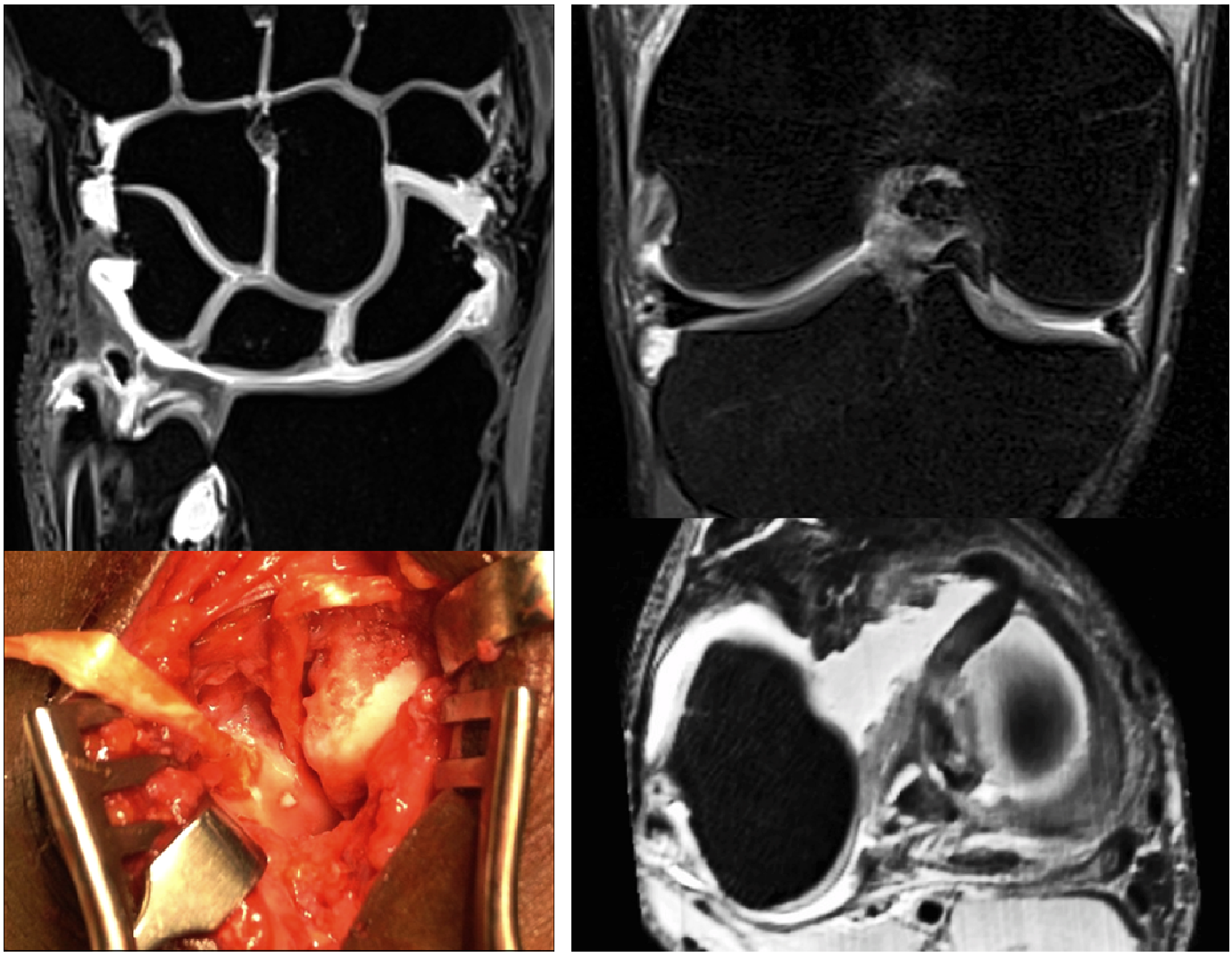
Web.: www.chuv.ch/rad

SYMPOSIUM D'IMAGERIE MUSCULOSQUELETTIQUE

Samedi 24 mai 2014 – 8h30-13h30, Auditoire Charlotte Olivier, BH08 - CHUV, Lausanne

Dr Fabio BECCE – Dr Patrick OMOUMI



SIEMENS

Bayer HealthCare

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SYMPOSIUM D'IMAGERIE MUSCULOSQUELETTIQUE
Samedi 24 mai 2014 – 8h30-13h30, Auditoire Charlotte Olivier, CHUV
Dr Fabio BECCE – Dr Patrick OMOUMI

PROGRAMME

8h15	Café d'accueil	
8h30	Introduction	R. MEULI, F. BECCE, P. OMOUMI

POIGNET ET MAIN

8h40	Imagerie des ligaments du poignet	F. BECCE
8h55	Imagerie de l'instabilité du carpe (DISI, VISI,…)	P. OMOUMI
9h10	Prise en charge des lésions ligamentaires du poignet	C. BOLLMANN
9h25	Diagnostic et prise en charge des fractures du scaphoïde	L. WEHRLI
9h40	Imagerie des tumeurs cartilagineuses de la main	A. LARBI
9h55	Diagnostic et prise en charge des kystes mucoïdes	T. CHRISTEN
10h10	Imagerie du canal carpien	F. BECCE
10h30	Pause café	

GENOU

11h00	Relecture des radiographies des surfaces articulaires	J. MALGHEM
11h30	Imagerie des ménisques : les pièges	P. OMOUMI
12h00	Le genou dégénératif : du ménisque à l'os sous-chondral	J. MALGHEM
12h45	Plastie du LCA : ce que le radiologue doit savoir	R. MARTIN
13h00	Les « boules » dans le genou : démarche diagnostique	A. LARBI
13h15	Imagerie morphologique et fonctionnelle du cartilage	P. OMOUMI
13h30	Fin	

ORATEURS

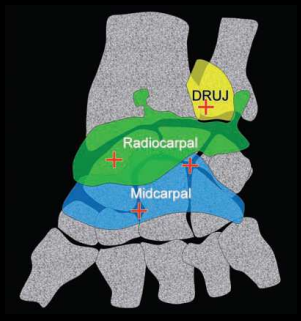
Pr Jacques MALGHEM	Radiologie, Cliniques Universitaires Saint-Luc, Bruxelles
Dr Ahmed LARBI	Radiologie, Cliniques Universitaires Saint-Luc, Bruxelles
Dr Christof BOLLMANN	Chirurgie de la main, CHUV, Lausanne
Dr Laurent WEHRLI	Chirurgie de la main, CHUV, Lausanne
Dr Thierry CHRISTEN	Chirurgie de la main, CHUV, Lausanne
Dr Robin MARTIN	Orthopédie et traumatologie, CHUV, Lausanne
Pr Reto MEULI	Radiologie, CHUV, Lausanne
Dr Fabio BECCE	Radiologie, CHUV, Lausanne
Dr Patrick OMOUMI	Radiologie, CHUV, Lausanne

Imagerie des Ligaments du Poignet

Fabio Becce
Service de Radiodiagnostic et Radiologie Interventionnelle
Centre Hospitalier Universitaire Vaudois

Articulations

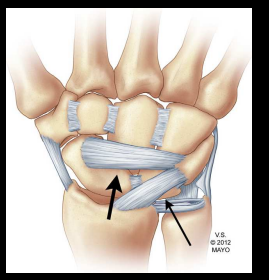
- Radio-ulnaire distale (RUD)
- Radiocarpienne
- Médiocarpienne



Moser et al. Multidetector CT arthrography of the wrist joint: how to do it. Radiographics. 2008

Ligaments

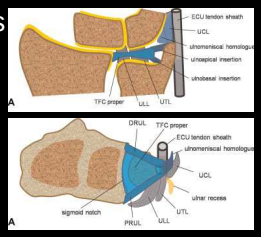
- Complexe fibrocartilagineux triangulaire (TFCC)
- Intrinsèques:
  - Interosseux
  - Capsulaires
- Extrinsèques:
  - Palmaires
  - Dorsaux
  - Collatéraux



Ringler. MRI of wrist ligaments. J Hand Surg Am. 2013

TFCC

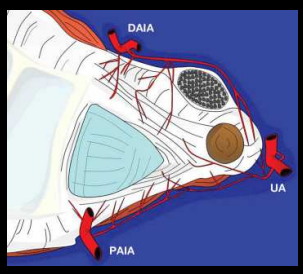
- Fibrocartilage triangulaire (disque articulaire)
- Ligaments radio-ulnaires
- Ligaments ulnocarpiens
- Ligament collatéral ulnaire
- Ménisque homologue
- Gaine du tendon extenseur ulnaire du carpe



Nõbauer-Huhmann et al. Anatomy and variants of the triangular fibrocartilage complex and its MR appearance at 3 and 7 T. Semin Musculoskelet Radiol. 2012

TFCC

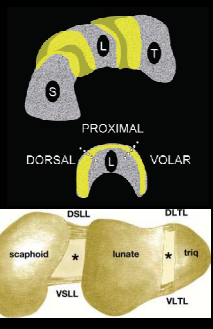
- Vascularisation

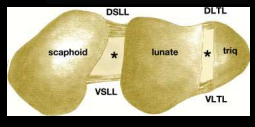


Cerezal et al. MR and CT arthrography of the wrist. Semin Musculoskelet Radiol. 2012

Ligaments Intrinsèques

- Intrinsèques interosseux:
  - Scapholunaire (SL)
  - Lunotriquétral (LT)

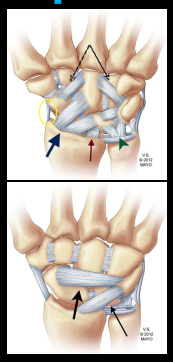




Moser et al. Multidetector CT arthrography of the wrist joint: how to do it. Radiographics. 2008
Cerezal et al. MR and CT arthrography of the wrist. Semin Musculoskelet Radiol. 2012

Ligaments Intrinsèques

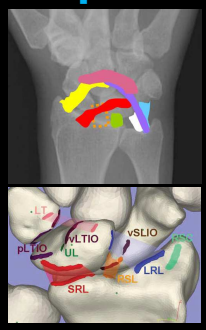
- Intrinsèques capsulaires:
  - Scaphotriquétral palmaire ("arqué")
  - Intercarpien dorsal (DIC)



Ringler. MRI of wrist ligaments. J Hand Surg Am. 2013

Ligaments Extrinsèques

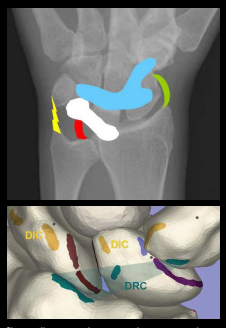
- Extrinsèques palmaires:
  - Radioscaphocapitate
  - Radiolunotriquétral
  - Ulnolunaire
  - Ulnotriquétral



Taljanovic et al. US of the intrinsic and extrinsic wrist ligaments and triangular fibrocartilage complex - normal anatomy and imaging technique. Radiographics. 2011
Nanno et al. Three-dimensional computed tomography of the carpal ligaments. Semin Musculoskelet Radiol. 2009

Ligaments Extrinsèques

- Extrinsèques dorsaux:
  - Radiotriquétral
  - Ulnotriquétral
- Extrinsèques collatéraux:
  - Radial
  - Ulnaire

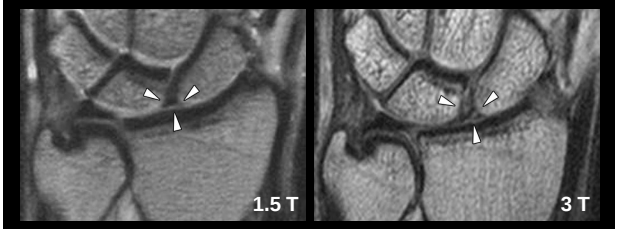


Taljanovic et al. US of the intrinsic and extrinsic wrist ligaments and triangular fibrocartilage complex - normal anatomy and imaging technique. Radiographics. 2011
Nanno et al. Three-dimensional computed tomography of the carpal ligaments. Semin Musculoskelet Radiol. 2009

IRM / Arthro-IRM

- Appareil (intensité du champ magnétique)
- Antenne
- Position du patient et poignet
- Protocole (séquences)

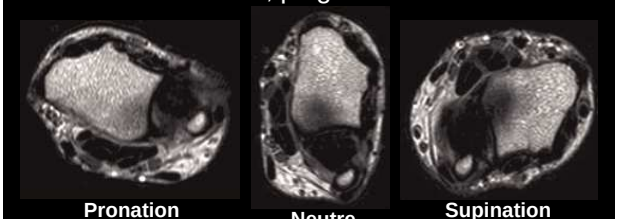
Champ Magnétique



Saupe et al. MR imaging of the wrist: comparison between 1.5- and 3-T MR imaging--preliminary experience. Radiology. 2005

Position

- Décubitus ventral, poignet au-dessus de tête
- Décubitus dorsal, poignet sur le côté



Pfirrmann et al. What happens to the triangular fibrocartilage complex during pronation and supination of the forearm? Analysis of its morphology and diagnostic assessment with MR arthrography. Skeletal Radiol. 2001
Nöbauer-Huhmann et al. Anatomy and variants of the triangular fibrocartilage complex and its MR appearance at 3 and 7 T. Semin Musculoskelet Radiol. 2012

Position

- Poignet en inclinaison radiale ou ulnaire

Gheno et al. Differences between radial and ulnar deviation of the wrist in the study of the intrinsic intercarpal ligaments: magnetic resonance imaging and gross anatomic inspection in cadavers. Skeletal Radiol. 2010

Protocole IRM

- T1 TSE axial et/ou coronal
- DP coronal avec/sans FS
- T2 TSE axial FS
- DP sagittal avec/sans FS
- (3D T1 GRE Gd FS)

Chhabra et al. Current perspectives on the advantages of 3-T MR imaging of the wrist. Radiographics. 2012

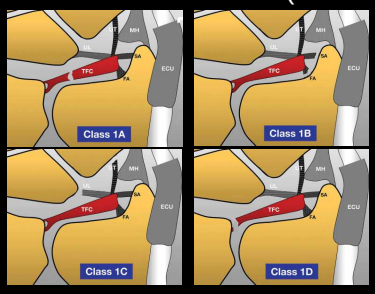
IRM

- Critères lésionnels du TFCC:
  - Dégénérescence (asymptomatique): hypersignal T1 ou DP
  - Défect/déchirure (a-/symptomatique): hypersignal T2 FS s'étendant à la surface, associé à épanchement RUD
  - Aiguë (0-3 mois), subaiguë (3-12 mois), chronique (> 1 an)

Chhabra et al. Current perspectives on the advantages of 3-T MR imaging of the wrist. Radiographics. 2012
Cerezal et al. MR and CT arthrography of the wrist. Semin Musculoskelet Radiol. 2012

IRM

- Lésions du TFCC: Palmer 1 (traumatiques)



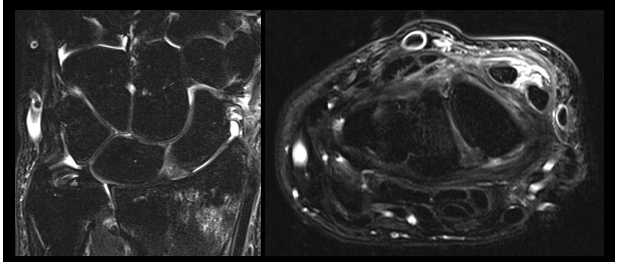
Cerezal et al. MR and CT arthrography of the wrist. Semin Musculoskelet Radiol. 2012

IRM

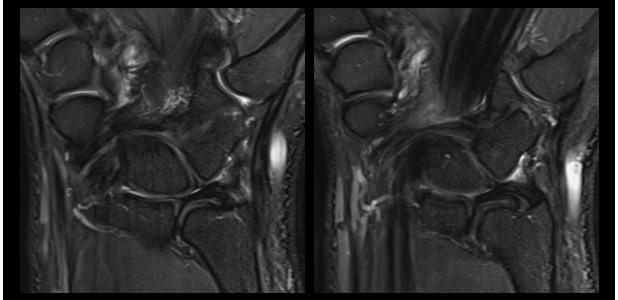
- Lésions du TFCC: Palmer 2 (dégénératives)
  - 2A: usure du TFCC
  - 2B: 2A + chondromalacie lunarienne/ulnaire
  - 2C: perforation du TFCC, chondromalacie lunarienne/ulnaire
  - 2D: 2C + déchirure ligament LT
  - 2E: 2D + arthrose ulnocarpienne

Palmer. Triangular fibrocartilage complex lesions: a classification. J Hand Surg Am. 1989
Cerezal et al. MR and CT arthrography of the wrist. Semin Musculoskelet Radiol. 2012

TFCC



Pièges



Pfirrmann et al. Variants, pitfalls and asymptomatic findings in wrist and hand imaging. Eur J Radiol. 2005

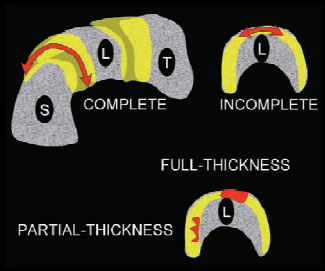
IRM

- Critères lésionnels des ligaments intrinsèques interosseux:
  - Hypersignal T2 FS
  - Distortion morphologique ou absence complète
  - Dissociation SL secondaire (> 3 mm), interruptions des arcs carpiens (Gilula), formation de kyste mucoïde

Chhabra et al. Current perspectives on the advantages of 3-T MR imaging of the wrist. Radiographics. 2012

IRM

- Déchirures des ligaments intrinsèques interosseux



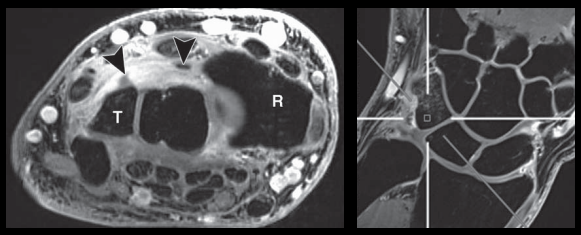
Moser et al. Multidetector CT arthrography of the wrist joint: how to do it. Radiographics. 2008

IRM

- Critères lésionnels des ligaments extrinsèques:
  - Entorse aiguë (grade 1): œdème périligamentaire
  - Déchirure partielle (grade 2): épaississement dû à œdème péri- et intraligamentaire
  - Déchirure complète (grade 3): interruption complète
  - Remaniements kystiques avulsifs
  - Kyste mucoïde

Chhabra et al. Current perspectives on the advantages of 3-T MR imaging of the wrist. Radiographics. 2012

Ligaments Extrinsèques



Becce et al. Dorsal fractures of the triquetrum: MRI findings with an emphasis on dorsal carpal ligament injuries. Am J Roentgenol. 2013

Arthro-IRM Directe

- Exploite les avantages fournis par l'épanchement articulaire:
  - Distend la capsule articulaire
  - Délimite les structures intra-articulaires
  - S'immisce dans les lésions

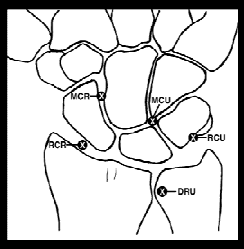
Indications

- Lésions du TFCC
- Déchirures des ligaments SL et/ou LT
- Lésions du cartilage articulaire
- Recherche de corps intra-articulaires ("libres")

Cerezal et al. Wrist MR arthrography: how, why, when. Radiol Clin N Am. 2005
Lomasney et al. Magnetic resonance arthrography of the upper extremity. Radiol Clin N Am. 2013

Abord

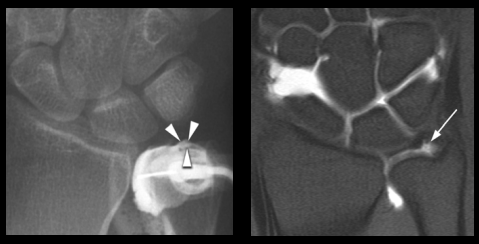
- Dorsal:
  - Arthrographie unicompartimentale (radiocarpienne)
  - Bicompartimentale
  - Tricompartimentale



Cerezal et al. Wrist MR arthrography: how, why, when. Radiol Clin N Am. 2005

Abord

- Arthrographie RUD

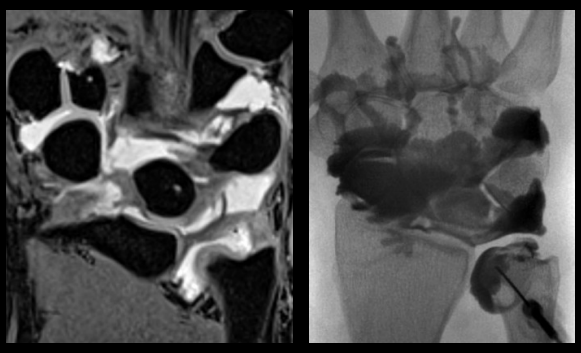


Zanetti et al. Characteristics of triangular fibrocartilage defects in symptomatic and contralateral asymptomatic wrists. Radiology. 2000
Rüegger et al. Peripheral tear of the triangular fibrocartilage: depiction with MR arthrography of the distal radioulnar joint. Am J Roentgenol. 2007

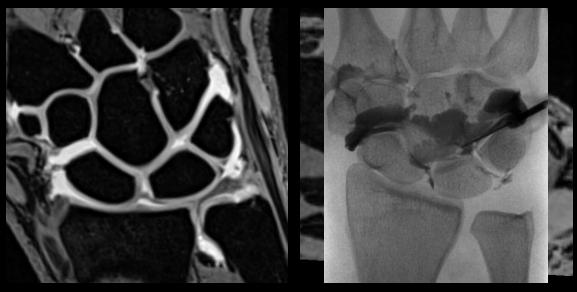
Protocole Arthro-IRM

- T1 TSE FS axial, coronal et sagittal et/ou 3D T1 GRE FS
- PD FS coronal
- T2 TSE FS axial

TFCC

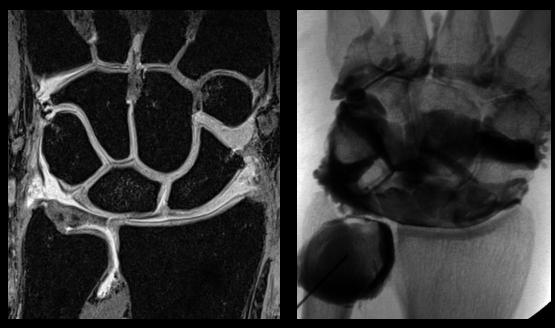


TFCC

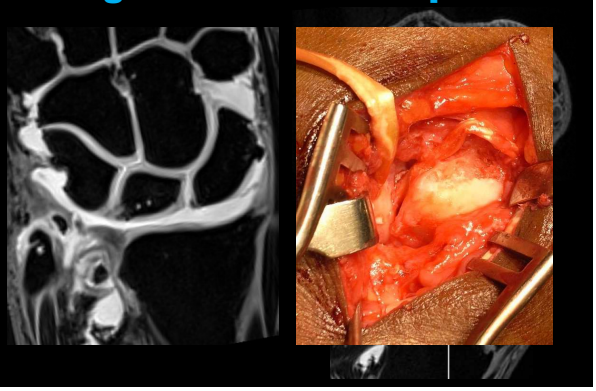


Ligaments Intrinsèques

Ligaments Intrinsèques

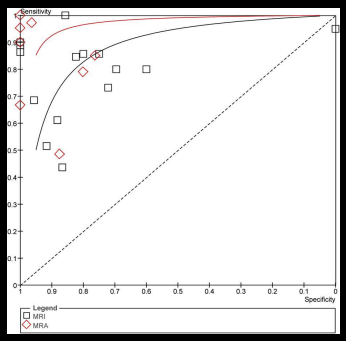


Ligaments Intrinsèques



Performance Diagnostique

- Lésions du TFCC



Smith et al. Diagnostic accuracy of magnetic resonance imaging and magnetic resonance arthrography for triangular fibrocartilaginous complex injury. J Bone Joint Surg Am. 2012

Performance Diagnostique

	IRM			Arthro-IRM		
	TFCC	SL	LT	TFCC	SL	LT
Sensibilité	0.44-1 (0.75)	0.59-0.89	0.04-0.50	0.48-1 (0.84)	0.68-1	0.50-0.82
Spécificité	0.60-1 (0.81)	0.70-1	0.90-0.97	0.76-1 (0.95)	0.87-1	0.94-1

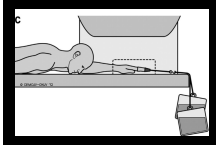
Smith et al. Diagnostic accuracy of magnetic resonance imaging and magnetic resonance arthrography for triangular fibrocartilaginous complex injury. J Bone Joint Surg Am. 2012
Ringler. MRI of wrist ligaments. J Hand Surg Am. 2013

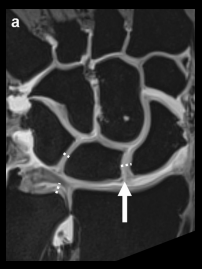
Performance Diagnostique

	1.5 T	3 T	*p*
Sensibilité			
TFCC	0.82	0.90	0.493
SL	0.57	0.70	0.482
LT	0.22	0.50	0.114
Spécificité			
TFCC	0.59	0.74	0.378
SL	0.83	0.94	0.051
LT	0.94	0.94	0.898

Anderson et al. Diagnostic comparison of 1.5 Tesla and 3.0 Tesla preoperative MRI of the wrist in patients with ulnar-sided wrist pain. J Hand Surg Am. 2008

Traction





Cerny et al. 3-T direct MR arthrography of the wrist: value of finger trap distraction to assess intrinsic ligament and triangular fibrocartilage complex tears. Eur J Radiol. 2013

Instabilité du carpe

Patrick Omoumi

Department of Radiology
Lausanne University Hospital
Switzerland

Objectifs

- Définitions
- Biomécanique du poignet
- Dissociation scapholunaire
- Imagerie

Définition

- « Incapacité du carpe à maintenir l'équilibre des forces s'exerçant sur le poignet dans lors des mouvements physiologiques. »

Schmitt R, Christopoulos G. *Eur Radiol* (2006)

Critères de qualité Rx

- Position neutre du poignet:
  - Flexion-extension
  - Déviation radiale-ulnaire
  - Pronation-supination

La radio de face:

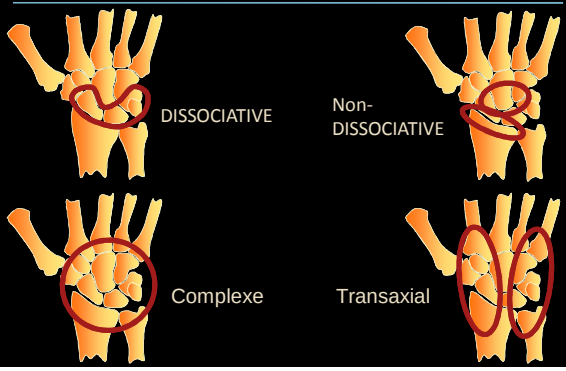
- Alignement de l'axe du radius, du capitatum et du M3
- Bonne visibilité des interlignes radio-ulnaire distal, lunotriquétral, et scapho-trapézoïdo-trapézien
- Continuité entre la corticale médiale de l' ulna et du processus styloïde ulnaire

La radio de profil strict

- Superposition M2-M3
- Alignement radius et M3
- Radius et ulna superposés
- Pisiforme entre entre la corticale antérieure du sommet du capitatum en arrière et la corticale antérieure du pôle distal du scaphoïde en avant

- Imagerie:
  - morphologique (une rupture ligamentaire ne veut pas dire qu'il y a instabilité du carpe)
  - Prémices de l'imagerie fonctionnelle…

Groupes d'instabilité

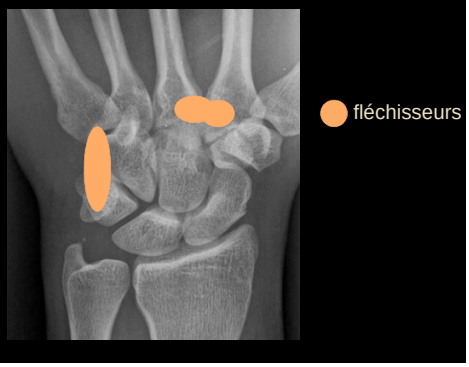


Group of instability	Instability entity	Cause
Dissociative	SL dissociation	Tear of the SL ligament (and secondary stabilizers)
	LT dissociation	Tear of the LT ligament (and secondary stabilizers)
Nondissociative	Radiocarpal instability Midcarpal instability	Tears of the RSC, vRLT and dRLT ligaments, secondary to malunioned radius fracture Congenital weakening or tears of the TCS and dIC ligaments
Complex	Perilunate	Carpal dislocation around the greater arc
	Transcaphoid perilunate	Fracture dislocation around the greater arc
Transaxial	Radial	Axial injury at the radial wrist
	Ulnar	Axial injury at the ulnar wrist
	Radial and ulnar	Axial injury at both the radial and the ulnar wrist

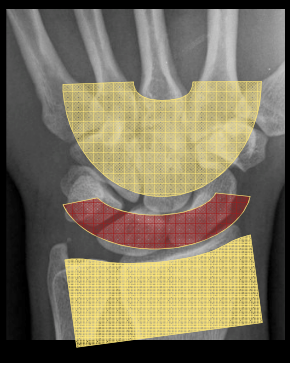
Schmitt R, Christopoulos G. *Eur Radiol* **(2006)**

Anatomie

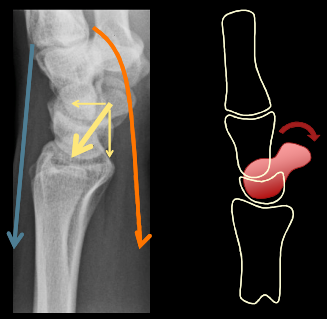
Anatomie



Notion de segment intercalé

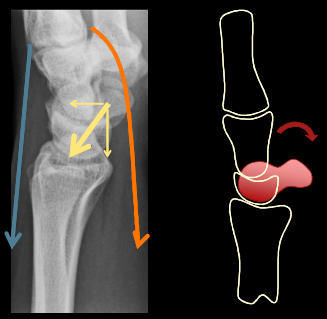


Compression axiale



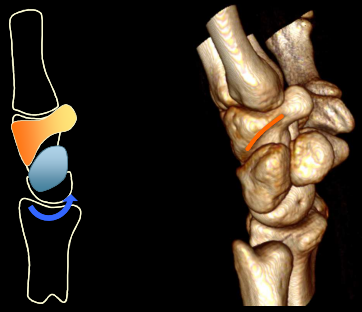
Schmitt R. European Radiology (2006)

Compression axiale



Schmitt R. European Radiology (2006)

Compression axiale



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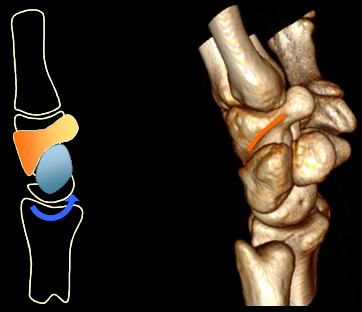
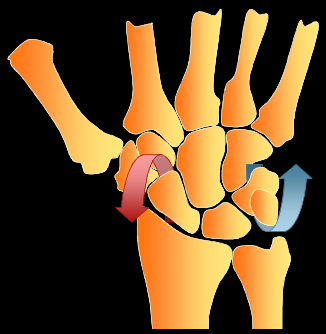
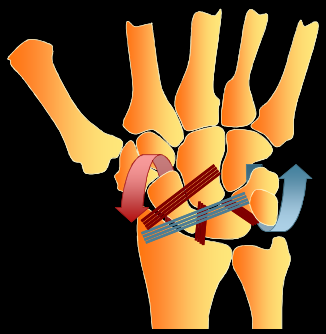


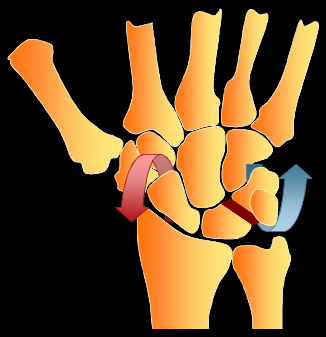
Mouvements de torsion



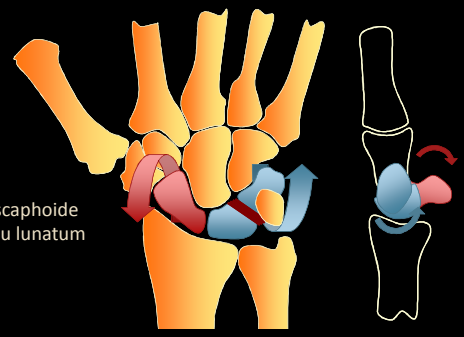
Stabilisation



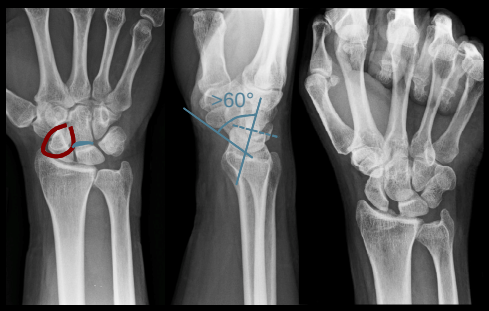
Rupture ligament SL



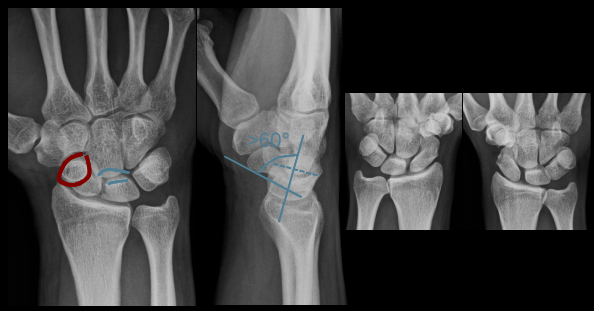
Rupture ligament SL: DISI



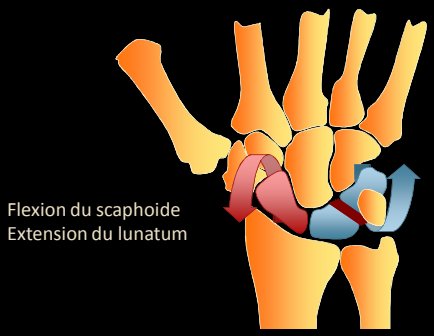
Rupture ligament SL: DISI



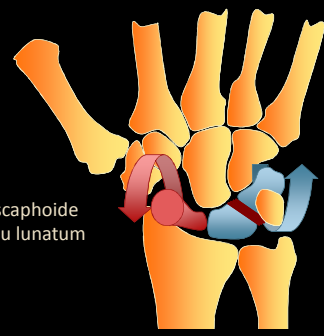
Rupture ligament SL: DISI



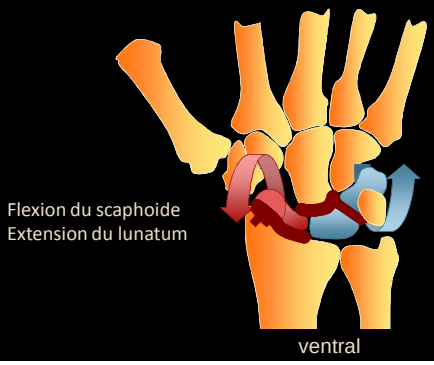
Rupture ligament SL: DISI



Rupture ligament SL: DISI



Rupture ligament SL: DISI



Clinique

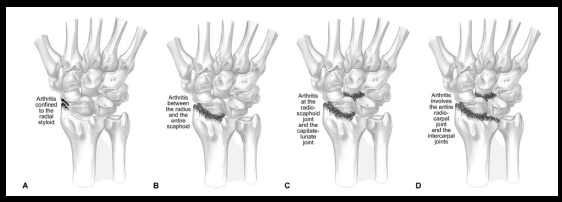
- Signe clinique:
  - Douleur, claquement, ressaut
- Examen clinique:
  - Ballotement
- Conséquence:
  - SLAC

Stades d'instabilité

Stage	Description	Ligamentary status	Carpal function
I	Pre-dynamic	Partial tear of the SL ligament	Normal at rest, normal under load
II	Dynamic	Complete tear of the SL ligament	Normal at rest, SL instability under load
III	Static	Complete tears of the SL ligament and the secondary stabilizers	SL instability at rest
IV	Osteoarthritic	Complete tears of the SL ligament and the secondary stabilizers	Osteoarthritis secondary to SLD

Schmitt R, Christopoulos G. *Eur Radiol* **(2006)**

Stades du SLAC



Arthrose type SLAC

Conclusion

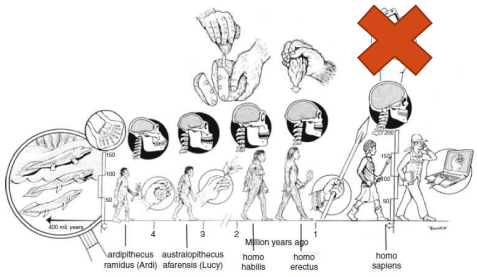
- Imagerie morphologique
  ≠ imagerie fonctionnelle
- Instabilité scapholunaire+++
- Rôle de l'imagerie:
  - Diagnostic instabilité

Pré-dynamique < dynamique < statique < arthrose

  - Bilan des lésions ligamentaires
  - Bilan de l'arthrose

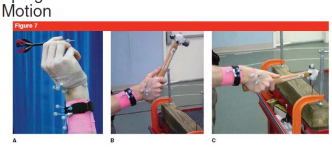
SCAPHOLUNATE LIGAMENT LESIONS

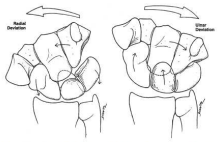
SCAPHOLUNATE LIGAMENT LESIONS



The Hand and the brain, Lundborg

The Advantage of Throwing the First Stone: How Understanding the Evolutionary Demands of *Homo sapiens* Is Helping Us Understand Carpal Motion

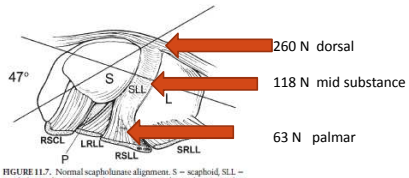




Rachel S. Rohde, MD
Joseph J. Crisco, PhD
Scott W. Wolfe, MD

J Am Acad Orthop Surg 2010;18: 51-58

SL LIGAMENT



260 N dorsal

118 N mid substance

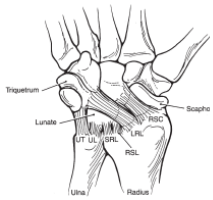
63 N palmar

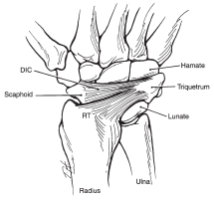
FIGURE 11.7. Normal scapholunate alignment. S = scaphoid, SLL = scapholunate ligament, L = lunate, RSCL = radioscaphocapitate ligament, P = interligamentous sulcus leading to the space of Poirier, LRLL = long radiolunate ligament, RSLL = radioscaphoidlunate ligament, SRLL = short radiolunate ligament.

11. Berger RA, Imeada T, Berglund L, An KN. Constraint and material properties of the subregions of the scapholunate interosseous ligament. *J Hand Surg Am.* 1999;24:953–962.

BERGER RA, HAND CLIN 1997

SECONDARY STABILIZERS





Scapholunate Instability: Current Concepts in Diagnosis and Management

Christina E. Kuo, MD, Scott W. Wolfe, MD

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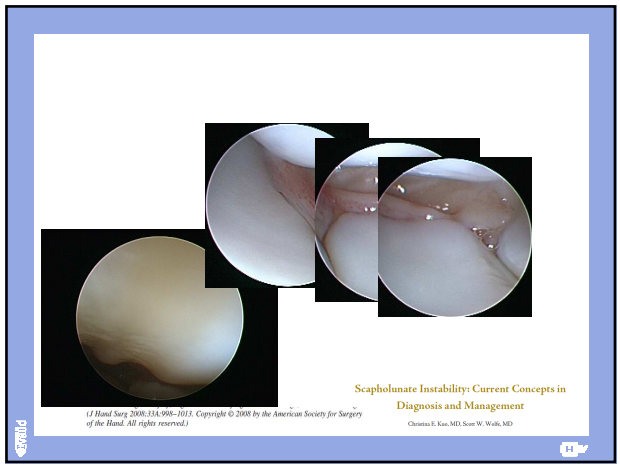
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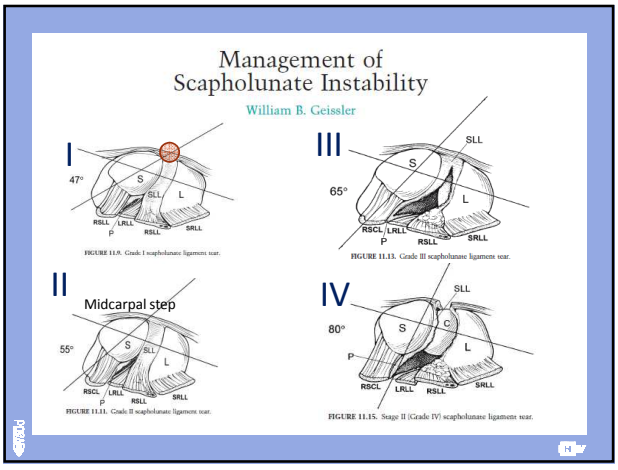
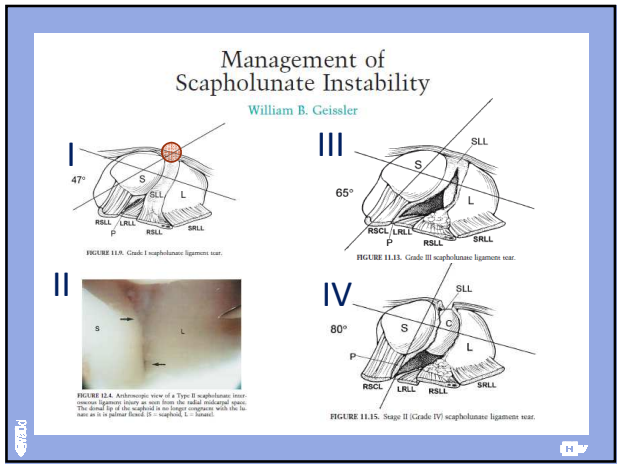

Management of Scapholunate Instability
William B. Geissler
I
47°
II
Midcarpal step
55°
III
65°
IV
80°
SLL
RSLL
LRLL
RSCL
SRLL
FIGURE 11.9. Grade I scapholunate ligament tear.
FIGURE 11.11. Grade II scapholunate ligament tear.
FIGURE 11.13. Grade III scapholunate ligament tear.
FIGURE 11.15. Stage II (Grade IV) scapholunate ligament tear.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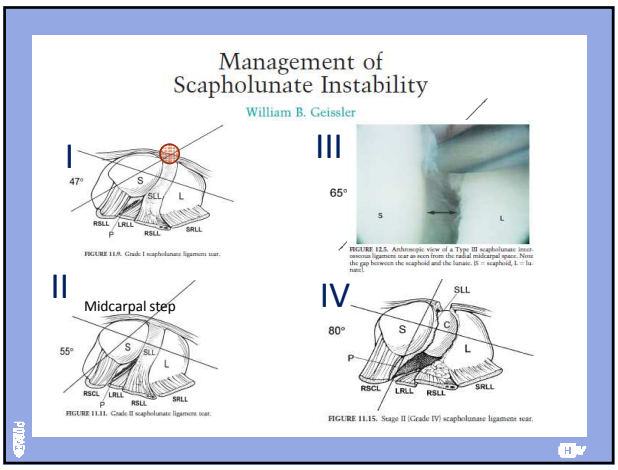
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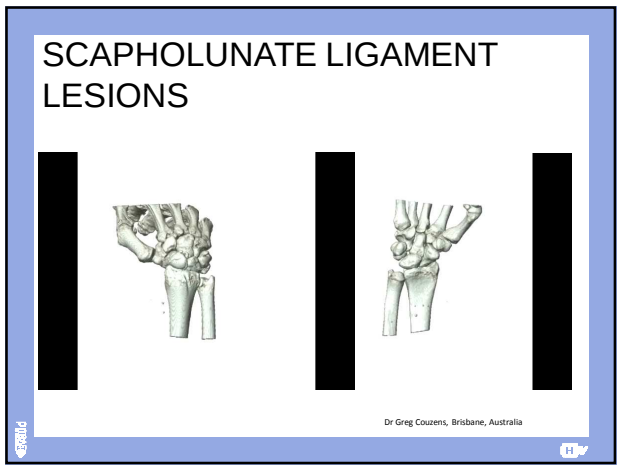
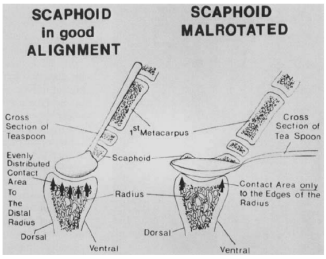

SCAPHOLUNATE LIGAMENT LESIONS
Dr Greg Couzens, Brisbane, Australia

Evolution of Arthritis of the Wrist

H. KIRK WATSON, M.D.,* AND JAIYOUNG RYU, M.D.**



1984 and 2002

Evolution of Arthritis of the Wrist

H. KIRK WATSON, M.D.,* AND JAIYOUNG RYU, M.D.**

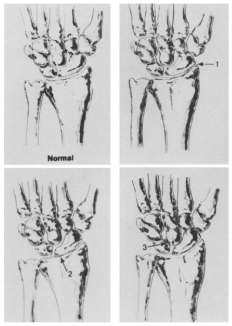


FIG. 5. The sequence of degenerative changes in SLAC wrist is consistent. First, the most radial portion of the radius–scaphoid joint; second, the rest of the radius–scaphoid joint; and third, the capitate–lunate joint.

1984 and 2002

TABLE 1. Stages of Scapholunate Instability[1]

	Stage				
	I. Occult	II. Dynamic	III. Scapholunate Dissociation	IV. DISI	V. SLAC
Injured ligaments	Partial SLIL	Incompetent or complete SLIL; partial volar extrinsics	Complete SLIL, volar or dorsal extrinsics	Complete SLIL, volar extrinsics; secondary changes in RL, ST, DIC ligaments	As in stage IV
X-rays	Normal	Usually normal	SL gap ≥3 mm; RS angle ≥60°	SL angle ≥70° SL gap ≥3 mm RL ≥15° CL ≥15°	I. Styloid DJD II. RS DJD III. CL DJD IV. Pancarpal DJD
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CL, capitolunate; DJD, degenerative joint disease; RL, radiolunate; RS, radioscaphoid; SL, scapholunate; ST, scaphotrapezoid.

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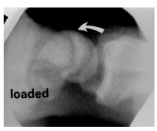
CASE 1

- Fall on outstretched left hand with radiocarpal pain, 36y old



Clinically: Watson Test (but difficult when associated lesion like distal radius fracture)

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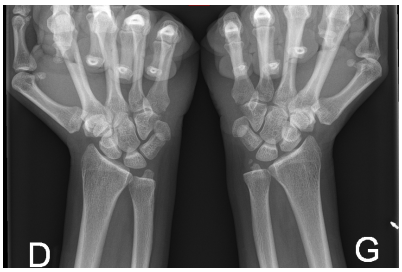
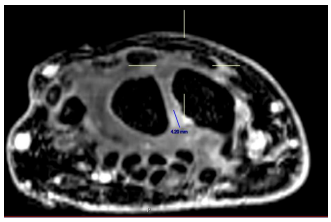
CASE 1



CASE 1

MRI



CASE 1

- Conservative treatment in a splint 6 weeks
- clinically no symptoms at 3 months after the injury

CORRECT DIAGNOSIS AS SOON AS POSSIBLE ! (After 6 weeks not acute anymore…)

TABLE 1. Stages of Scapholunate Instability[3]

	Stage				
	I. Occult	II. Dynamic	III. Scapholunate Dissociation	IV. DISI	V. SLAC
Injured ligaments	Partial SLIL	Incompetent or complete SLIL; partial volar extrinsics	Complete SLIL, volar or dorsal extrinsics	Complete SLIL volar extrinsics; secondary changes in RL, ST, DIC ligaments	As in stage IV
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CL, capitolunate; DJD, degenerative joint disease; RL, radiolunate; RS, radioscaphoid; SL, scapholunate; ST, scaphotrapezoid.

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CASE 2

40 years old manager, fall on his left wrist

CASE 2

CORRECT DIAGNOSIS AS SOON AS POSSIBLE ! (After 6 weeks not acute anymore…)

TABLE 1. Stages of Scapholunate Instability[3]

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Wrist Arthroscopy

Geissler III

CASE 2

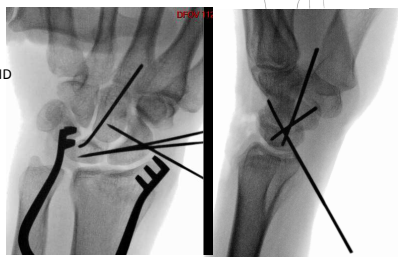
+/-

K-WIRE FIXATION AND OPEN REPAIR

For 6 weeks,

Then removal and

HAND THERAPY !!!



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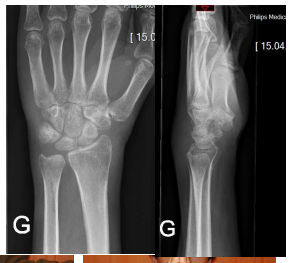
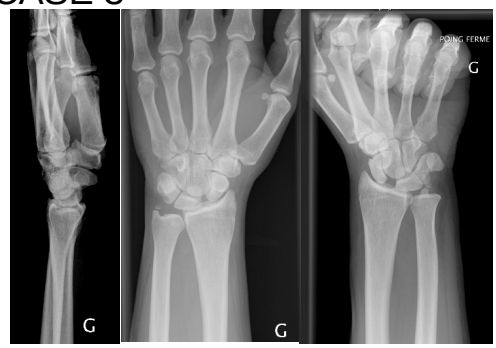


CASE 3



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Scapholunate Instability: Current Concepts in Diagnosis and Management

Christina E. Kuo, MD, Scott W. Wolfe, MD

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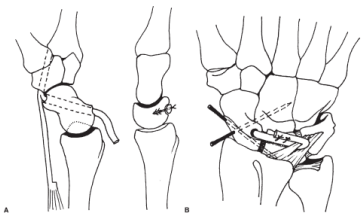
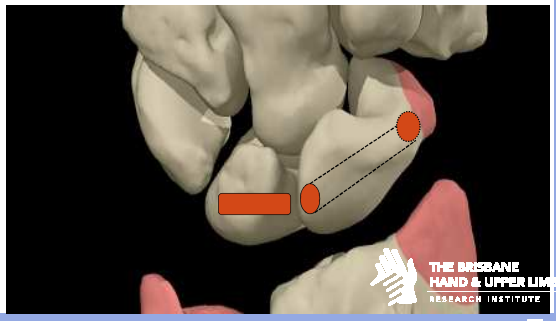
- Modification of 3LT (mod Brunelli)
  - Stanley , Garcia-Elias

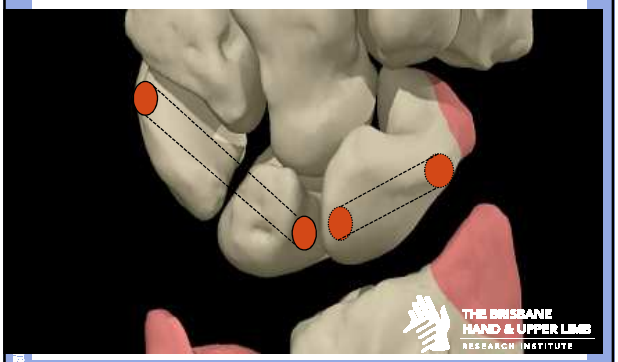


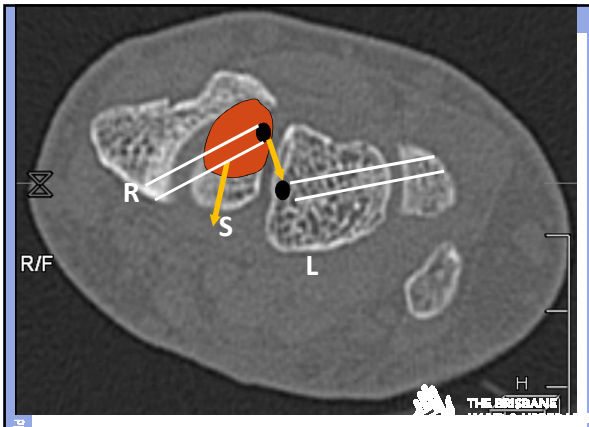
Scapholunate Ligament Reconstruction

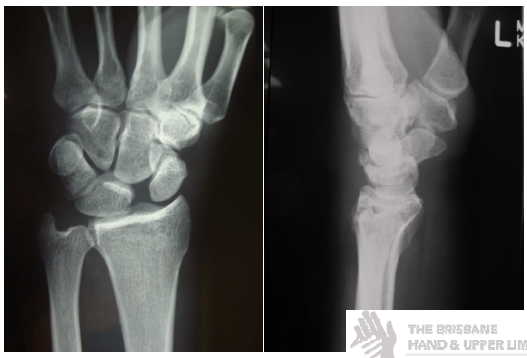
Mark Ross, MBBS, FRACS (Orth)[1,2,3] Jeremy Loveridge, MBBS[1,2] Kenneth Cutbush, MBBS, FRACS (Orth)[1]
Greg Couzens, MBBS, FRACS (Orth)[1,2]

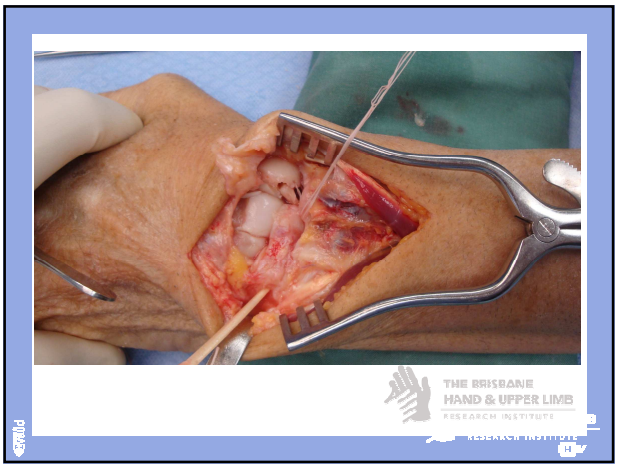
J Wrist Surg 2013;2:110–115.

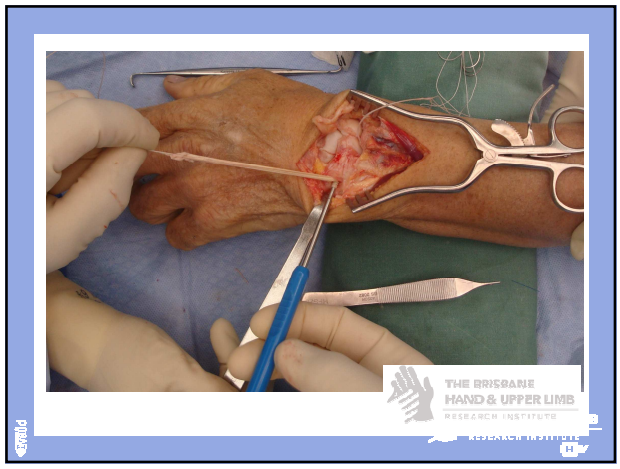












LUNOTRIQUETRAL LESIONS

Fig. 3. Posteroanterior and lateral radiographs of the wrist demonstrating subtle disruption of the Gilula lines at the lunotriquetral joint, and static volar intercalated segment instability deformity.

LUNOTRIQUETRAL LESIONS

- NONSURGICAL TREATMENT
- ARTHROSCOPIC DEBRIDEMENT
- DIRECT REPAIR / PINNING
- CAPSULODESIS
- ARTHRODESIS
- LIGAMENT RECONSTRUCTION
- ULNAR SHORTENING OSTEOTOMY

JHS • Vol 37A, October 2012

Lunotriquetral Ligament Tears

LUNOTRIQUETRAL LESIONS

EVIDENCE-BASED MEDICINE

Lunotriquetral Ligament Tears

Cameron T. Atkinson, MD, Jeffry Watson, MD

SHORTCOMINGS OF THE EVIDENCE

Lunotriquetral ligament tears are uncommon, variably diagnosed, and often diagnosed in association with other wrist pathology. The diagnoses of "instability" and "complete tear" are poorly defined and potentially unreliable. The available evidence is limited to a few small, retrospective case series and comparative studies, often from an advocate of a specific surgical treatment. The indications for surgery are variable and unclear. The outcomes are judged entirely on subjective outcomes, often as assessed by the surgeon. Symptom relief seems generally incomplete, and the results are judged primarily on the basis of patient satisfaction.

OUR CURRENT CONCEPTS FOR THIS PATIENT

In our opinion, the infrequency of patients presenting with ongoing pain from an LT ligament tear suggests that most acute injuries might become asymptomatic without formal diagnosis and treatment. We diagnose LT tears on the basis of localized LT tenderness and positive ballottement tests in the setting of ulnar-sided pain and decreased grip. We routinely order radiographs to look for malalignment and magnetic resonance arthrograms to look for an LT ligament tear. We would suggest a 6-week period of cast immobilization of the wrist and forearm, followed by a period of observation lasting at least 6 months, before considering surgical treatment. We emphasize that there is nothing to indicate that this condition will worsen over time or result in degenerative sequelae if left untreated. The surgical plan typically consists of confirmation of the diagnosis with arthroscopy, followed by reconstruction of the LT ligament with a distally based extensor carpi ulnaris reconstruction through bone tunnels with 8 weeks of transarticular pin immobilization.

JHS • Vol 37A, October 2012

LUNOTRIQUETRAL LESIONS

Isolated Lunotriquetral Ligament Tears Treated With Ulnar Shortening Osteotomy

Ather Mirza, MD, Justin B. Mirza, DO, Alexander Y. Shin, MD, Daniel J. Lorenzana, BA, Brian K. Lee, BS, Brett Izzo, MD

JHS • Vol 38A, August 2013

- 53 patients, LT tears arthroscopically confirmed.
- minimum 1 year follow-up

TABLE 2. Comparison of Chun and Palmer Wrist Grade Distribution Before Surgery and at Final Follow-Up

	Preoperative	Final
Excellent	0	27 (51%)
Good	0	17 (32%)
Fair	15 (28%)	9 (17%)
Poor	30 (57%)	0
No grade	8 (15%)	0

TAKE HOME MESSAGES

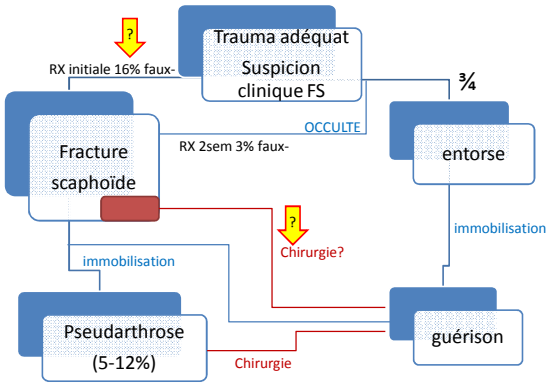
- ALWAYS KEEP A HIGH INDEX OF SUSPICION FOR SL or LT LESIONS (or TFCC) (« WRIST SPRAIN » is not a precise diagnosis)
- A 3T MRI MACHINE IS NOT ENOUGH TO HAVE ADEQUATE IMAGES (technical factors and correct interpretation)
- THE DIAGNOSTIC DELAY SHOULD NOT EXCEED 4-6 WEEKS THE TREATMENT/PROGNOSIS WILL CHANGE IF DIAGNOSED LATE

THANK YOU FOR YOUR ATTENTION !

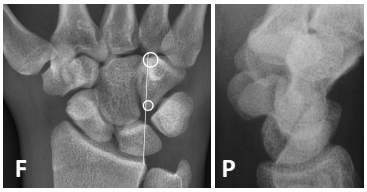
Dr Laurent WEHRLI
Centre de la main
Service de Chirurgie Plastique et de la Main
Département de l'Appareil Locomoteur
CHUV, Lausanne

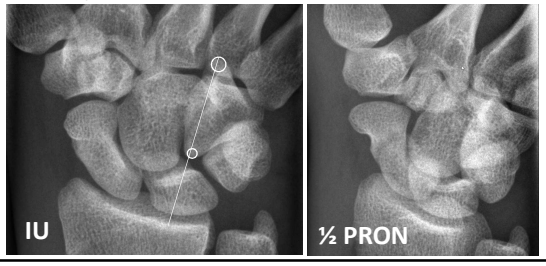
24 mai 2014

Rôle de la radiologie spécialisée

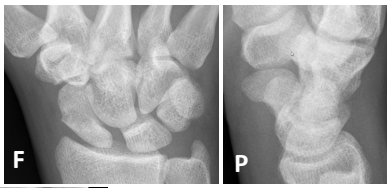


- H 18 ans
- Chute scooter
- Fracture ouverte tibia
- RX à 2j à Sion

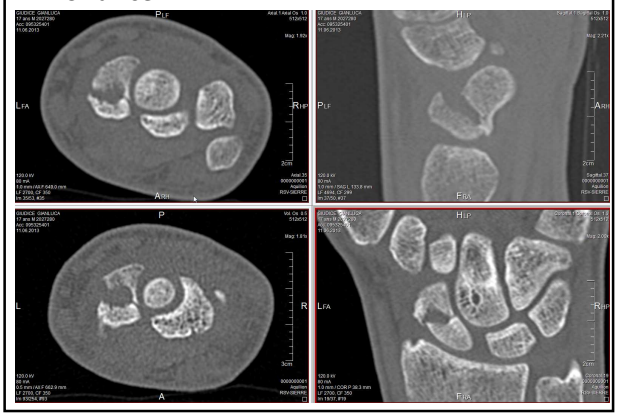




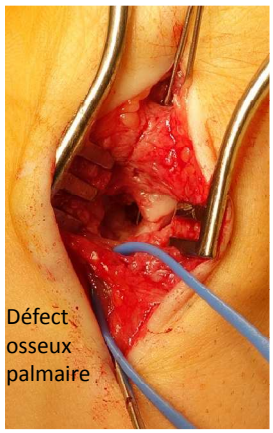
- à 7 sem



- CT à 7sem

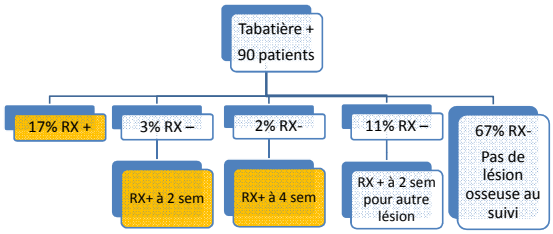


- à 8 sem: voie palmaire
- Embrochage RL
- Réduction scaphoïde distal
- Greffe spongieuse
- Vis rétrograde



- RX à 2 mois post-op
- A 6 mois:
  - 70% mobilité
  - 90% force

Clinique + RX → évolution



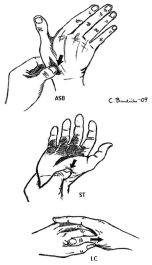
Biais: Tests cliniques spécifiques non utilisés!
Si asymptomatique à 1, 2, ou 4 sem: fin du traitement!
Pas d'incidence en hyper-pronation
67% = entorse soulagée par immobilisation?

Pillai 2005 Management of clinical fractures of the scaphoid results of an audit and literature review

Tests cliniques

• Inclinaison ulnaire	(Hopkins 1933)
• Piston index et médius	(Cole 1935)
• Extension	(Soto-Hall 1941)
• Pron ou Sup contre R	(Verdan 1960)
• Pron + IU	(Powell 1988)
• Tabatière douloureuse	(Zarnett 1991)
• Œdème/discoloration tabatière	(Barton 1992)
• Piston pouce	(Esberger 1994)
• Piston pouce + pron + IU	(Jacobsen 1995)
• …	

Mieux suspecter fracture occulte? score scaphoïdien clinique



- 13 confirmations fracture/154 IRM (8.4%)
- 9 contusions osseuses/154 IRM (5.8%)
- ➢ Meilleure prédiction fracture occulte: score≥4
  - IU, douleur tabatière (3 points)
  - Extension, douleur tubercule (2 points)
  - Piston (1 point)

Score <4: Valeur préd nég 96%

Score ≥4 par spécialiste: sensibilité et spécificité 100%

score ≥4 et RX- → IRM

Bergh 2013 Clinical scaphoid score (CSS) to identify scaphoid fracture with MRI in patients with normal x-ray after a wrist trauma

Types de fracture (=rupture corticale)

- *(Œdème/contusion osseuse IRM)*
  - *rupture capillaire*
  - *µfractures trabécuaires (ligne IRM non corticale)*
- Occulte (RX invisible, puis visible)
- In situ stricte (réimpaction corticale)
- Déplacée
  - Diastasis/Rotation
  - Translation (latérale, AP)
  - Flexion (humpback)
- Multifragmentaire

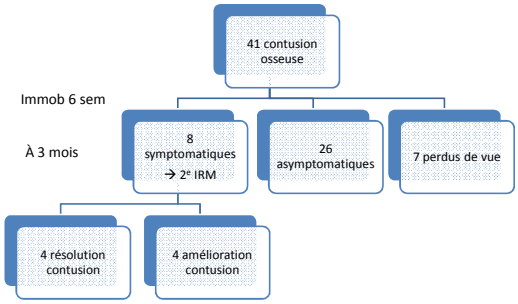
Œdème osseux (IRM) = fracture?

- 50 patients avec suspicion fracture occulte → IRM à 10-14j:
  - Fracture: ligne hypo-T1 traversant le scaphoïde de cortex à cortex; ligne hyper-STIR
  - Bone bruising: Hypo-T1 diffus; Hyper-T2 sans composante linéaire
- → 50 oedèmes osseux → immobilisation 8 sem
- 4 encore symptomatiques à 8 sem → IRM: 1 fracture

Œdème → plâtre puis suivi RX ou IRM

Thavarajah 2011 Does scaphoid bone bruising lead to occult fracture A prospective study of 50 patients

Œdème osseux (IRM) → pseudarthrose?



La Hei 2007 Scaphoid bone bruising–probably not the precursor of asymptomatic non-union of the scaphoid

Suspicion fracture occulte: Intérêt IRM (2013)

€

- Immobilisation et suivi arrêtés à 48h si IRM- pour fracture
- Douleurs identiques à 14 et 42j
- Pas d'impact sur l'activité
  - Professionnelle
  - Sportive
- £504.13 (MRI) and £532.87 (control) (=gain 5%)

Patel 2013 Cost and clinical effectiveness of MRI in occult scaphoid fractures
A randomised controlled trial

Suspicion fracture occulte: Intérêt IRM (2005)

€

RCT – Australie – IRM 475 AUD (320 €)

- 11 patients avec IRM -17 patients groupe contrôle

➢ Pas d'impact sur durée arrêt travail
➢ Si pas de fracture: gain immobilisation 1 sem (3j vs 10j)
➢ Le gain du coût du suivi ne compense par le surcoût de l'IRM

Biais:
•4 IRM/17 patients chez groupe contrôle
•4 scintigraphie chez groupe contrôle (0 dans groupe IRM)

Brooks 2005 Cost effectiveness of adding magnetic resonance imaging to the usual management of suspected scaphoid fractures

Erreur de suspicion fracture occulte: Intérêt IRM (2009)

€

2x27 patients prospectifs – Danemark – IRM 330€

- Hôpital 1: IRM dans la semaine
  - Stop immob si IRM-
- Hôpital 2: suivi RX
  - Stop immob à 2 sem si 2eRX- et ø douleur
  - Stop immob à 4-6 sem si 3eRX-

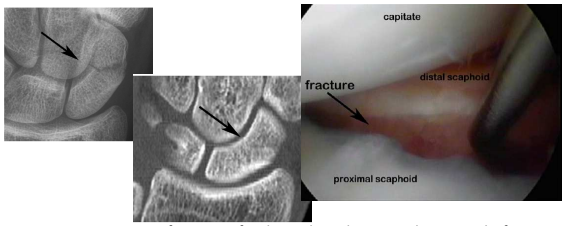
➢ Gain principalement sur l'AT (11 vs 27j)
➢ Immobilisation 4j vs 20j; AT 11j vs 27j
➢ Le gain du coût suivi du ne compense par le surcoût de l'IRM

Biais: L'étude ne considère que les patients sans fractures!!
Evaluation par téléphone à 3 mois de l'arrêt de travail et de la fonction de la main

Hansen 2009 Cost-effectiveness of MRI in managing suspected scaphoid fractures

Radiologie vs clinique

- Déplacement = instabilité arthroscopique
- « In situ » ≠ stabilité arthroscopique



Buijze 2012 Diagnostic Performance of Radiographs and Computed Tomography for Displacement and Instability of Acute Scaphoid Waist Fractures

CT
Facteurs prédictifs pour pseudarthrose

	Union Rate
	Yes
Humpback	78% (14/18)
Translation	88% (36/41)
Comminution	89% (25/28)
Sclerosis	100% (6/6)
Cysts	96% (40/42)

Pas fact. préd.

Grewal 2013 Use of Computed Tomography to Predict Union and Time to Union in Acute Scaphoid Fractures Treated Nonoperatively

IRM
facteurs prédictifs pour pseudarthrose

Seules mesures reproductibles:
gap et translation (plan sagittal)

- 40 in situ/49
  - 0% pseudarthrose
- 9 déplacées/49
  - 3 pseudarthroses/9 (33.3%)

Bhat 2004 MRI and plain radiography in the assessment of displaced fractures of the waist of the carpal scaphoid

Déplacement sur CT à 4 sem

- Aucun (≤0.5mm) 43/59
  - 26 Stop immob à 4 sem
  - 17 Poursuite immob +1-4 sem

  98% consolidation
- Modéré 14/59
  - Consolidation 11/14
- Sévère (>1.5mm) 2/59
  - Consolidation 0/2

  69% consolidation

À 4 sem: ø dépl + consolidation = stop immob

Geoghegan 2009 Undisplaced scaphoid waist fractures is 4 weeks immobilisation in a below-elbow cast sufficient if a week 4 CT scan suggests fracture union

CT à 4 sem: fact. prédictifs pour pseudarthrose

- Gap <2mm → 0 pseudarthrose/13
- Gap 2-3mm → 3 pseudarthroses/7 (43%)
- Gap > 3mm → 7 pseudarthroses/11 (64%)

- Résorption >50% fracture: fact prédictif
- Sclérose: Non prédictif

Amirfeyz 2011 Displaced scaphoid waist fractures The use of a week 4 CT scan to predict the likelihood of union with nonoperative treatment

Prédiction pseudarthrose par hyposignal IRM injecté?

- Pas de corrélation entre:
  - mauvaise prise de contraste IRM du pôle proximal à 1-2 sem

  Et
  - future consolidation CT à 12 sem d'immoblisation

- 4 pseudarthroses/32 (12%)

Dawson 2001 Scaphoid blood flow and acute fracture healing

Vissage fracture

Herbert (pleine)

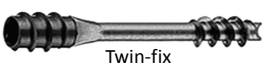
CCS (Medartis)

Herbert/Whipple (cannulée)

HCS (Synthes)

Acutrak

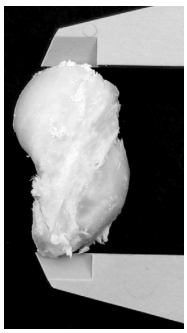
Acutrak 2



Twin-fix

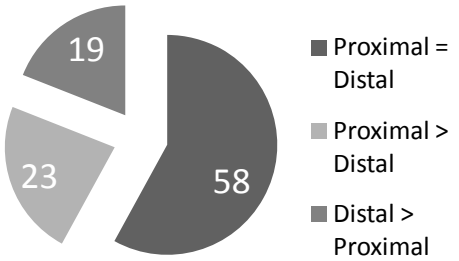
Longueur / largeur pôle proximal

- Hommes
  - 31.3 ± 2.1
  - 4.5 ± 1.4
- Femmes
  - 27.3 ± 1.7
  - 3.7 ± 0.5



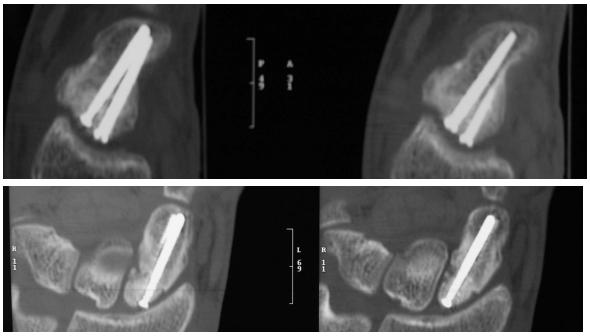
Heinzelmann 2007 Anthropometry of the human scaphoid

Proportion entre la taille des 2 pôles



Ceri 2004 The Morphological and Morphometric Features of the Scaphoid Cadaveric study of 200 scaphoid bones (100 cadavers)

Intérêt du CT à 4 mois: % consolidation



Merci pour votre attention!

Les tumeurs cartilagineuses de la main

Lausanne le 24 Mai 2014

A.Larbi, V.Perlepe*, X.Pavard*, F.Lecouvet*, J.Malghem*, P.Viala**, C.Cyteval**, B.Vande Berg**

**Département d'imagerie médicale, UCL, Bruxelles.*
***Imagerie musculo-squelettique, CHU Lapeyronie, Montpellier.*

Objectifs

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- Comment reconnaît-on une lésion à matrice chondroïde?

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- Quelles sont les spécificités de ces lésions?

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- Quelles sont les spécificités de ces lésions?
- Comment fait on la différence avec le chondrosarcome?

Introduction

- Tumeurs caractérisées par la présence d'une matrice cartilagineuse
- Tous les compartiments de la main
- Fréquence environ 10%*

*Marty, F.L., et al., [A retrospective study of hand and wrist tumors in adults]. Chir Main. 29(3): p. 183-7.

Disponible en ligne sur ScienceDirect www.sciencedirect.com
Elsevier Masson France EM|consulte www.em-consulte.com
CHIRURGIE DE LA main
Chirurgie de la main 29 (2010) 183–187

Article original

Étude rétrospective d'une série de 623 tumeurs de la main et du poignet chez l'adulte

A retrospective study of hand and wrist tumors in adults

F.-L. Marty [a], E. Marteau [b], P. Rosset [a], G. Faizon [a], J. Laulan [b,*]
[a] Service de chirurgie orthopédique et traumatologique 2, hôpital Trousseau, CHU de Tours, 37044 Tours cedex, France
[b] Unité de chirurgie de la Main, service de chirurgie orthopédique et traumatologique 1, hôpital Trousseau, CHU de Tours, 37044 Tours cedex, France

Reçu le 15 août 2009 ; reçu sous la forme révisée 3 janvier 2010 ; accepté le 19 mars 2010

- Étude rétrospective
- 623 tumeurs main et poignet

Effectif de chaque type tumoral

Type histologique	Effectif (%)	Type histologique	Effectif (%)
Kyste synovial	221 (35,5)	Ostéome ostéoïde	4 (0,6)
TCG des GS*	67 (10,8)	Ostéochondromatose	3 (0,5)
Amylose	47 (7,5)	Mixome	3 (0,5)
Kyste mucoïde	44 (7,1)	Carcinome épidermoïde	2 (0,3)
Chondrome	43 (6,9)	Neurofibromatose	2 (0,3)
Granulome inflammatoire	35 (5,6)	Résidu ungual	2 (0,3)
Lipome	19 (3,0)	Verrue séborrhéique	2 (0,3)
Tumeur glomique	19 (3,0)	Calcification	1 (0,2)
Exostose	17 (2,8)	Fasciite nodulaire	1 (0,2)
Angiome	16 (2,6)	Fibrome non ossifiant	1 (0,2)
Kyste et inclusion épidermique	16 (2,6)	Hématome	1 (0,2)
Schwannome	11 (1,8)	Hidradénome	1 (0,2)
Hémangiome	10 (1,6)	Kyste anévrismal	1 (0,2)
Kyste sébacé	6 (1,0)	Lymphangiome	1 (0,2)
Botriomycome	5 (0,8	Lymphome	1(0,2)
Névrome	5 (0,8)	Mélanome malin	1 (0,2)
Fibrose de dupuytren	4 (0,6)	Métastase rénale	1 (0,2)
Histiocytofibrome bénin	4 (0,6)	Sarcome épithélioïde	1 (0,2)
Nodule rhumatoïde	4 (0,6)	Synovialosarcome	1 (0,2)

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Chondrome 7%

Effectif de chaque type tumoral

Type histologique	Effectif (%)	Type histologique	Effectif (%)
Kyste synovial	221 (35,5)	Ostéome ostéoïde	4 (0,6)
TCG des GS*	67 (10,8)	Ostéochondromatose	3 (0,5)
Amylose	47 (7,5)	Mixome	3 (0,5)
Kyste mucoïde	44 (7,1)	Carcinome épidermoïde	2 (0,3)
Chondrome	43 (6,9)	Neurofibromatose	2 (0,3)
Granulome inflammatoire	35 (5,6)	Résidu ungual	2 (0,3)
Lipome	19 (3,0)	Verrue séborrhéique	2 (0,3)
Tumeur glomique	19 (3,0)	Calcification	1 (0,2)
Exostose	17 (2,8)	Fasciite nodulaire	1 (0,2)
Angiome	16 (2,6)	Fibrome non ossifiant	1 (0,2)
Kyste et inclusion épidermique	16 (2,6)	Hématome	1 (0,2)
Schwannome	11 (1,8)	Hidradénome	1 (0,2)
Hémangiome	10 (1,6)	Kyste anévrismal	1 (0,2)
Kyste sébacé	6 (1,0)	Lymphangiome	1 (0,2)
Botriomycome	5 (0,8	Lymphome	1(0,2)
Névrome	5 (0,8)	Mélanome malin	1 (0,2)
Fibrose de dupuytren	4 (0,6)	Métastase rénale	1 (0,2)
Histiocytofibrome bénin	4 (0,6)	Sarcome épithélioïde	1 (0,2)
Nodule rhumatoïde	4 (0,6)	Synovialosarcome	1 (0,2)

Chondrome 7%
Exostose 3%

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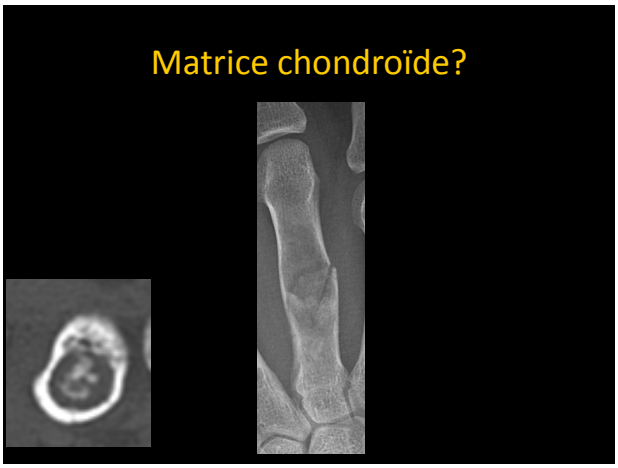
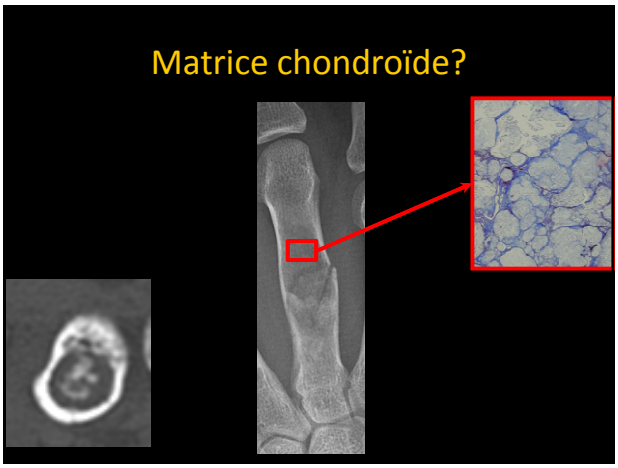
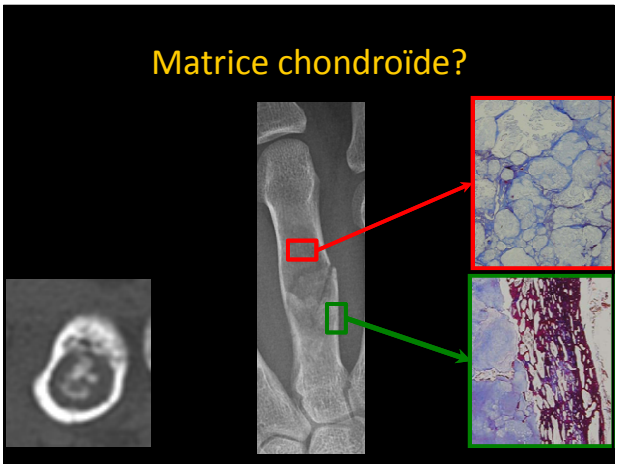
Nodule rhumatoïde	4 (0,6)	Synovialosarcome	1 (0,2)

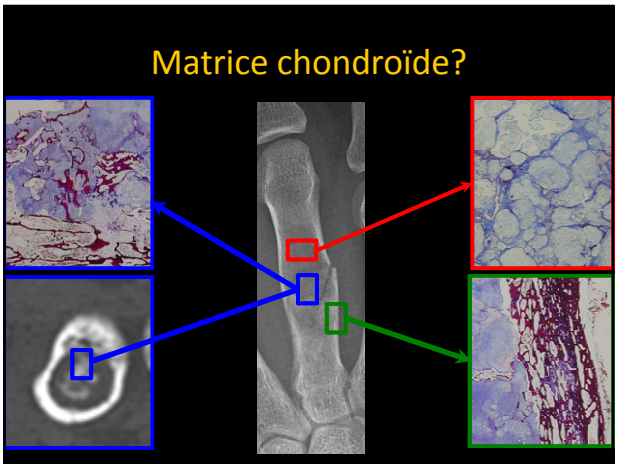
Chondrome 7%
Exostose 3%
Ostéochondromatose 0,5%

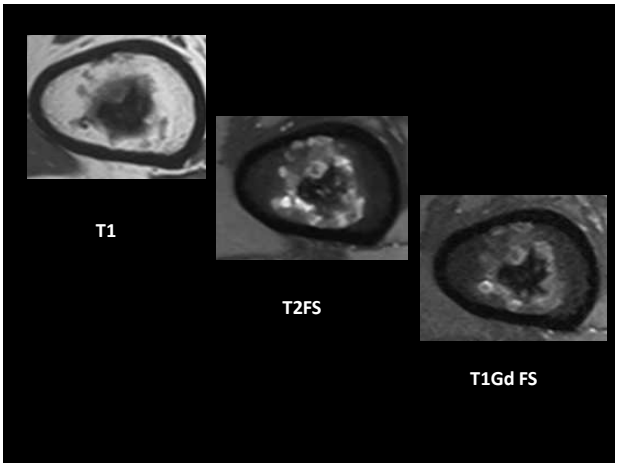
Matrice chondroïde?

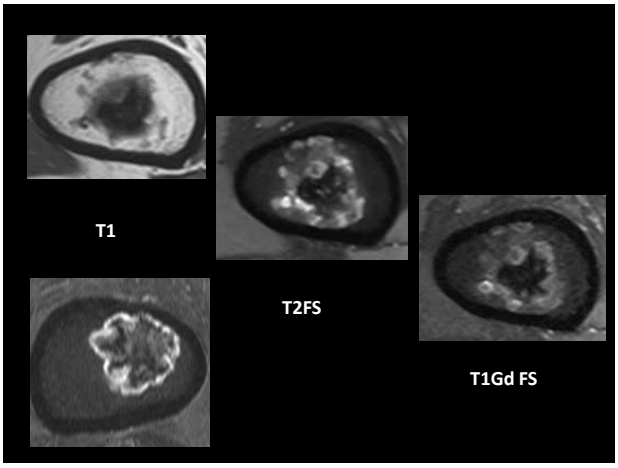

Matrice chondroïde?


Matrice chondroïde?


Matrice chondroïde?


Matrice chondroïde?


T1
T2FS
T1Gd FS


T1
T2FS
T1Gd FS

Spécificités radiologiques

Spécificités radiologiques

- Lésions osseuses

Spécificités radiologiques

- Lésions osseuses
  - Enchondrome
  - Enchondromatose diffuse

Spécificités radiologiques

- Lésions osseuses
  - Enchondrome
  - Enchondromatose diffuse
- Lésions corticales

Spécificités radiologiques

- Lésions osseuses
  - Enchondrome
  - Enchondromatose diffuse
- Lésions corticales
  - Exostose
  - La lésion de Nora

Spécificités radiologiques

- Lésions osseuses
  - Enchondrome
  - Enchondromatose diffuse
- Lésions corticales
  - Exostose
  - Lésion de Nora
- Lésions périostées ou sous périostées

Spécificités radiologiques

- Lésions osseuses
  - Enchondrome
  - Enchondromatose diffuse
- Lésions corticales
  - Exostose
  - Lésion de Nora
- Lésions périostées ou sous périostées
  - Chondrome sous périosté

L'enchondrome

L'enchondrome

- Cartilage hyalin
- 3% des tumeurs osseuses
- 10 à 40 ans*
- Extrémités 35 à 65% des cas
- Proximalité Phalange

* DAHLIN, General aspects and date on 8542 cases. 5th Edn Philadelphia, 1986(Chondroma. In : 4th edition): p. 33-51

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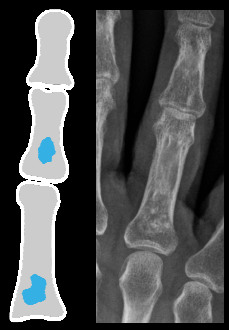

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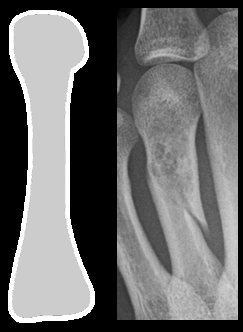

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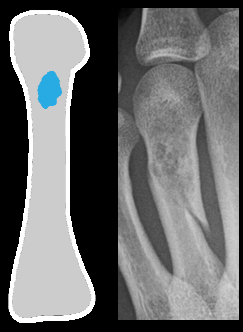

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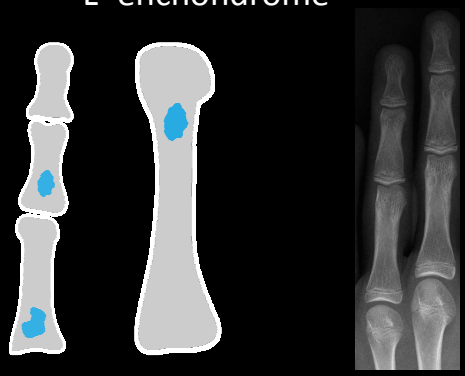
L'enchondrome



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- Distalité MCP
- Découverte fortuite ou fracture

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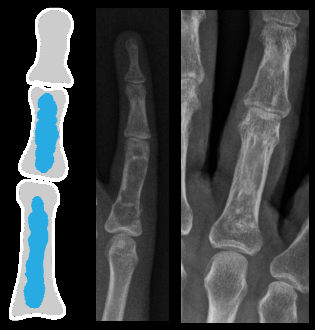
- Extension diaphysaire ou épiphysaire



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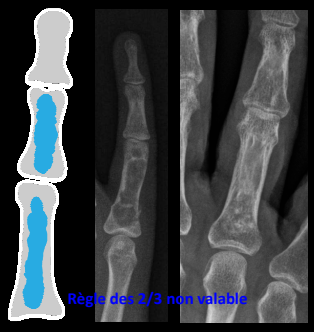
- Découverte fortuite ou fracture
- Extension diaphysaire ou épiphysaire



Règle des 1/3 non valable

* DAHLIN, General aspects and date on 8542 cases. 5th Edn Philadelphia, 1986(Chondroma. In : 4th edition): p. 33-51

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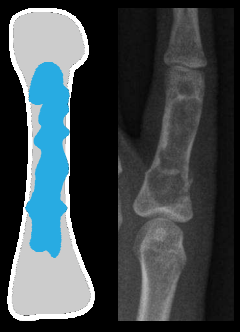
- Distalité MCP
- Découverte fortuite ou fracture
- Extension diaphysaire ou épiphysaire
- Érosions endostéales



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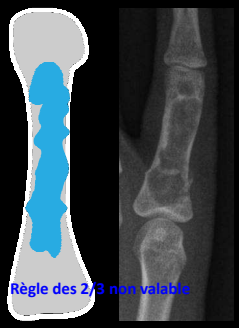
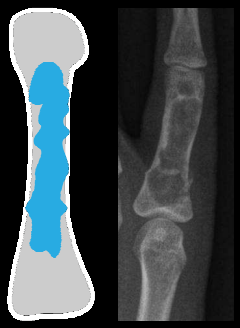


Règle des 2/3 non valable

* DAHLIN, General aspects and date on 8542 cases. 5th Edn Philadelphia, 1986(Chondroma. In : 4th edition): p. 33-51

L'enchondrome

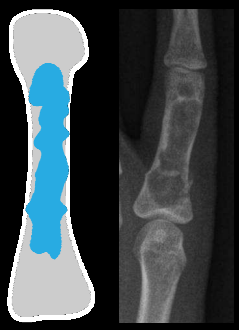
- Cartilage hyalin
- 3% des tumeurs osseuses
- 10 à 40 ans*
- Extrémités 35 à 65% des cas
- Proximalité Phalange
- Distalité MCP
- Découverte fortuite ou fracture
- Extension diaphysaire ou épiphysaire
- Érosions endostéales
- Pas de rupture corticale



* DAHLIN, General aspects and date on 8542 cases. 5th Edn Philadelphia, 1986(Chondroma. In : 4th edition): p. 33-51

L'enchondrome

- Cartilage hyalin
- 3% des tumeurs osseuses
- 10 à 40 ans*
- Extrémités 35 à 65% des cas
- Proximalité Phalange
- Distalité MCP
- Découverte fortuite ou fracture
- Extension diaphysaire ou épiphysaire
- Érosions endostéales
- Pas de rupture corticale
- Pas d'extension T mous



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L'enchondromatose diffuse

L'enchondromatose diffuse

- Ostéochondrodysplasie

L'enchondromatose diffuse

- Ostéochondrodysplasie
- Maladie d'Ollier

L'enchondromatose diffuse

- Ostéochondrodysplasie
- Maladie d'Ollier
- Syndrome Maffucci

L'enchondromatose diffuse

- Ostéochondrodysplasie
- Maladie d'Ollier
- Syndrome Maffucci
- Non héréditaire
- Prédominance masculine
- Âge découverte dans l'enfance

L'enchondromatose diffuse

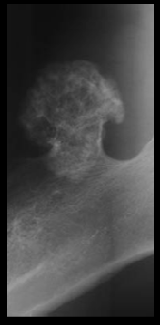
- Ostéochondrodysplasie
- Maladie d'Ollier
- Syndrome Maffucci
- Non héréditaire
- Prédominance masculine
- Âge découverte dans l'enfance
- Risque de dégénérescence
  - Ollier 5 à 30%
  - Maffucci*:
    - 15 à 20% pour les enchondromes
    - 3 à 5% pour les angiomes

*Schaison, F., et al., [Chondrosarcoma secondary to multiple cartilage diseases. Study of 29 clinical cases and review of the literature]. Rev Chir Orthop Reparatrice Appar Mot, 1999. 85(8): p. 834-45.

L'exostose

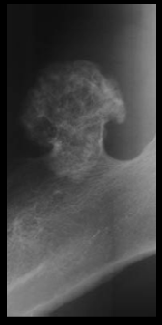
L'exostose

- Ostéochondrome solitaire
- Tumeur bénigne la plus fréquente



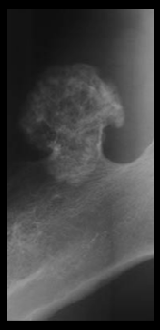
L'exostose

- Ostéochondrome solitaire
- Tumeur bénigne la plus fréquente
- Métaphysaire ou métaphyso-diaphysaire
- Extrémités 10% des cas



L'exostose

- Ostéochondrome solitaire
- Tumeur bénigne la plus fréquente
- Métaphysaire ou métaphyso-diaphysaire
- Extrémités 10% des cas
- Sessile ou pédiculée
- Continuité corticale et spongieuse



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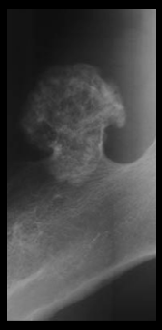
- Tumeur bénigne la plus fréquente
- Métaphysaire ou métaphyso-diaphysaire
- Extrémités 10% des cas
- Sessile ou pédiculée
- Continuité corticale et spongieuse
- Dégénérescence faible (<1%) et plus rare aux extrémités



La lésion bizarre de Nora

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- Rare
- Prolifération ostéochondromateuse paraostéale

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- Phalanges (P1 et P2 +++)
- Pieds et mains

La lésion bizarre de Nora

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- Prolifération ostéochondromateuse paraostéale
- Phalanges (P1 et P2 +++)
- Pieds et mains
- Lésion évolutive
  - Tuméfaction T mous
  - Périostite réactive floride
  - Masse ostéocartilagineuse

La lésion bizarre de Nora

- Rare
- Prolifération ostéochondromateuse paraostéale
- Phalanges (P1 et P2 +++)
- Pieds et mains
- Lésion évolutive
  - Tuméfaction T mous
  - Périostite réactive floride
  - Masse ostéocartilagineuse
- Pas de continuité avec l'os spongieux (≠ exostose)

Le chondrome périosté

Le chondrome périosté

- Prolifération entre périoste et corticale
- En regard des insertions tendineuses

* DAHLIN, General aspects and date on 8542 cases. 5th Edn Philadelphia, 1986(Chondroma. In : 4th edition): p. 33-51

Le chondrome périosté

- Prolifération entre périoste et corticale
- En regard des insertions tendineuses
- 15% des chondromes*

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Le chondrome périosté

- Prolifération entre périoste et corticale
- En regard des insertions tendineuses
- 15% des chondromes*
- Découverte avant 20 ans
- Tuméfaction des parties molles

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Le chondrome périosté

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- 15% des chondromes*
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- Destruction du versant cortical sous périosté
- Global respect de la médullaire

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Diagnostic différentiel difficile avec le chondrosarcome parostéal

* DAHLIN, General aspects and date on 8542 cases. 5th Edn Philadelphia, 1986(Chondroma. In : 4th edition): p. 33-51

Principal diagnostic différentiel: Chondrosarcome

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Éléments cliniques en faveur d'un chondrosarcome

Epidémiologie	*Chondromatose diffuse* *Âge avancé*

Principal diagnostic différentiel: Chondrosarcome

Éléments cliniques en faveur d'un chondrosarcome

Epidémiologie	*Chondromatose diffuse* *Âge avancé*
Clinique	*Apparition d'une douleur* *Augmentation de taille*

Principal diagnostic différentiel: Chondrosarcome

Éléments cliniques en faveur d'un chondrosarcome

Epidémiologie	*Chondromatose diffuse* *Âge avancé*
Clinique	*Apparition d'une douleur* *Augmentation de taille*
Topographie	*Rare aux extrémités* *Phalange proximale*

Principal diagnostic différentiel: Chondrosarcome

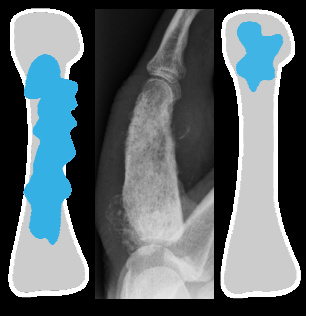
Éléments radiologiques en faveur d'un chondrosarcome

RX	Ostéolyse Contours osseux irréguliers

Principal diagnostic différentiel: Chondrosarcome

Éléments radiologiques en faveur d'un chondrosarcome

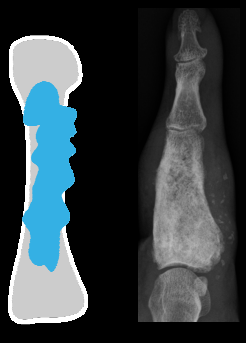
RX	Ostéolyse Contours osseux irréguliers Extension épiphyse



Principal diagnostic différentiel: Chondrosarcome

Éléments radiologiques en faveur d'un chondrosarcome

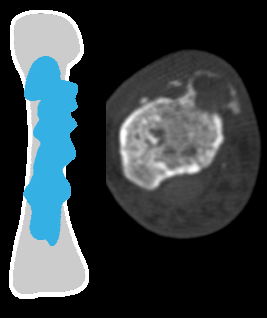
RX	Ostéolyse Contours osseux irréguliers Extension épiphyse Extension T mous



Principal diagnostic différentiel: Chondrosarcome

Éléments radiologiques en faveur d'un chondrosarcome

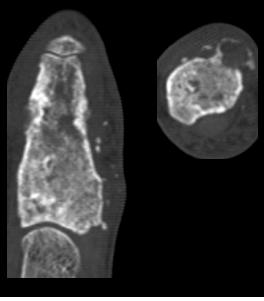
RX	Ostéolyse Contours osseux irréguliers Extension épiphyse Extension T mous
TDM	Rupture corticale



Principal diagnostic différentiel: Chondrosarcome

Éléments radiologiques en faveur d'un chondrosarcome

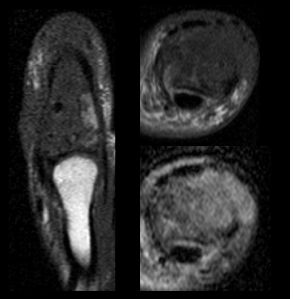
RX	Ostéolyse Contours osseux irréguliers Extension épiphyse Extension T mous
TDM	Rupture corticale Extension T mous



Principal diagnostic différentiel: Chondrosarcome

Éléments radiologiques en faveur d'un chondrosarcome

RX	Ostéolyse Contours osseux irréguliers Extension épiphyse Extension T mous
TDM	Rupture corticale Extension T mous
MRI	Extension T mous Perfusion



Principal diagnostic différentiel: Chondrosarcome

Éléments radiologiques en faveur d'un chondrosarcome

RX	Ostéolyse Contours osseux irréguliers Extension épiphyse Extension T mous
TDM	Rupture corticale Extension T mous
MRI	Extension T mous Perfusion
Scintigraphie	Hyperfixation intense après croissance

Que pensez vous de cet enchondrome?

Patient de 57 ans, tuméfaction indolore

Patient de 57 ans, tuméfaction indolore

Phalange proximale

Patient de 57 ans, tuméfaction indolore

Phalange proximale

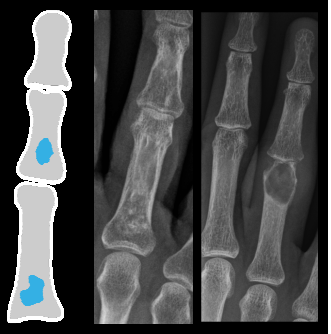
Lésion distale

Patient de 57 ans, tuméfaction indolore

Phalange proximale

Lésion distale

Ceci n'est pas un enchondrome…



Patient de 57 ans, tuméfaction indolore

Phalange proximale

Lésion distale

Tuméfaction des parties molles

Patient de 57 ans, tuméfaction indolore

Phalange proximale

Lésion distale

Tuméfaction des parties molles

Goutte intra osseuse

Take home messages

- Lésion fréquente

Take home messages

- Lésion fréquente
- Enchondrome ++++

Take home messages

- Lésion fréquente
- Enchondrome ++++
- Chondrosarcome rare mais contexte clinique et critères RX

Take home messages

- Lésion fréquente
- Enchondrome ++++
- Chondrosarcome rare mais contexte clinique et critères RX
- Pensez aux autres diagnostics (dépôts apatite, PPC, calcinose pseudo tumorale, goutte, chondromatose secondaire…)

Les tumeurs cartilagineuses de la main

Lausanne le 24 Mai 2014

A.Larbi, V.Perlepe*, X.Pavard*, F.Lecouvet*, J.Malghem*, P.Viala**, C.Cyteval**, B.Vande Berg**

**Département d'imagerie médicale, UCL, Bruxelles.*
***Imagerie musculo-squelettique, CHU Lapeyronie, Montpellier.*

Kystes synoviaux

Terminologie

kyste arthrosynovial

kyste mucoïde kyste ténosynovial

kyste de poulie

=

kystes synoviaux

Kystes synoviaux

Etiologie

tumeur la plus fréquente poignet-main

dégénérescence capsulaire

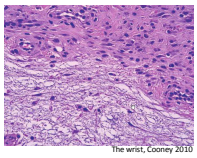
hernie synoviale

tumeur

post-traumatique

F>M, jeune adulte

tissu conjonctif, paroi acellulaire



The wrist, Cooney 2010

Kystes synoviaux

Motif de consultation

esthétique 38%

crainte malignité 28%

douleur 26%

Westbrook AP et al., J Hand Surg Br 2000

Anamnèse

date d'apparition

douleur – gêne

fluctuation taille

antécédent traumatisme

Kystes synoviaux

Clinique

nodule élastique / ferme, taille variable

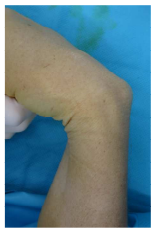
douloureux-indolent

parfois non visible, non palpable

uni ou multiloculé

peut se trouver à distance de son origine

mobile par rapport au plan cutané



Kystes synoviaux

Clinique

70% radio-carpien dorsal

20% radio-carpien palmaire

} SL ou STT dans 90%

10% autre (1ère coulisse, canal carpien, Guyon, CMC, extenseurs, gaine fléchisseurs…)

rechercher instabilité poignet

L. Wehrli

L. Wehrli

Kystes synoviaux

Clinique

diagnostic différentiel

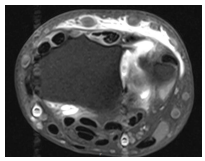
- synovite
- tumeur à cellules géantes
- muscle accessoire (extensor digitorum brevis manus)
- kyste épidermique
- anévrisme artère radiale
- sarcome synovial, autres tumeurs

Kystes synoviaux

Examens complémentaires

- RX
- US
- IRM

quand kyste occulte, instabilité, arthrose, suspicion malignité, récidive



Kystes synoviaux

Traitement

- abstention (régression spontanée)
- aspiration
- injection cortisone
- chirurgie

enfants: taux de résorption spontanée élevé

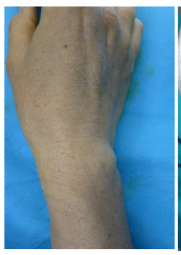
généralement chirurgie + efficace que ttt conservateur

récidive post chirurgie 11-83%!

L. Wehrli

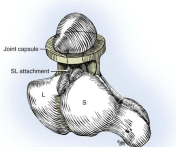
Kystes synoviaux

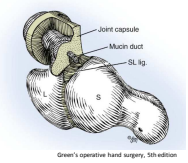
Chirurgie



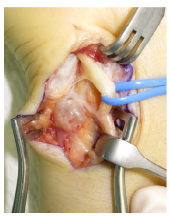
Kystes synoviaux

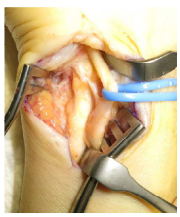
Chirurgie





Green's operative hand surgery, 5th edition





Kystes synoviaux

Chirurgie

Conclusion

urgent d'attendre

rassurer patient

imagerie rarement nécessaire

Imagerie du Canal Carpien

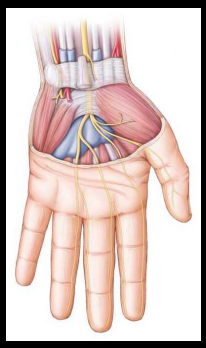
Fabio Becce
Service de Radiodiagnostic et Radiologie Interventionnelle
Centre Hospitalier Universitaire Vaudois

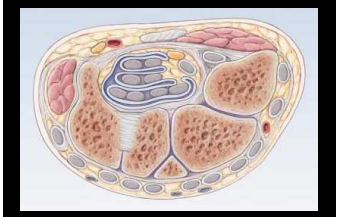
Syndrome du Canal Carpien

- Compression du nerf médian au poignet
- Syndrome canalaire le + fréquent
- Incidence: 1-3/1000/an
- Prévalence: 50/1000
- Ethnie: Caucasiens
- Sexe: ♀ > ♂, 3-10/1
- Age: 45-60 ans

De Krom et al. Risk factors for carpal tunnel syndrome. Am J Epidemiol. 1990

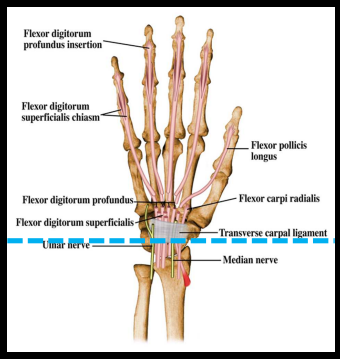
Anatomie





Katz et al. Carpal tunnel syndrome. New Engl J Med. 2002

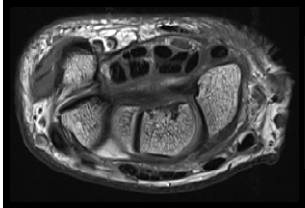
Anatomie

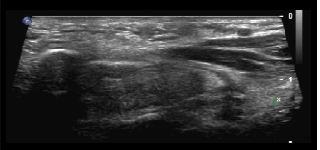


Proximal

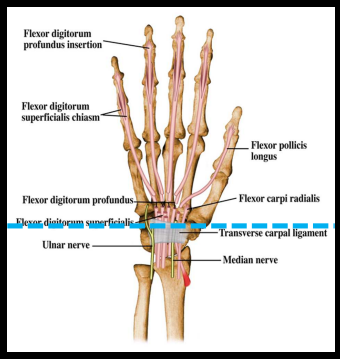
http://depts.washington.edu/msatlas/hacarptun.html

Anatomie





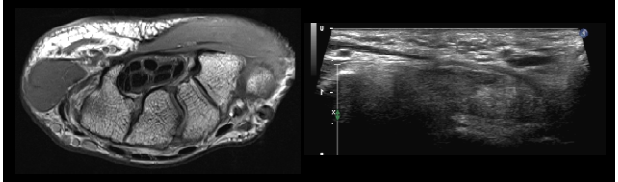
Anatomie



Distal

http://depts.washington.edu/msatlas/hacarptun.html

Anatomie



Clinique

- Symptômes 1° (≥ 2):
  - Paresthésies nocturnes → réveil
  - → soulagées en secouant la main (
  - Douleurs et/ou paresthésies provoq préhension
  - Troubles sensitifs dans territoire du
- Symptômes 2°:
  - Cervicalgies, paresthésies sans douleur, faiblesse subjective, maladresse/lâchage

Wilder-Smith et al. Diagnosing carpal tunnel syndrome-clinical criteria and ancillary tests. Nat Clin Pract Neurol. 2006

Clinique

- Tests de provocation:
  - Signe de Tinel (sensibilité/spécificité, 25-85/54-98%)
  - Test de Phalen (38-100/55-100%)
  - Test de compression du carpe (89/96%)
  - Signe du “poignet carré”: rapport épaisseur/largeur > 0.7 (70/70%)

Katz et al. Carpal tunnel syndrome. New Engl J Med. 2002

Massy-Westropp et al. A systematic review of the clinical diagnostic tests for carpal tunnel syndrome. J Hand Surg Am. 2000

Electrophysiologie

- Pas indispensable, mais souvent avant chirurgie
- Ralentissement de vitesse de conduction nerveuse motrice, puis sensitive
- Allongement de latence motrice distale, puis sensitive
- Sensibilité ≈ 85%
- Spécificité ≈ 95%

Jablecki et al. Second AAEM literature review of the usefulness of nerve conduction studies and needle electromyography for the evaluation of patients with carpal tunnel syndrome. Muscle Nerve. 2002

Etiologies

- Idiopathique (fibrose synoviale?)
- Extrinsèques acquises:
  - Traumatismes (EDR, lacération)
  - Téno-/synovites (PR)
  - Tumeurs (chondrome) et pseudotumeurs (kyste mucoïde, calcifications)
  - Grossesse
  - Hémodialyse chronique (amylose, fistule AV)
  - Diabète, hypothyroïdie, acromégalie,…

Boutry et al. Pathologies nerveuses et vasculaires. Imagerie musculosquelettique: pathologies locorégionales. 2008

Etiologies

- Extrinsèques congénitales:
  - Variantes anatomiques musculotendineuses
  - Artère médiane persistante ± nerf médian bifide
- Intrinsèques:
  - Tumeurs nerveuses bénignes (schwannome, neurofibrome, hamartome fibrolipomateux, névrome post-traumatique/chirurgical) ou malignes

Boutry et al. Pathologies nerveuses et vasculaires. Imagerie musculosquelettique: pathologies locorégionales. 2008

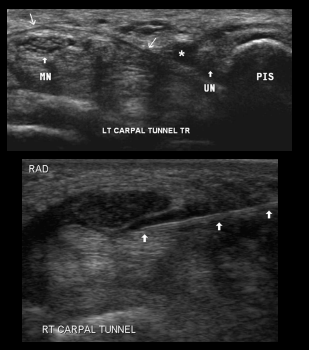
Traitement

- Repos ± attelle
- Corticostéroïdes oraux (AINS, diurétiques)
- Infiltration (corticostéroïdes, anesthésiques)
- Thérapie par ultrasons
- Chirurgie (ouverte, endoscopique):
  - Persistance ou sévérité des symptômes
  - Succès ≈ 90% à 1 an

Goodyear-Smith et al. What can family physicians offer patients with carpal tunnel syndrome other than surgery? A systematic review of nonsurgical management. Ann Fam Med. 2004
Scholten et al. Surgical treatment options for carpal tunnel syndrome. Cochrane Database Syst Rev. 2007

Traitement

- Infiltration sous US



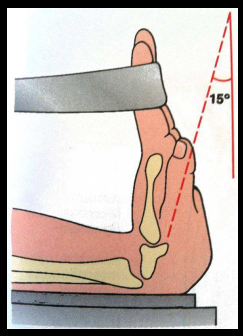
Smith et al. Sonographically guided carpal tunnel injections. The ulnar approach. J Ultrasound Med. 2008

Imagerie

- Présentation clinique atypique/équivoque
- Discordance clinique-électrophysiologie
- Infiltration guidée par US
- Echec/récidive post-opératoire

Wilson et al. Imaging of the carpal tunnel. Semin Musculoskelet Radiol. 2012
Buchberger. Radiologic imaging of the carpal tunnel. Eur J Radiol. 1997

Radiographie



Greenspan. Orthopedic imaging: a practical approach. 2011

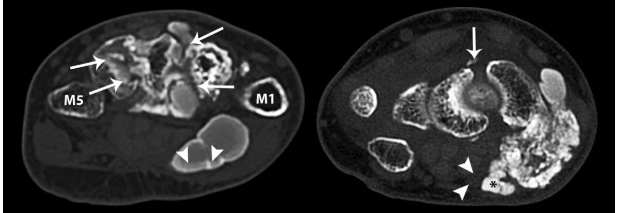
Radiographie

- Dépôts d'hydroxyapatite de calcium

Duey et al. Carpal tunnel syndrome resulting from hydroxyapatite deposition. Curr Probl Diagn Radiol. 2006

CT

- Calcinose (sclérodermie)



Freire et al. MDCT imaging of calcinosis in systemic sclerosis. Clin Radiol. 2013

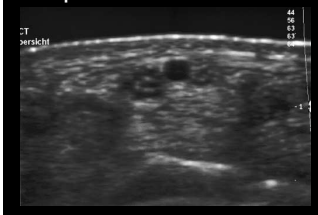
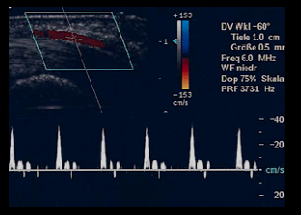
Signes US / IRM

- Augmentation de surface de section du nerf en amont (”pseudonévrome”) et/ou partie proximale (≥ 12 mm^2, 9-15 mm^2), aplatissement distal?
- Bombement palmaire du rétinaculum (> 2-4 mm)
- Hypoéchogénicité/hypersignal T2 du nerf, perte de l’aspect fasciculé/”folliculaire”, réhaussement?

Klauser et al. Entrapment neuropathies II: carpal tunnel syndrome. Semin Musculoskelet Radiol. 2010
Jarvik et al. Diagnosis of carpal tunnel syndrome: electrodiagnostic and MR imaging evaluation. Neuroimaging Clin N Am. 2004
Boutry et al. Pathologies nerveuses et vasculaires. Imagerie musculosquelettique: pathologies locorégionales. 2008

US

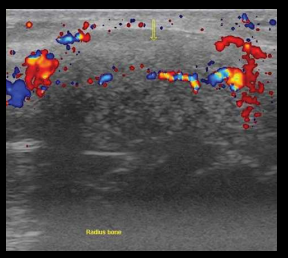
- Nerf médian bifide + artère médiane persistante

Gassner et al. Persistent median artery in the carpal tunnel: color Doppler ultrasonographic findings. J Ultrasound Med. 2002

US

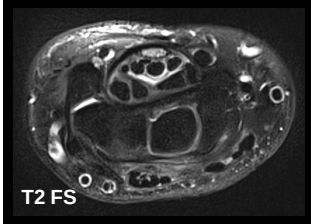
- Tophus goutteux

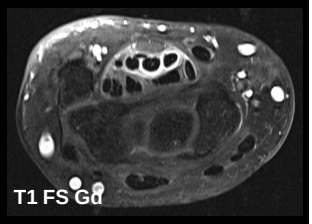


Therimadasamy et al. Carpal tunnel syndrome caused by gouty tophus of the flexor tendons of the fingers: sonographic features. J Clin Ultrasound. 2011

IRM

- Ténosynovite des fléchisseurs

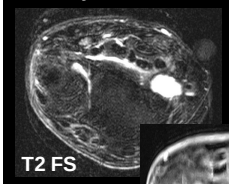


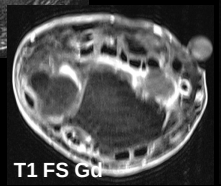


Phillips. Carpal tunnel syndrome as a manifestation of systemic disease. Ann Rheum Dis. 1967

IRM

- Kyste mucoïde

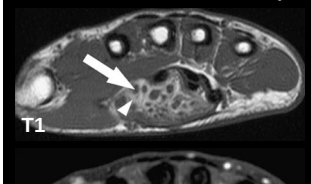


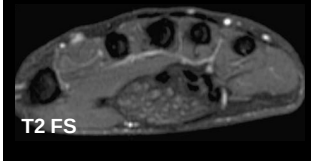


Kerrigan et al. Ganglion cysts and carpal tunnel syndrome. J Hand Surg Am. 1988

IRM

- Hamartome fibrolipomateux

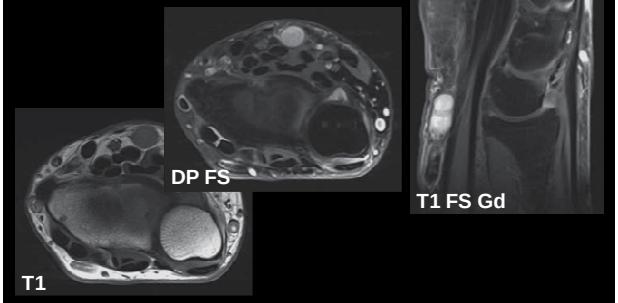




Courtesy: PD Dr. Gustav Andreisek, USZ
Silverman et al. Fibrolipomatous hamartoma of nerve. A clinicopathologic analysis of 26 cases. Am J Surg Pathol. 1985

IRM

- Schwannome



Zekeridou et al. Schwannoma of the palmar cutaneous nerve: electrodiagnosis with radiologic and pathologic correlations. Arch Neurol. 2012

Signes IRM Post-Opératoires

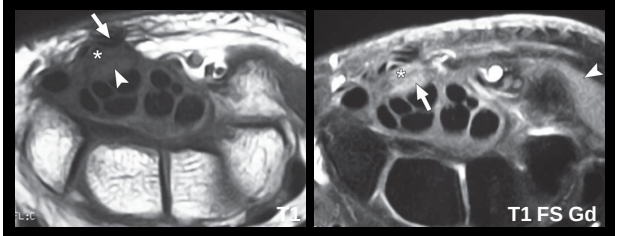
- Repousse du rétinaculum
- Effet de masse extra-/intracanalaire
- Fibrose
- Surface de section du nerf
- Signal T2 et/ou réhaussement du nerf
- Décompression du canal

Wu et al. Potential MR signs of recurrent carpal tunnel syndrome: initial experience. J Comput Assist Tomogr. 2004

Campagna et al. MRI assessment of recurrent carpal tunnel syndrome after open surgical release of the median nerve. Am J Roentgenol. 2009

IRM

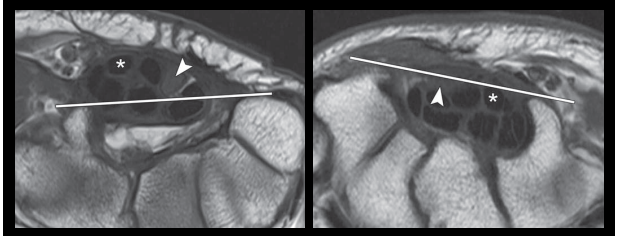
- Fibrose post-opératoire



Campagna et al. MRI assessment of recurrent carpal tunnel syndrome after open surgical release of the median nerve. Am J Roentgenol. 2009

IRM

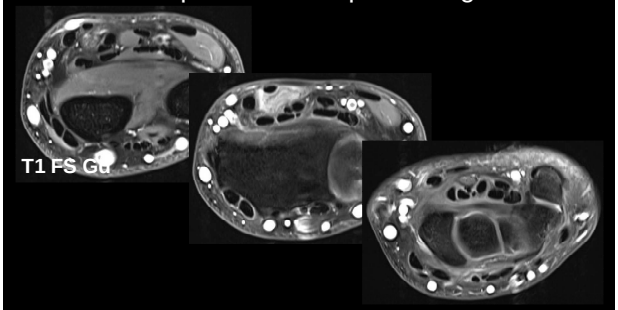
- Echec/récidive post-opératoire



Campagna et al. MRI assessment of recurrent carpal tunnel syndrome after open surgical release of the median nerve. Am J Roentgenol. 2009

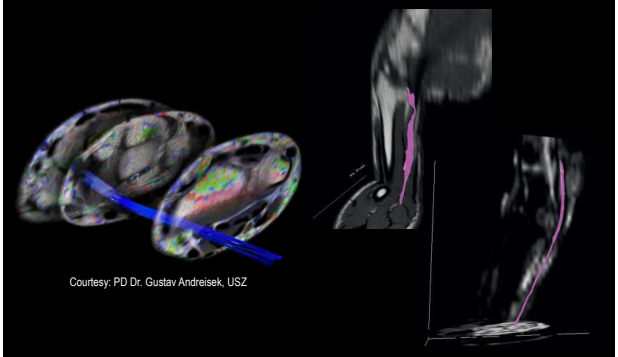
IRM

- Névrome post-traumatique/chirurgical



Wu et al. Potential MR signs of recurrent carpal tunnel syndrome: initial experience. J Comput Assist Tomogr. 2004

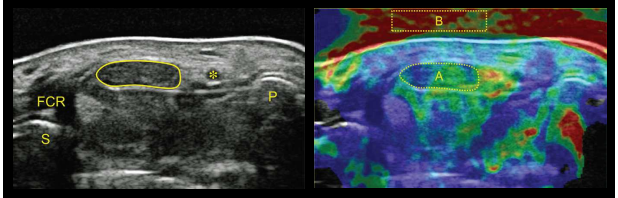
DTI



Courtesy: PD Dr. Gustav Andreisek, USZ

Kabakci et al. Tractography of the median nerve. Semin Musculoskelet Radiol. 2009

Elastographie



Miyamoto et al. Carpal tunnel syndrome: diagnosis by means of median nerve elasticity--improved diagnostic accuracy of US with sonoelastography. Radiology. 2014

Syndrome du Canal Carpien

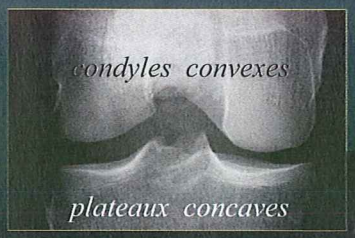
- Diagnostic clinique ± électrophysiologique
- Imagerie: rôle limité dans démarche diagnostique (idiopathique), essentiellement dans situations cliniques équivoques et discordance clinique-EP
- US: rôle potentiel dans traitement non-chirurgical (infiltration)
- IRM/US: rôle établi dans suivi post-opératoire (échec/récidive)

GENOU

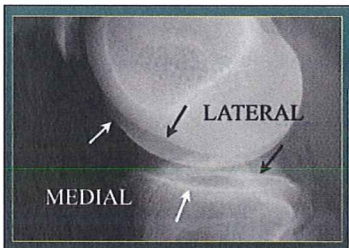
les surfaces articulaires

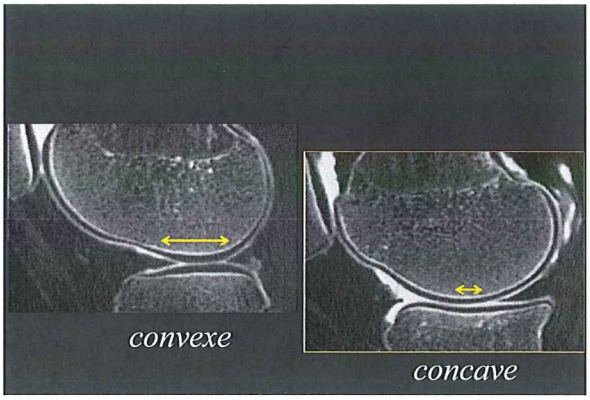
- anatomie différenciée des surfaces médiales et latérales
- os sous-chondral abrasé
- modifications intra-spongieuses

ARTICULATION FEMORO-TIBIALE



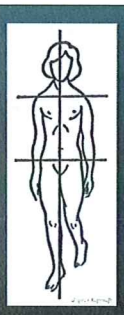
plan sagittal

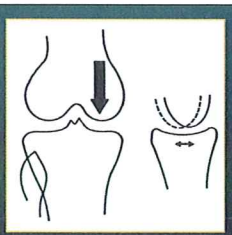




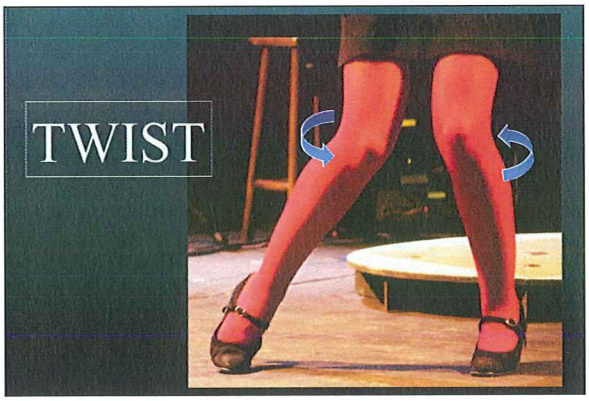
convexe

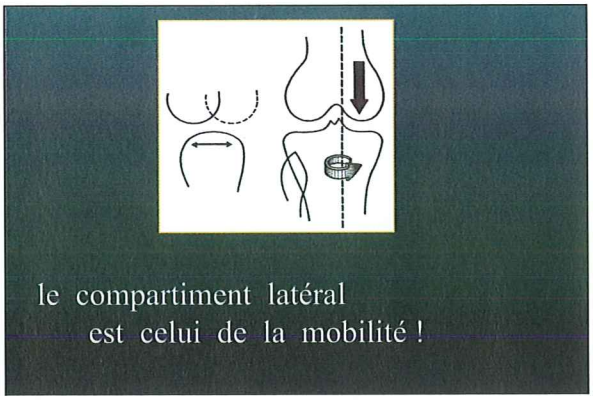
concave

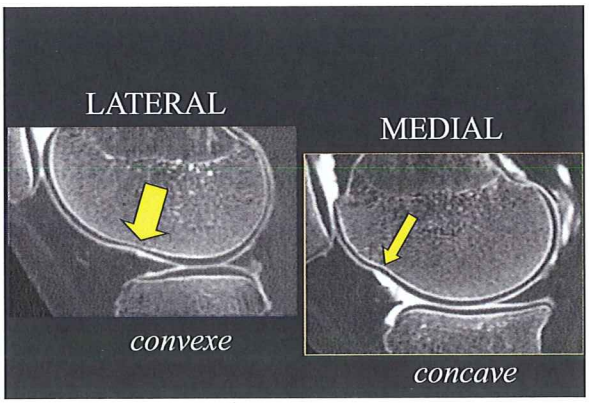


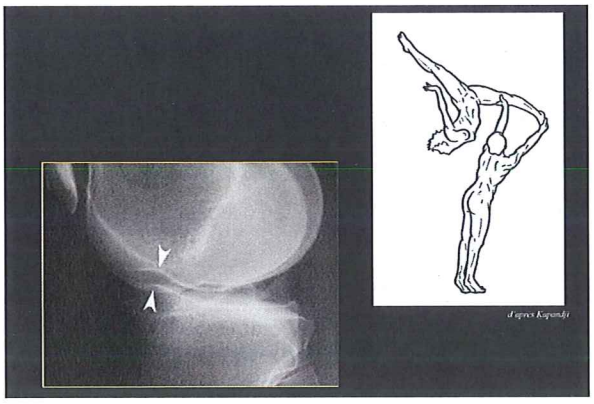


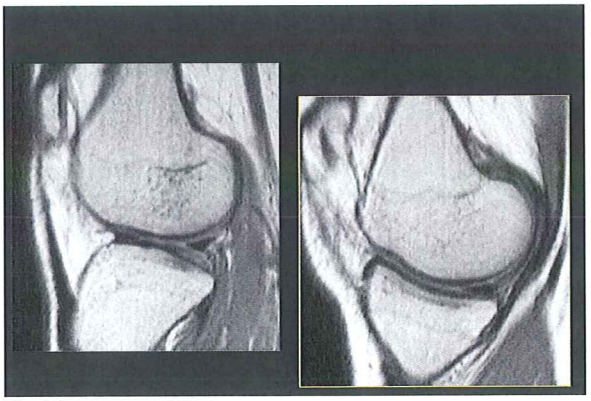
le compartiment médial
est celui de la stabilité !

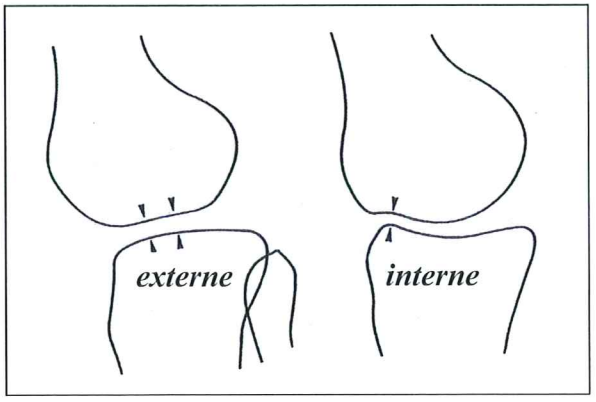

TWIST


le compartiment latéral
est celui de la mobilité !

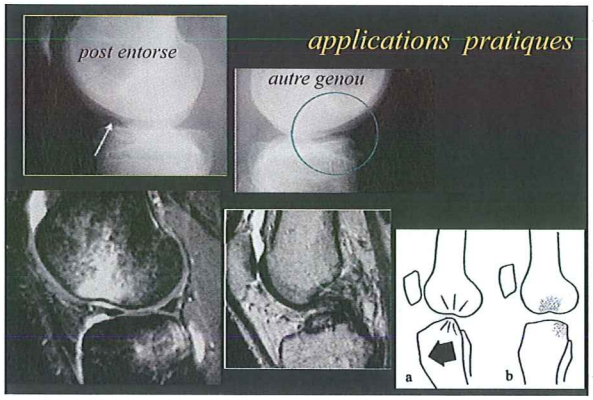

LATERAL
MEDIAL
convexe
concave



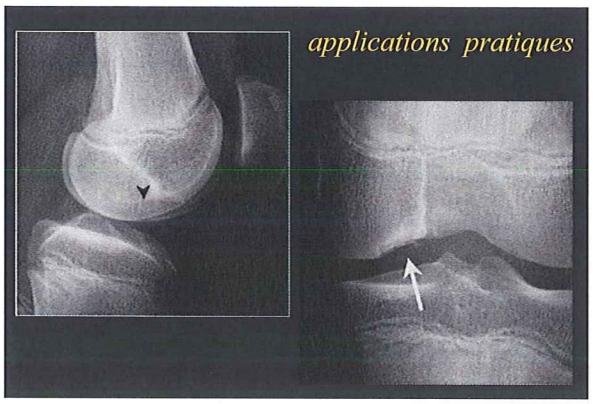



externe
interne

HI HAN
antérieure
interne


applications pratiques
post entorse
autre genou
a
b

applications pratiques
contrôle d'une
ostéochondrite disséquante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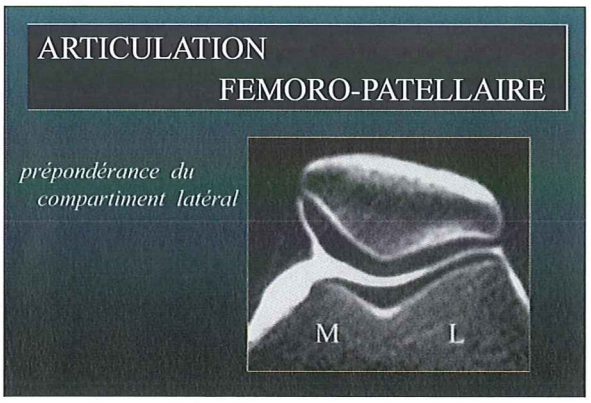
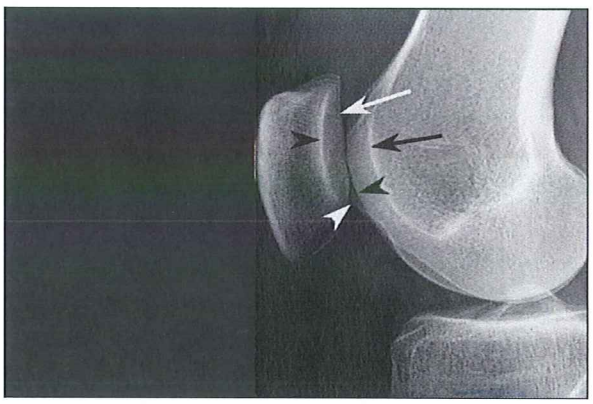
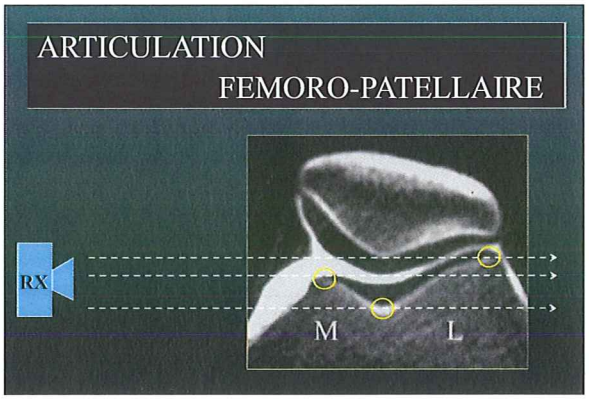

ARTICULATION
FEMORO-PATELLAIRE
prépondérance du
compartiment latéral
M
L

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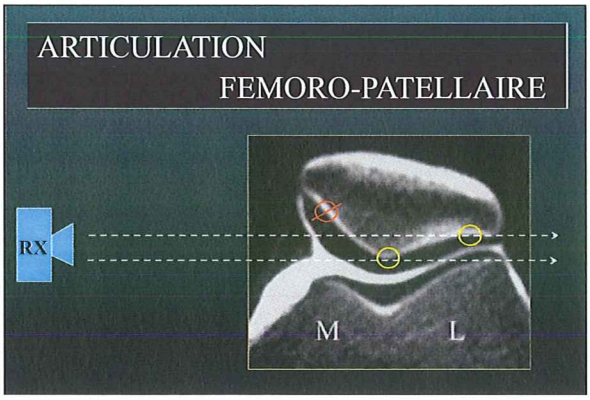
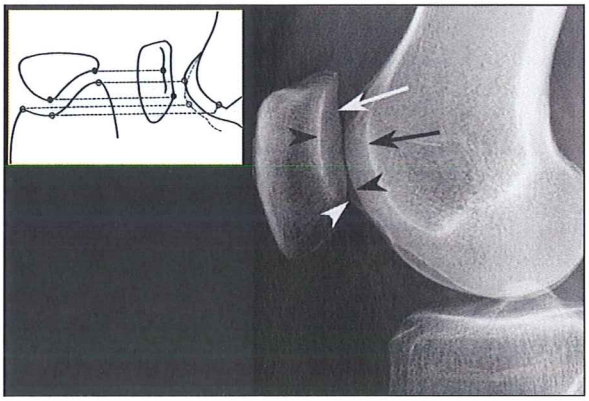
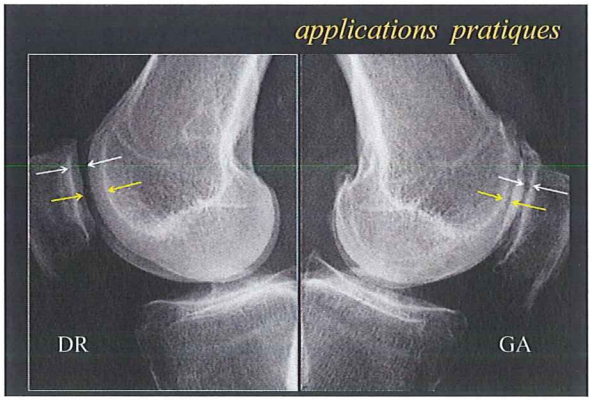
FEMORO-PATELLAIRE
RX
M
L


ARTICULATION
FEMORO-PATELLAIRE
RX
M
L

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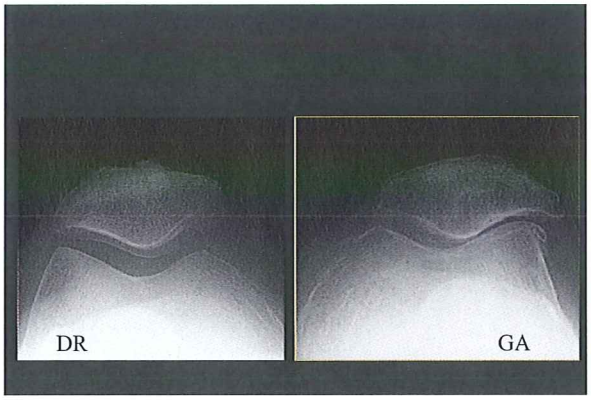
DR
GA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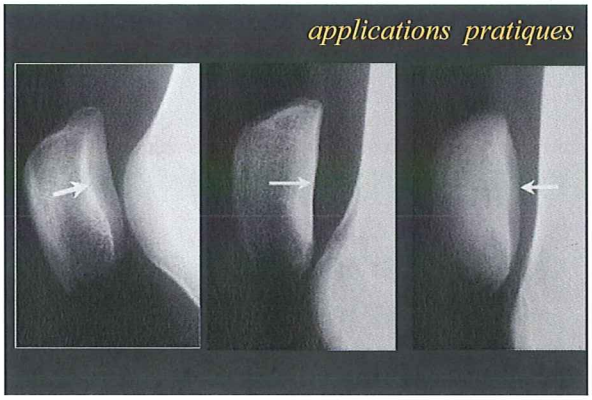
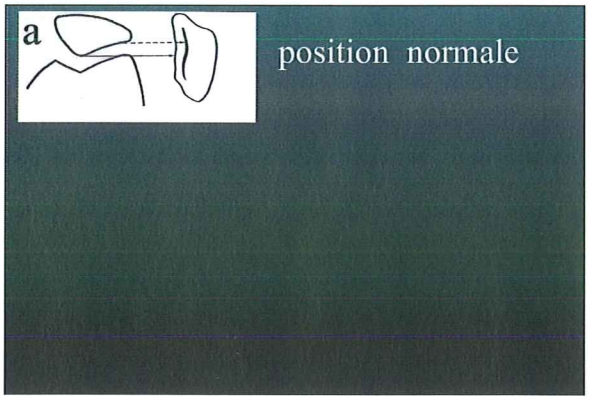
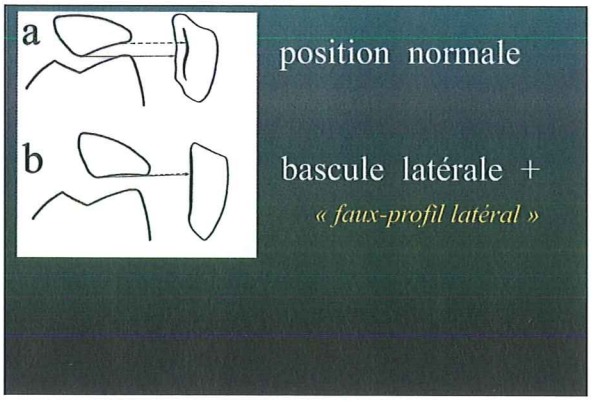
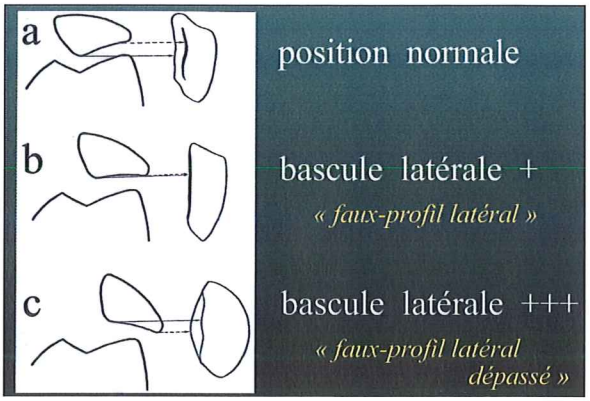
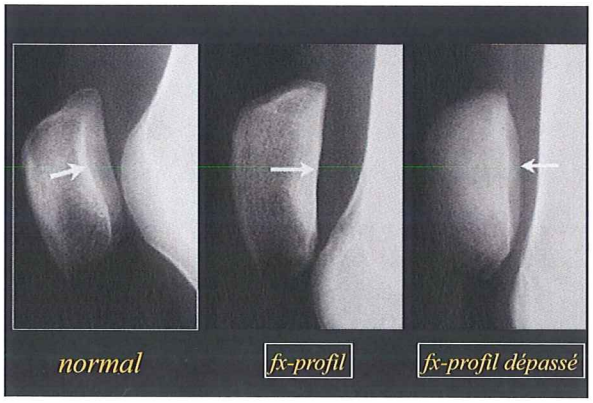
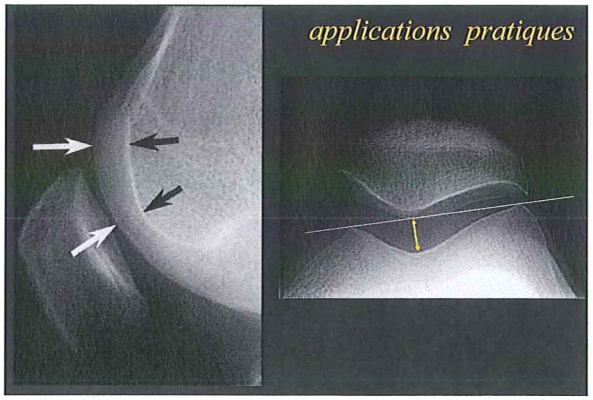

applications pratiques

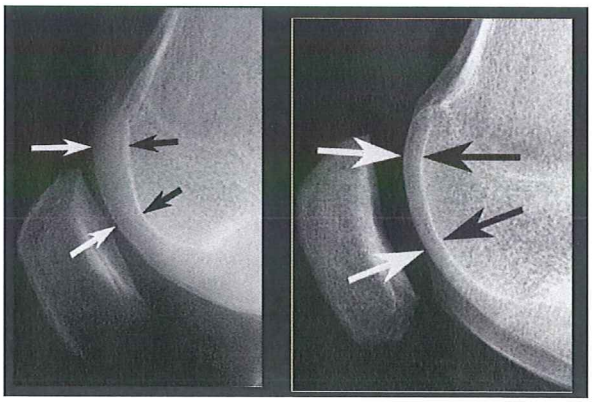

a
position normale

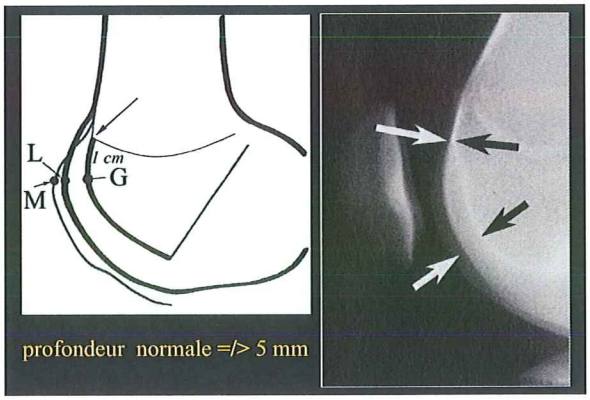

a
b
position normale
bascule latérale +
« faux-profil latéral »

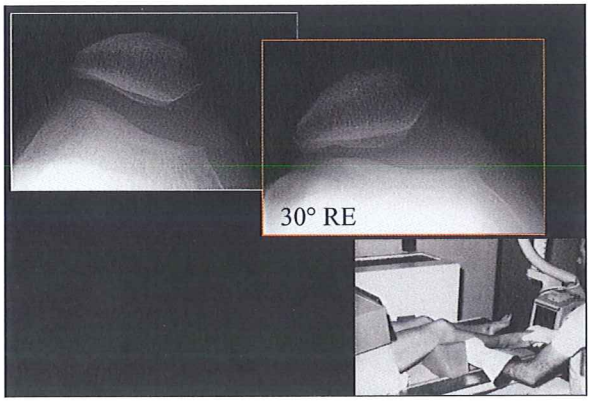

a
b
c
position normale
bascule latérale +
« faux-profil latéral »
bascule latérale +++
« faux-profil latéral dépassé »


normal
fx-profil
fx-profil dépassé

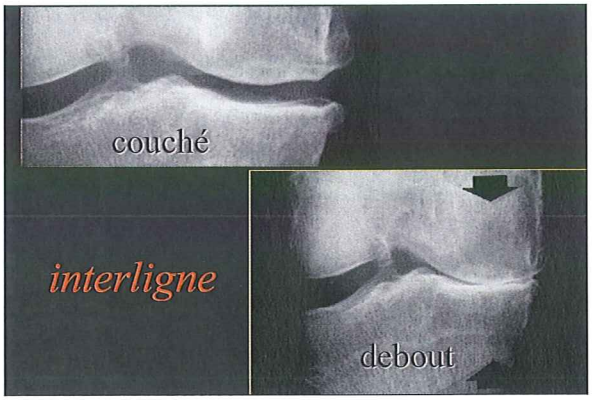

applications pratiques

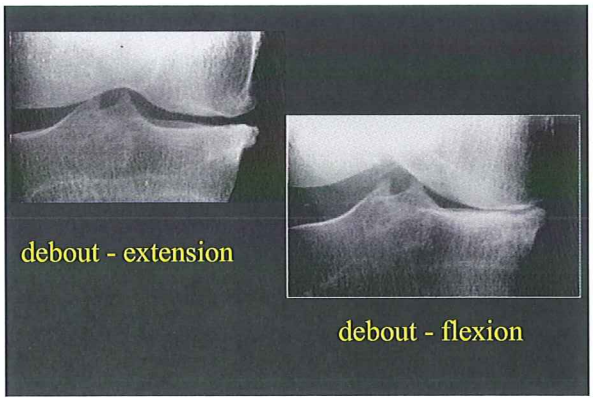


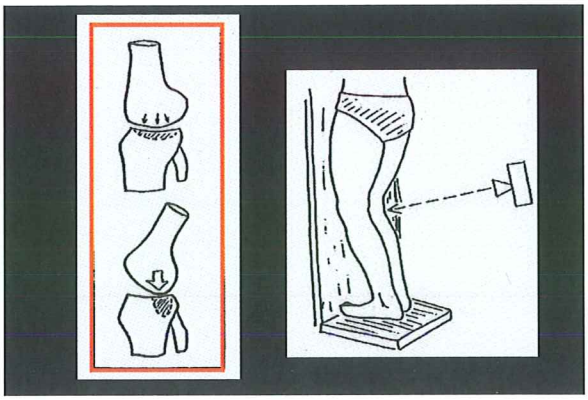

L
1 cm
G
M
profondeur normale =/> 5 mm


30° RE

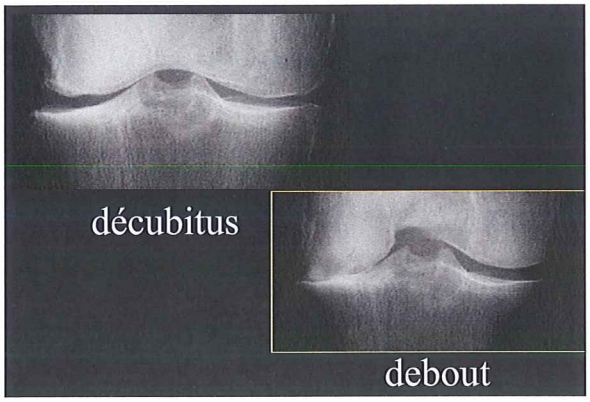
• interligne
• os sous-chondral

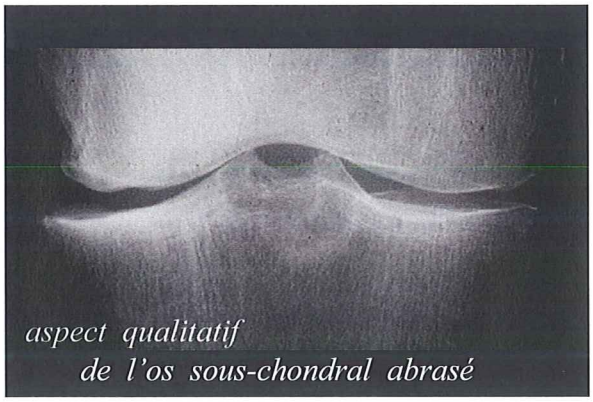

couché
interligne
debout

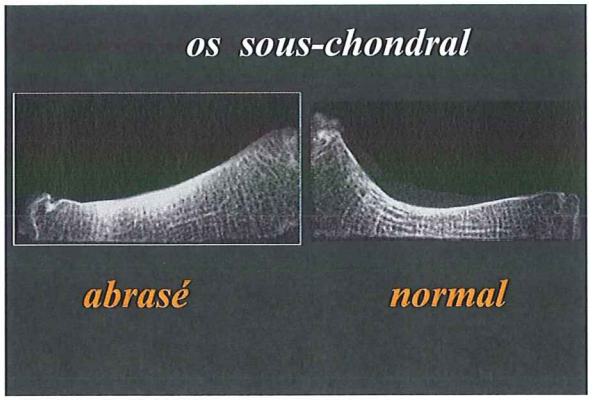

debout - extension
debout - flexion

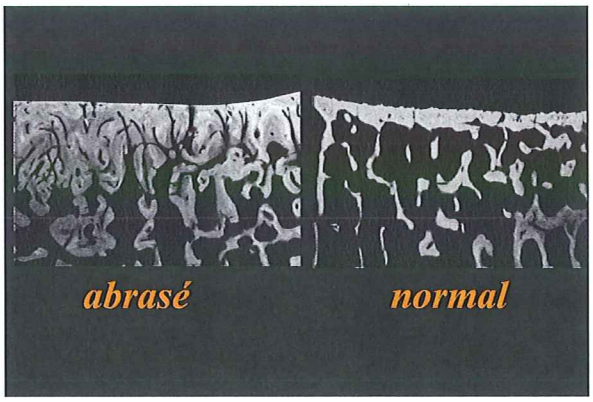


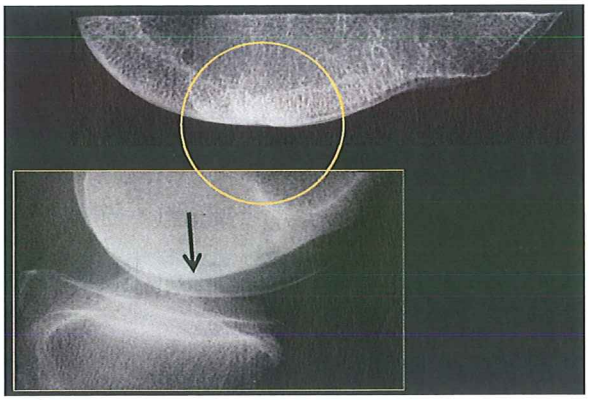
aspect qualitatif
de l'os sous-chondral abrasé

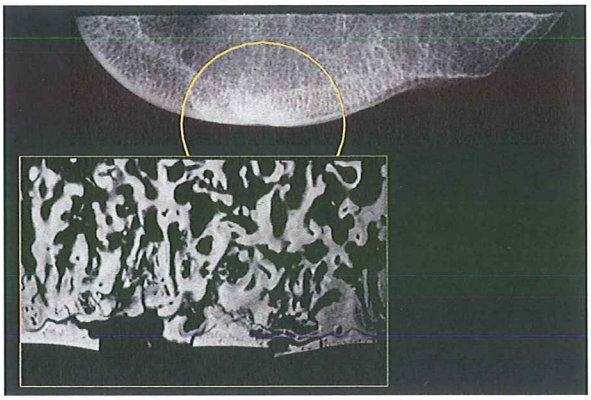

décubitus
debout

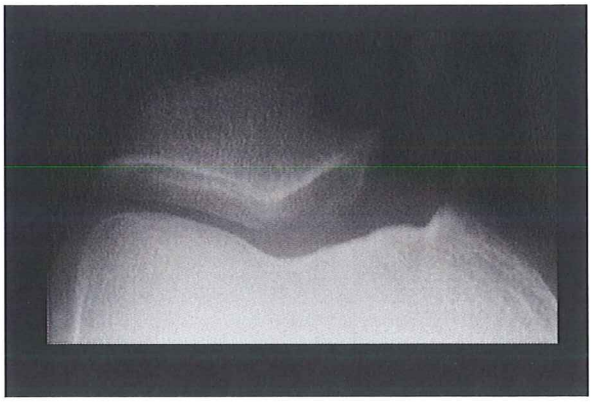

aspect qualitatif
de l'os sous-chondral abrasé

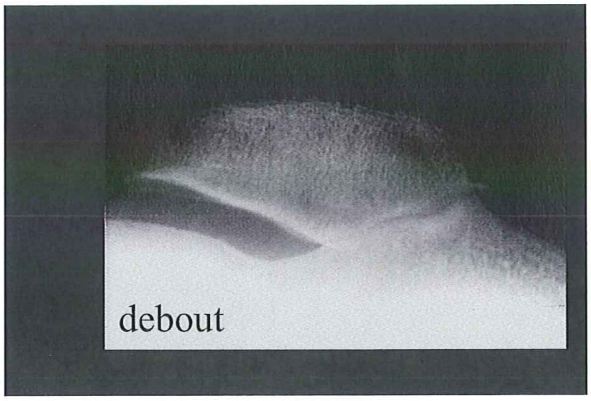

os sous-chondral
abrasé
normal

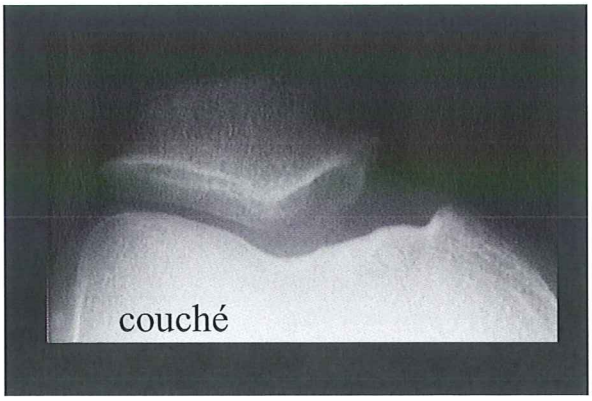

abrasé
normal

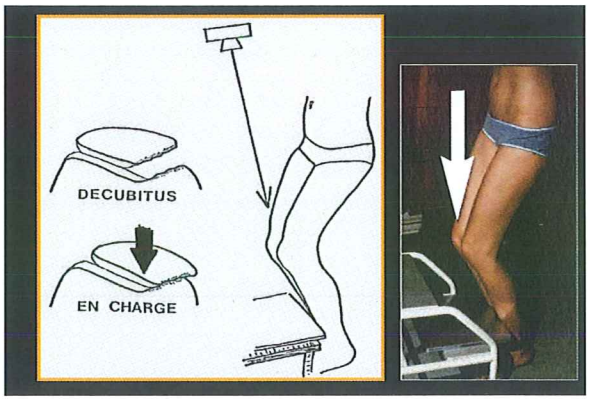






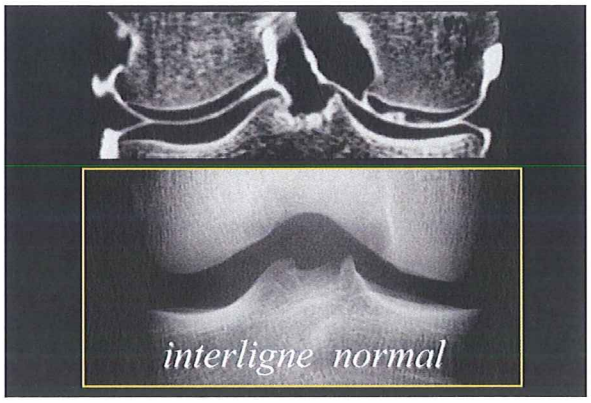

debout

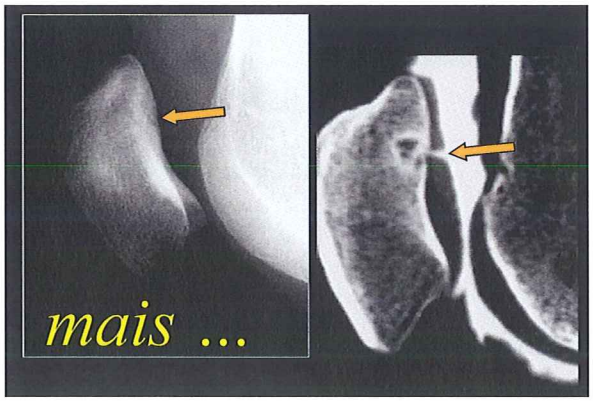

couché

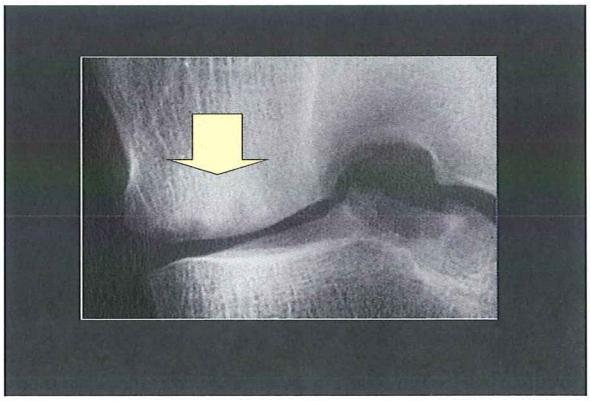


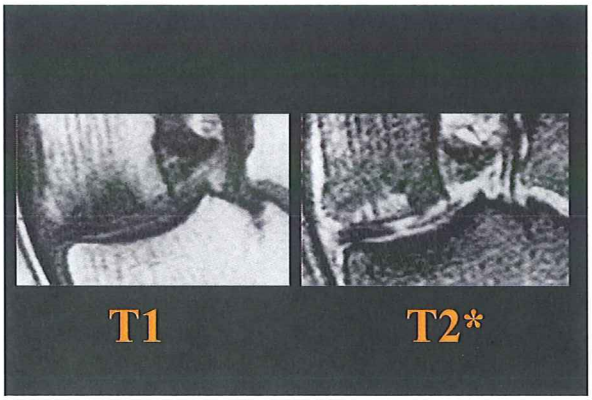
INTERLIGNE

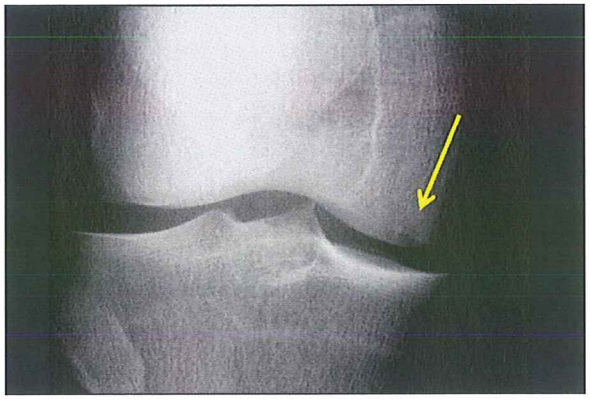
- *lésions étendues*
- *lésions focales*

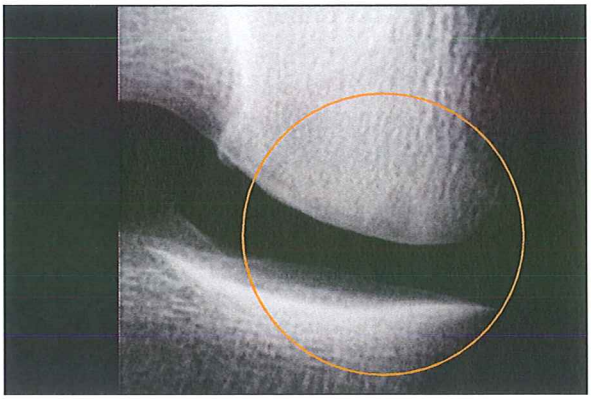


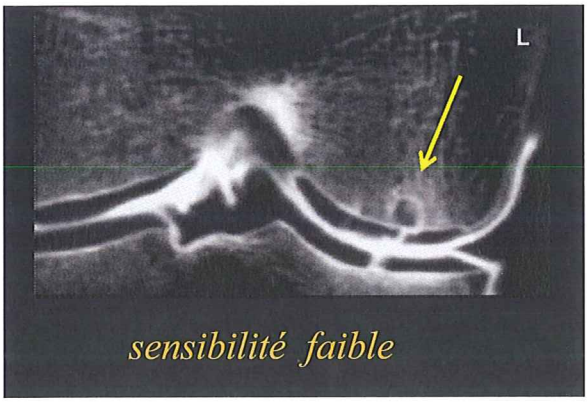


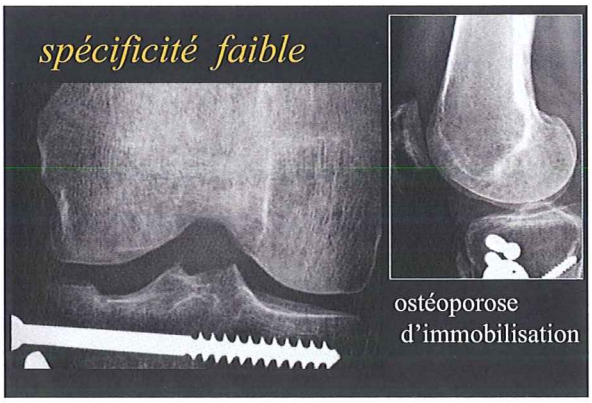




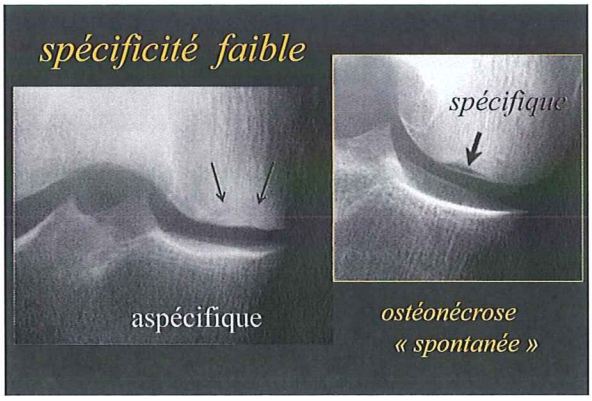





L
sensibilité faible


spécificité faible
ostéoporose
d'immobilisation

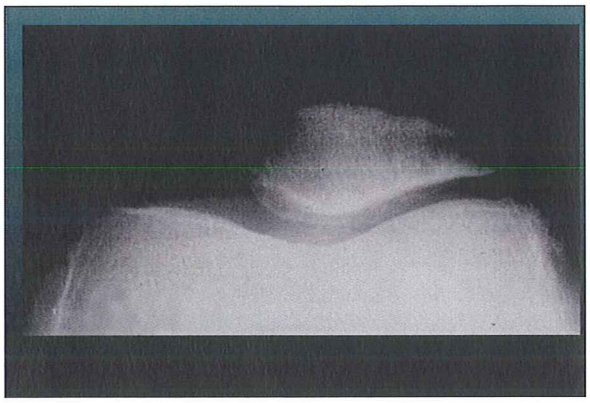
spécificité faible
aspécifique

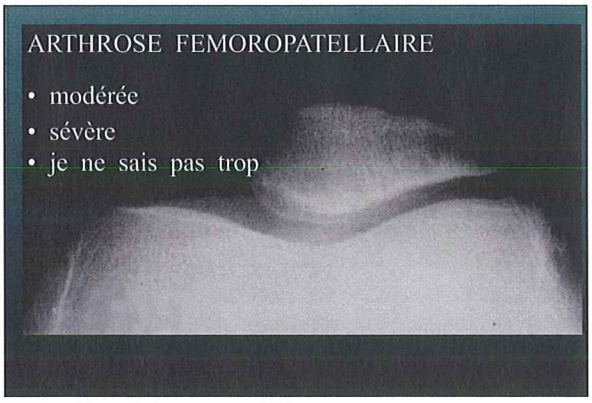

spécificité faible
spécifique
aspécifique
ostéonécrose
« spontanée »

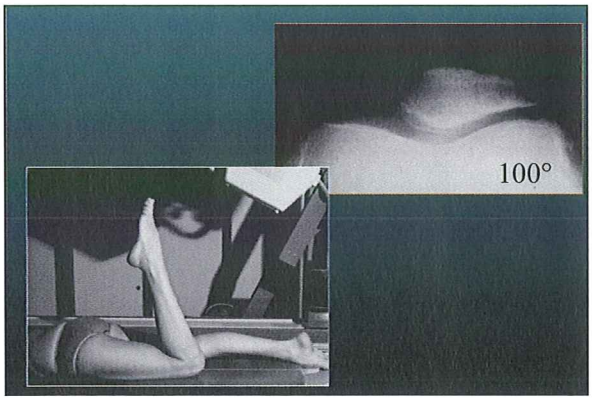
QUE RETENIR

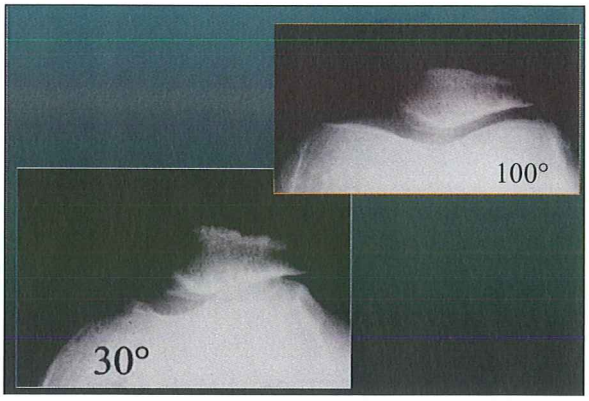
- l'anatomie différenciée des surfaces articulaires peut être (facilement) reconnue de profil
- l'aspect particulier de la surface osseuse abrasée
- des anomalies subtiles de densité osseuse permettent de pressentir des lésions focales

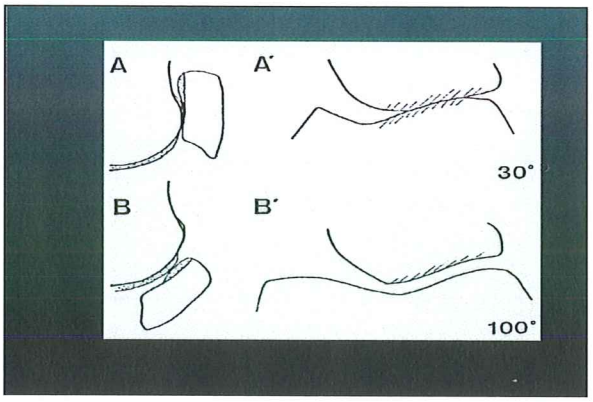
Quiz

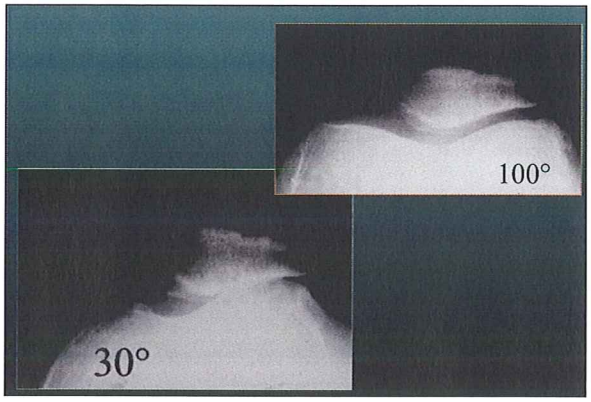




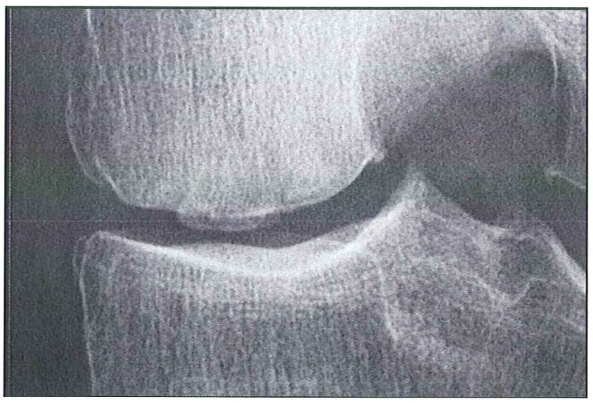


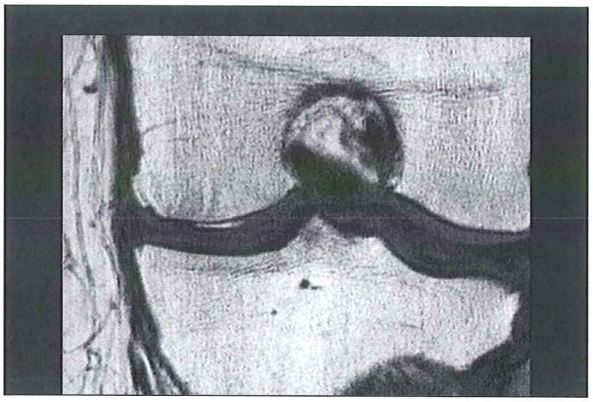


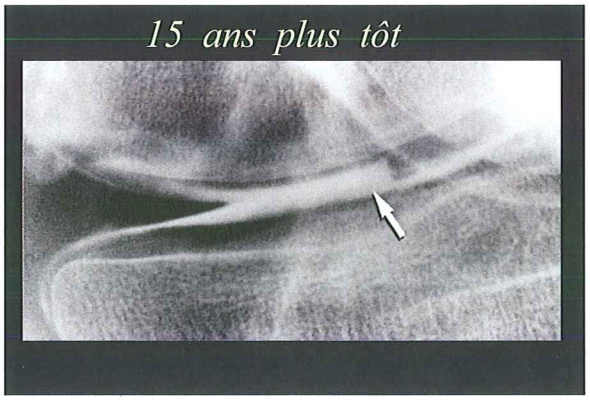


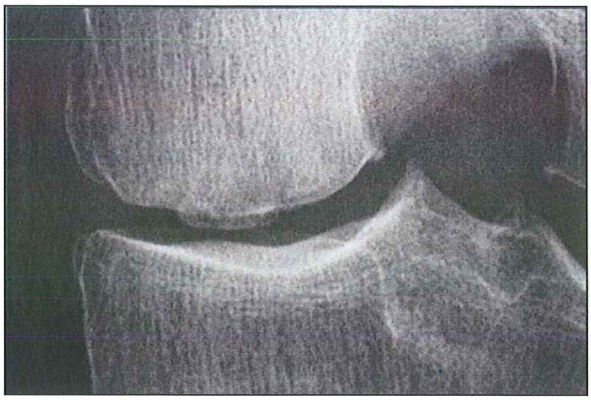


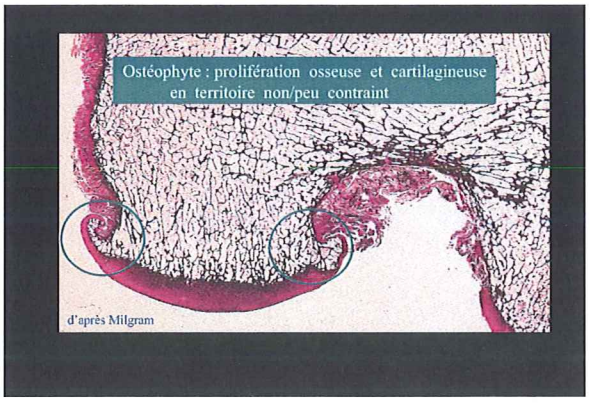
BONUS

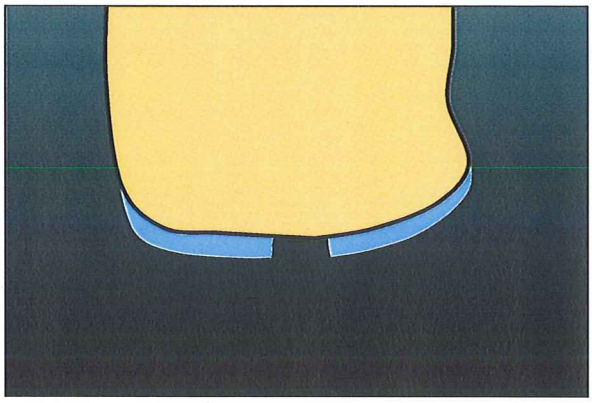


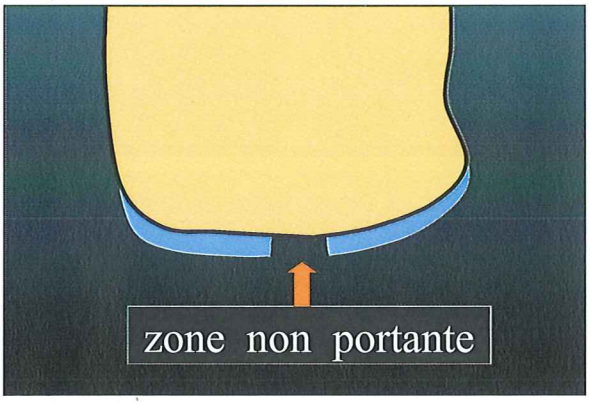


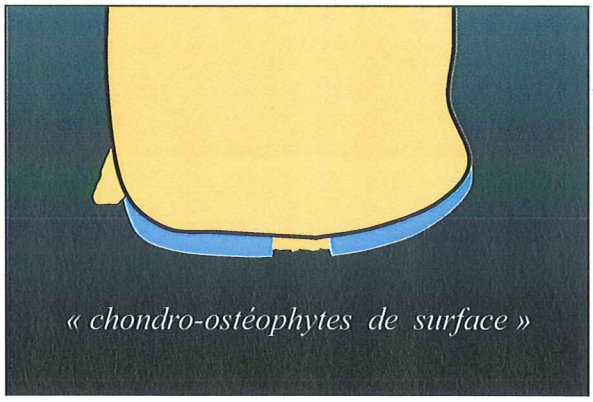

15 ans plus tôt

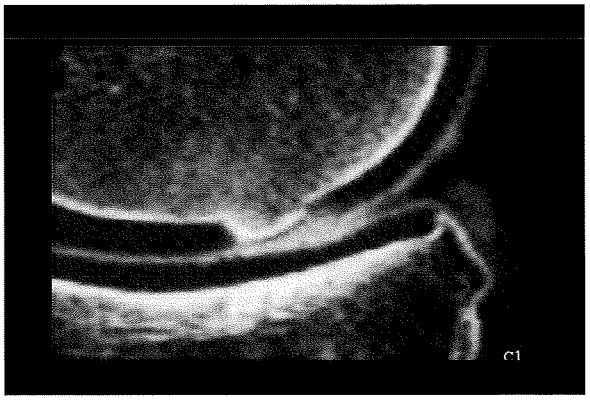



Ostéophyte : prolifération osseuse et cartilagineuse
en territoire non/peu contraint
d'après Milgram




zone non portante


« chondro-ostéophytes de surface »


C1

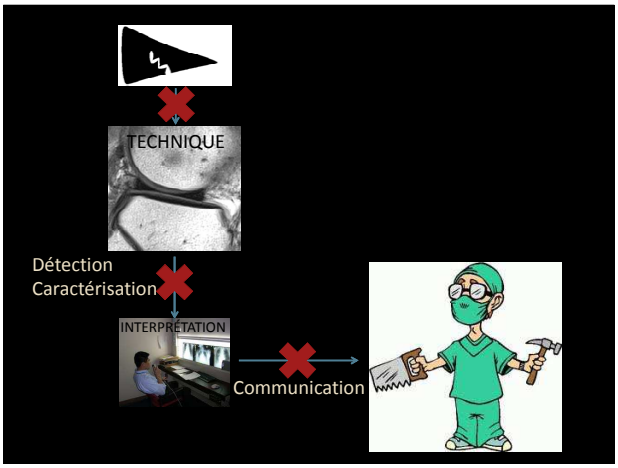
Ménisques: les pièges

Patrick Omoumi

Department of Radiology
Lausanne University Hospital
Switzerland

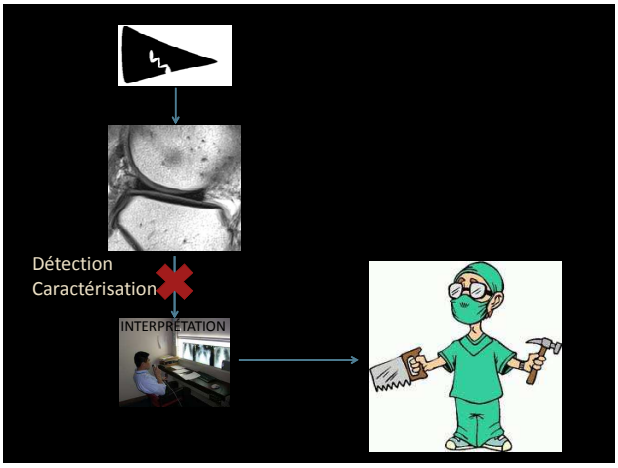
Que ferons-nous?

- On se limitera à l'IRM
  - Ni le CTA
  - Ni le chirurgien
- Définition des erreurs / arthroscopie
- Pas ménisque post-opératoire
- Revue de la littérature
- Revue de quelques erreurs d'interprétation fréquentes, non exhaustive
- Références:
  - *Ménisque élémentaire - Malghem 2004,*
  - *Ménisque Instable - Vande Berg 2004,*
  - *Genou Lésions méniscales - Cotten 2010,*
  - *Anatomie Méniscale Normale - Vande Berg 2010*

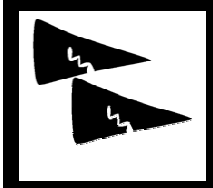


Technique

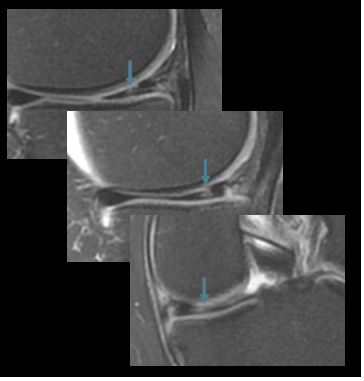
- ≥ 2 plans: sagittal, coronal
- ≥ 1 pondération: DP / P. intermédaire
- +- Saturation du signal de la graisse
- Définitions:
  - épaisseur de coupe: 3mm, gap: 1.5mm



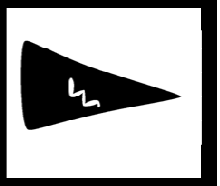
Analyse du signal



Rupture



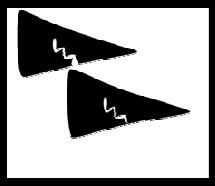
Analyse du signal

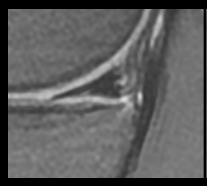


Pas de rupture

Rupture/[illegible]ure de grade 2

Analyse du signal

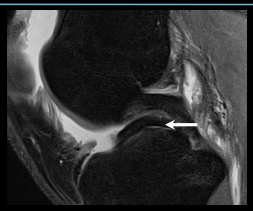


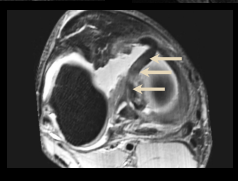


Equivoque

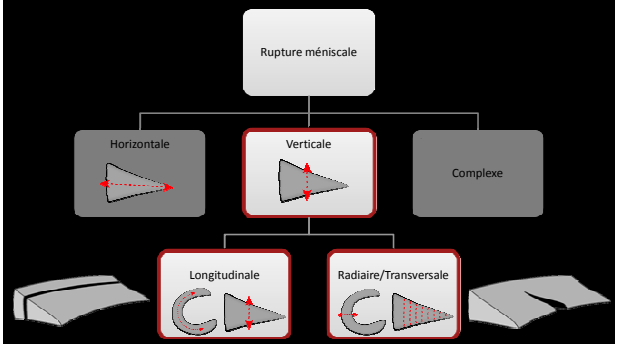
« ne correspondant probablement pas à une rupture »

Analyse de la forme

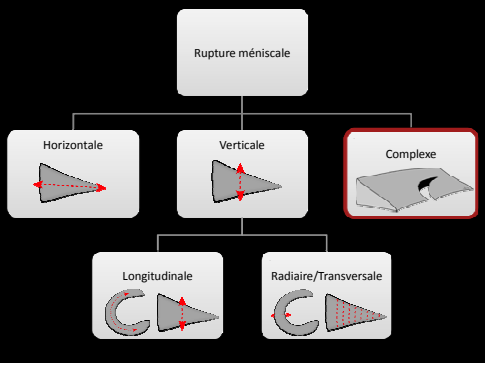




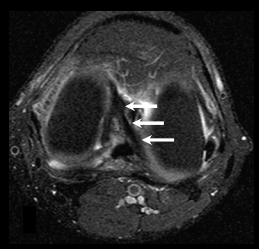
Description des ruptures: terminologie



Description des ruptures: terminologie

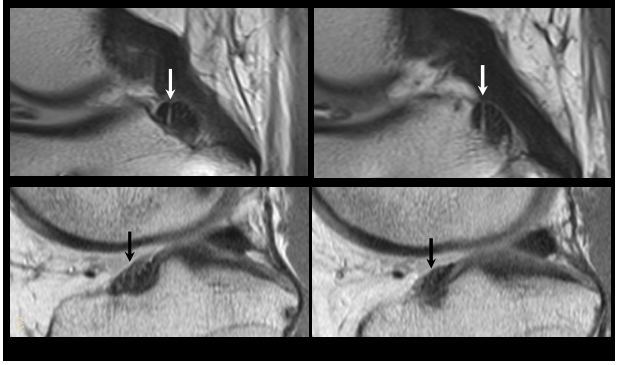


Variantes anatomiques

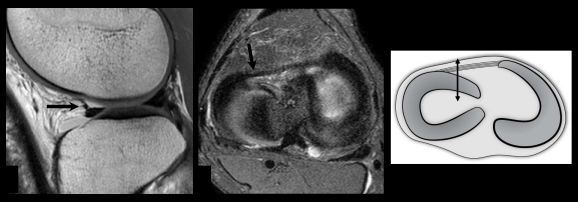


Ligament interméniscal oblique

Variantes anatomiques

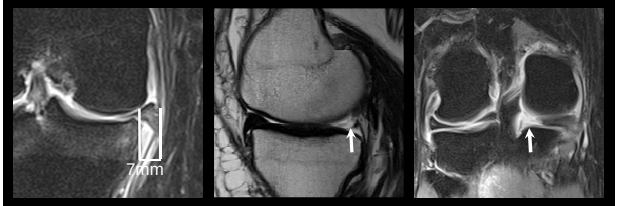


Variantes anatomiques

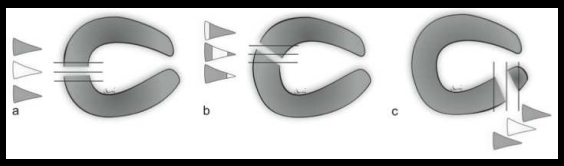


Insertion du ligament interméniscal transverse

Position

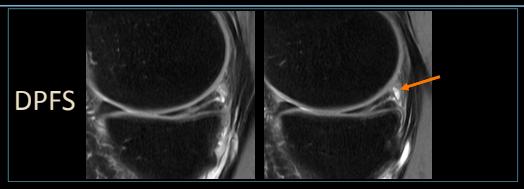


Patterns difficiles



Mises au point - Ménisque élémentaire - Malghem 2004

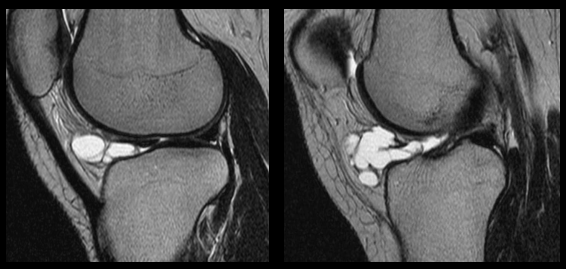
Associations



>90% des kystes juxta-méniscaux associés à des ruptures méniscales

De Smet AA, del Rio AM. *AJR Am J Roentgenol* **(2011)**

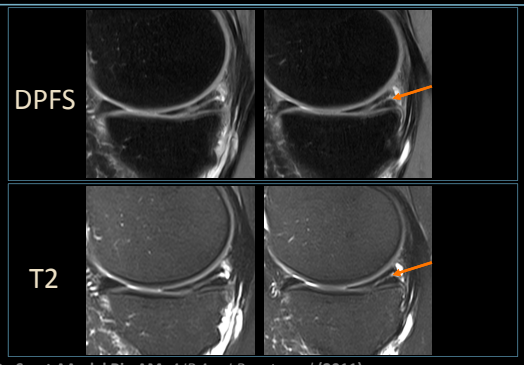
Associations



Corne antérieure ménisque latéral: 65%

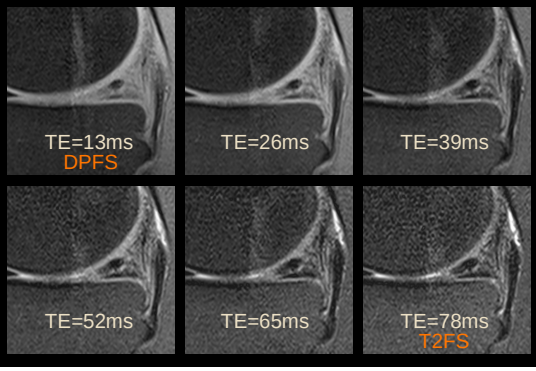
De Smet AA, del Rio AM. *AJR Am J Roentgenol* **(2011)**

Paramètres techniques: TE

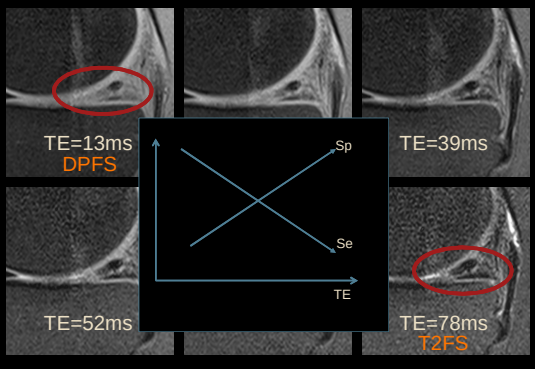


De Smet AA, del Rio AM. *AJR Am J Roentgenol* (2011)

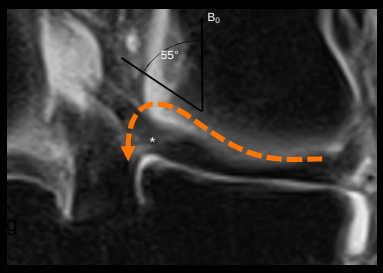
Influence des paramètres techniques: TE

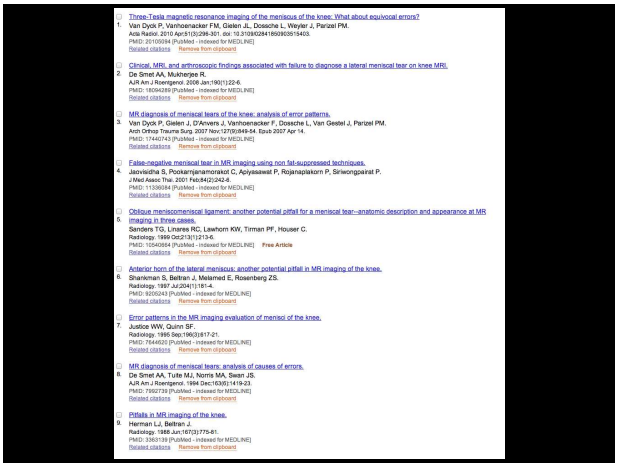


Influence des paramètres techniques: TE



Influence des paramètres techniques: TE et angle magique





Three-Tesla magnetic resonance imaging of the meniscus of the knee: What about equivocal errors?
1. Van Dyck P, Vanhoenacker FM, Gielen JL, Dossche L, Weyler J, Parizel PM.
Acta Radiol. 2010 Apr;51(3):296-301. doi: 10.3109/02841850903515403.
PMID: 20100394 [PubMed - indexed for MEDLINE]
Related citations Remove from clipboard

Clinical, MRI, and arthroscopic findings associated with failure to diagnose a lateral meniscal tear on knee MRI.
2. De Smet AA, Mukherjee R.
AJR Am J Roentgenol. 2006 Jan;190(1):22-6.
PMID: 16394269 [PubMed - indexed for MEDLINE]
Related citations Remove from clipboard

MR diagnosis of meniscal tears of the knee: analysis of error patterns.
3. Van Dyck P, Gielen J, D'Anvers J, Vanhoenacker F, Dossche L, Van Geedel J, Parizel PM.
Arch Orthop Trauma Surg. 2007 Nov;127(9):849-54. Epub 2007 Apr 14.
PMID: 17440743 [PubMed - indexed for MEDLINE]
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False-negative meniscal tear in MR imaging using non fat-suppressed techniques.
4. Jeovisidha S, Pookarnjanamorakot C, Apiyasawat P, Rojanaplakorn P, Siriwongpairat P.
J Med Assoc Thai. 2001 Feb;84(2):242-6.
PMID: 11336084 [PubMed - indexed for MEDLINE]
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Oblique meniscomeniscal ligament: another potential pitfall for a meniscal tear--anatomic description and appearance at MR imaging in three cases.
5. Sanders TG, Linares RC, Lawhorn KW, Tirman PF, Houser C.
Radiology. 1999 Oct;213(1):213-6.
PMID: 10540664 [PubMed - indexed for MEDLINE] Free Article
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Anterior horn of the lateral meniscus: another potential pitfall in MR imaging of the knee.
6. Shankman S, Beltran J, Melamed E, Rosenberg ZS.
Radiology. 1997 Jul;204(1):181-4.
PMID: 9205243 [PubMed - indexed for MEDLINE]
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Error patterns in the MR imaging evaluation of menisci of the knee.
7. Justice WW, Quinn SF.
Radiology. 1995 Sep;196(3):617-21.
PMID: 7644620 [PubMed - indexed for MEDLINE]
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MR diagnosis of meniscal tears: analysis of causes of errors.
8. De Smet AA, Tuite MJ, Norris MA, Swan JS.
AJR Am J Roentgenol. 1994 Dec;163(6):1419-23.
PMID: 7992739 [PubMed - indexed for MEDLINE]
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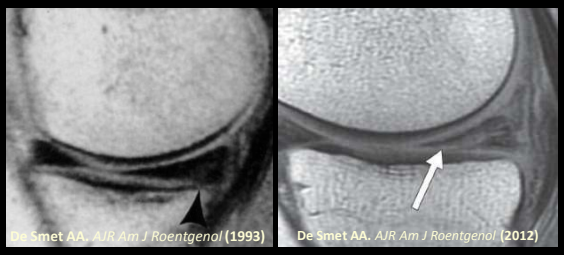
Pitfalls in MR imaging of the knee.
9. Herman LJ, Beltran J.
Radiology. 1988 Jun;167(3):775-81.
PMID: 3363139 [PubMed - indexed for MEDLINE]
Related citations Remove from clipboard

1993 = 2012



1993	2012
Médial: Se= 93; Sp= 88%	Médial: Se= 88; Sp= 80%
Latéral: Se= 79; Sp= 96%	Latéral: Se= 79; Sp= 91%

Van Dyck P, Parizel PM. *Acta Radiol* (2010)

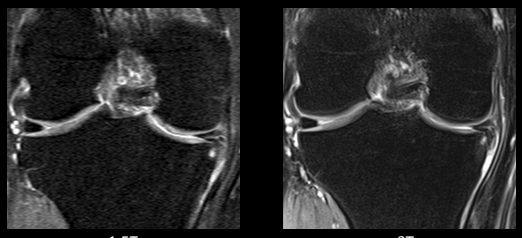
Performance de l'IRM en pathologie méniscale

- Méta-analyse des articles publiés entre 1991 et 2000
- IRM (de 0.1 à 1.5T)
- → On se trompe pour 10 ménisques sur 100!

- Ménisque médial: Se= 93; Sp= 88%
- Ménisque latéral: Se= 79; Sp= 96%
- La plus faible Se=corne postérieure MLat

Oei EH, Myriam Hunink MG. *Radiology* **(2003)**

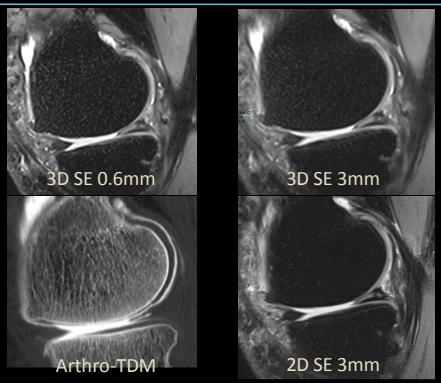
IRM 1.5T = 3T



1.5T 3T

Grossman JW, De Smet AA, Shinki K. Comparison of the accuracy rates of 3-T and 1.5-T MRI of the knee in the diagnosis of meniscal tear. AJR Am J Roentgenol 2009; Aug;193(2):509-14.

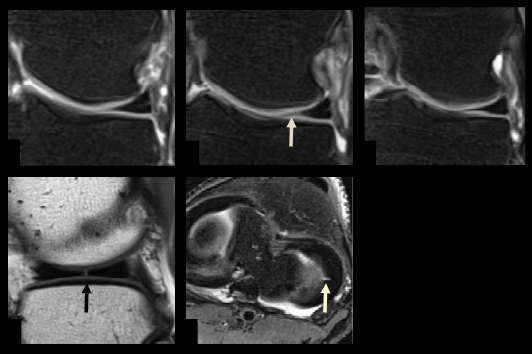
3D SE 3T ≤ 2D SE 3T

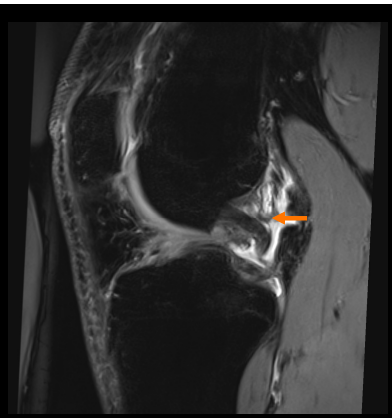


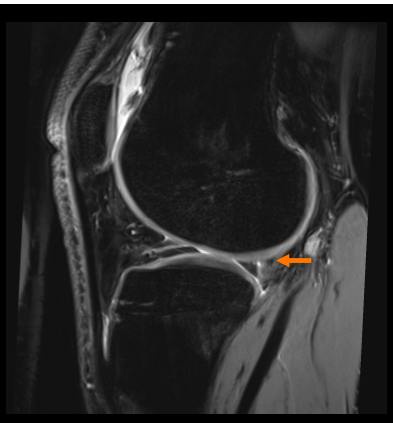
Erreurs d'interprétation rares

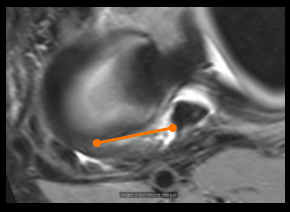
- *Lecture rétrospective*:
- erreurs inévitables (non visibles en IRM)
- signes IRM équivoques — 80%
- erreurs d'interprétation — 20%

- En général pas d'impact thérapeutique



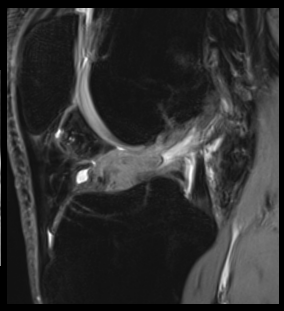






≥14mm

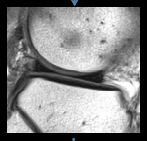
≥ 3 coupes si:
Épaisseur 3mm, gap 0.5mm



Association à ruptures de LCA

Rupture verticale longitudinale CP

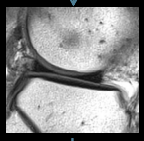
- 2 plans orthogonaux
- Séquences appropriées
- Limites de l'IRM: 80% des erreurs



- Signal/Forme
- Variantes anatomiques
- Patterns/Topographie
- Associations lésionnelles

- Erreurs de détection: rares
- Erreurs de caractérisation: ?

Détection
Caractérisation



- Côté, Compartiment
- Terminologie appropriée:
  - Anomalie de signal ≠ Rupture

  - "Pas une rupture"
  - "Probablement pas une rupture"
  - "Rupture"

Communication

LE GENOU DEGENERATIF

ménisque

os sous-chondral

et tutti quanti ...

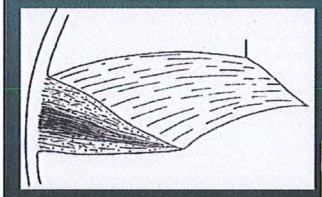
1ère partie : MENISQUES

- lésions dégénératives *(versus traumatiques)*
- rupture radiaire de la corne postérieure du ménisque médial

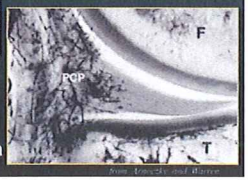
2ème partie : LESIONS DU CARTILAGE

3ème partie : OS SOUS-CHONDRAL

LESIONS MENISCALES ELEMENTAIRES



Rappel anatomique



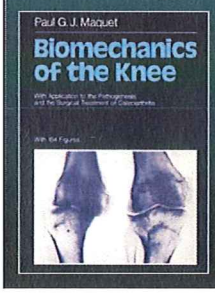
vascularisation

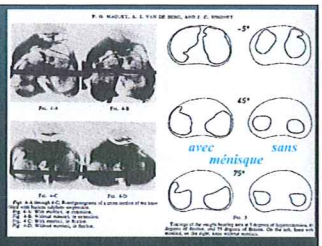
Rôle
des ménisques

structures vestigiales ?

congruence et lubrification

Rôle fonctionnel
des ménisques





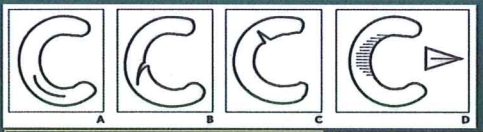
congruence et lubrification

- doublement des surfaces de contact
- transmission de 50% des contraintes

structures proprioceptives

---

classification des lésions principales



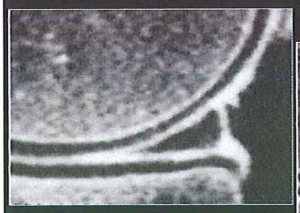
verticales

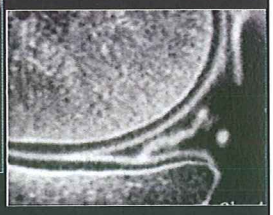
a. longitudinales
b. obliques
c. radiaires

horizontales

partielles ou complètes ... et complexes

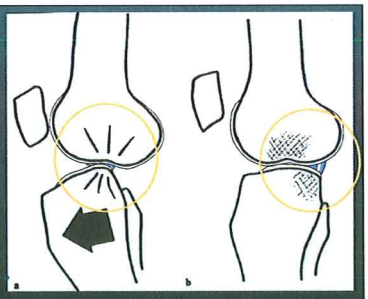
pathogénie



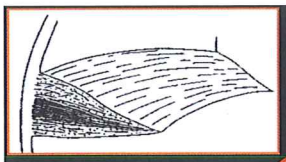


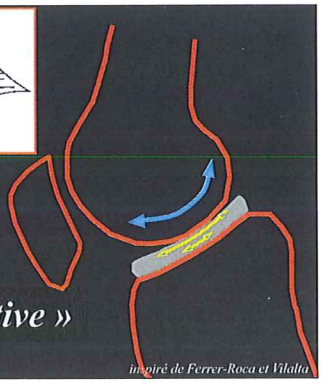
traumatique

dégénérative



lésion « traumatique »





lésion « dégénérative »

inspiré de Ferrer-Roca et Vilalta

Les classiques

Noble et Hamblen 1975 — 100 autopsies

anomalies méniscales : 73 %

ruptures horizontales : 60 %

ruptures verticales : 12 % longitudinales
27 % obliques

Les classiques

Dandy 1990 — 1.000 arthroscopies

ruptures méniscales : 70,5 % médiales
29,5 % latérales

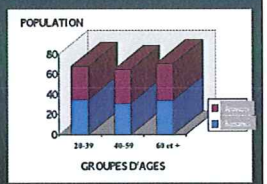
lésions verticales : 75 % des lésions médiales
54 % des lésions latérales

Etude personnelle *V. Staumont et coll. 1998*

étude rétrospective

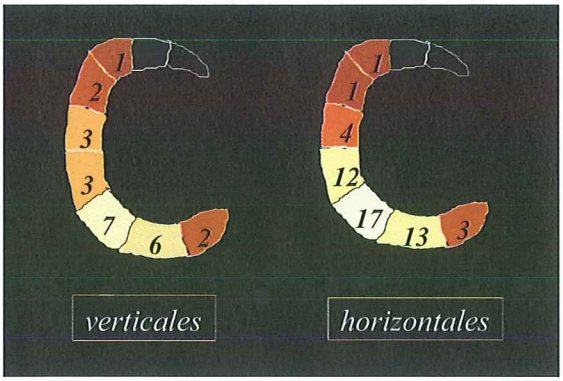
sélection aléatoire

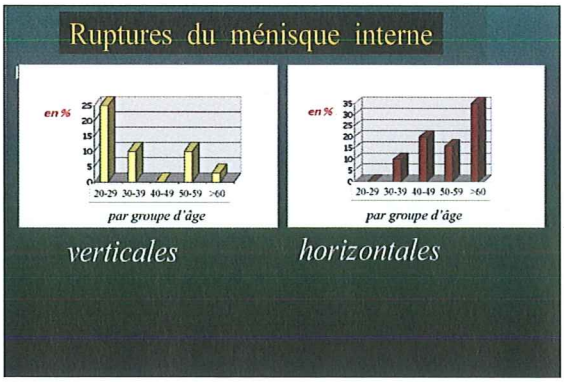
lecture aveugle quant au sexe et à l'âge

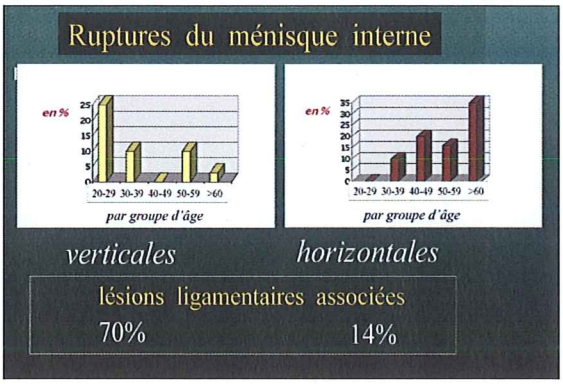


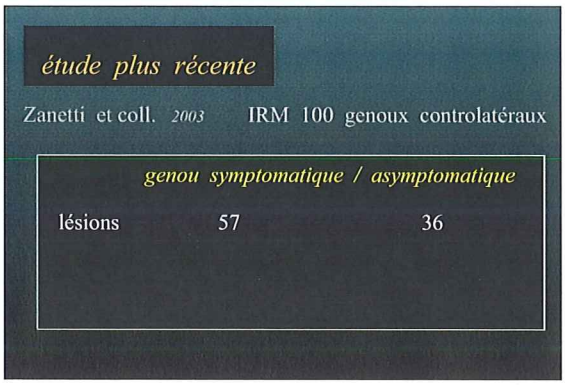
204 dossiers d'IRM

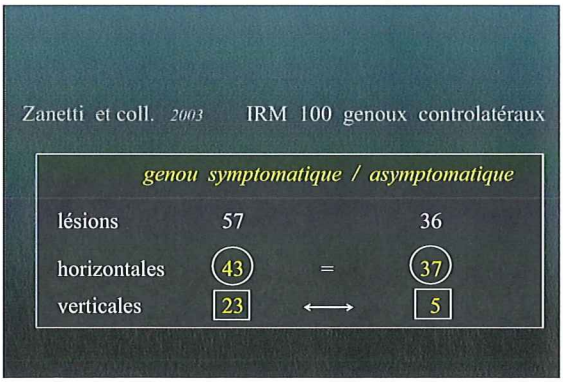
Staumont V. Ruptures isolées et lésions longitudinales verticales ou horizontales du ménisque interne : relation avec l'âge. Mémoire de licence en radiodiagnostic. Université Catholique de Louvain 1998, 26 p.


1
2
3
3
7
6
2
1
1
4
12
17
13
3
verticales
horizontales

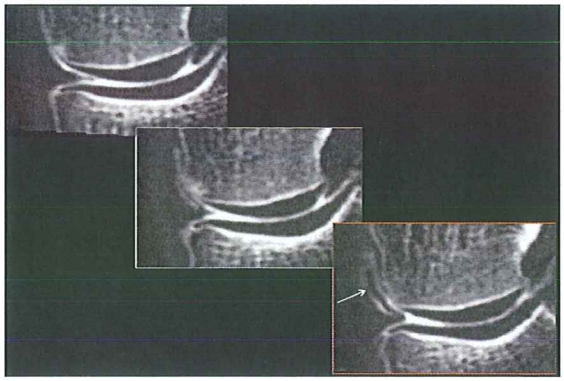

Ruptures du ménisque interne
en %
20-29 30-39 40-49 50-59 >60
par groupe d'âge
en %
20-29 30-39 40-49 50-59 >60
par groupe d'âge
verticales
horizontales

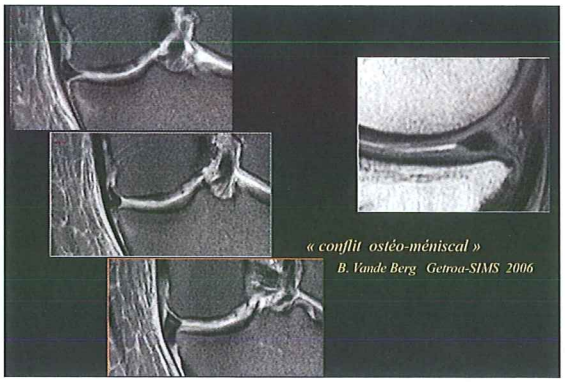

Ruptures du ménisque interne
en %
20-29 30-39 40-49 50-59 >60
par groupe d'âge
en %
20-29 30-39 40-49 50-59 >60
par groupe d'âge
verticales
horizontales
lésions ligamentaires associées
70%
14%


étude plus récente
Zanetti et coll. 2003 IRM 100 genoux controlatéraux
genou symptomatique / asymptomatique
lésions 57 36


Zanetti et coll. 2003 IRM 100 genoux controlatéraux
genou symptomatique / asymptomatique
lésions 57 36
horizontales 43 = 37
verticales 23 ⟷ 5

pourquoi une lésion méniscale dégénérative
peut devenir symptomatique ?





Conséquences pratiques

- pondération clinique
  « leave-me-alone » lésions
- méniscectomie pas anodine

Conséquences pratiques

méniscectomie pas anodine

Les classiques

KNEE JOINT CHANGES AFTER MENISCECTOMY
T. J. Fairbank, London, England
November 1948

- *pincement des interlignes*
- *déformation des condyles*
- *ostéophytose*

étude plus récente Englund et coll. *2003*

155 patients *16 ans après meniscectomie*

arthrose symptomatique : 50%

étude plus récente Englund et coll. *2003*

155 patients *16 ans après meniscectomie*

arthrose symptomatique : 50%

risque par rapport à témoins

x 2,7 pour lésions traumatiques
x 7 pour lésions dégénératives

modifications sous-chondrales après méniscectomie

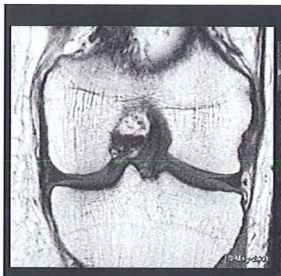
- ostéonécrose [Hall 1979]
- microfractures sous-chondrales
- oedème médullaire juxta-articulaire

modifications sous-chondrales après méniscectomie

Kobayashi et al. *Arthroscopy 2002 18 238-245*

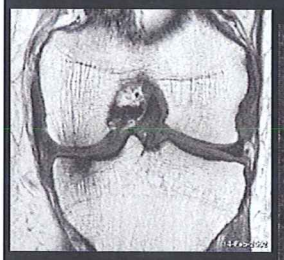
IRM quelques mois après méniscectomie

- anomalies de signal (fémur ou tibia) dans 34 % des cas
- dépend de l'extension de la méniscectomie

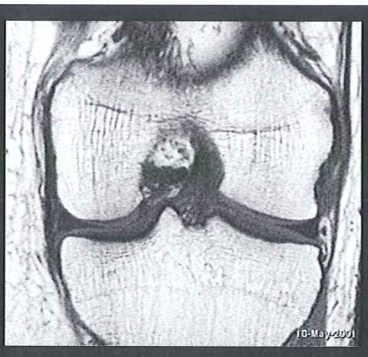


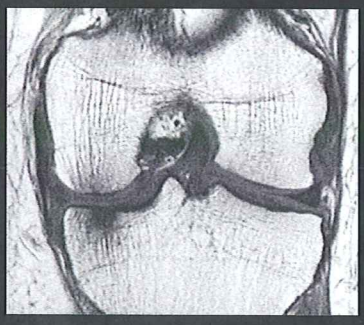
homme de 43 ans

bénéficie (?) d'une méniscectomie



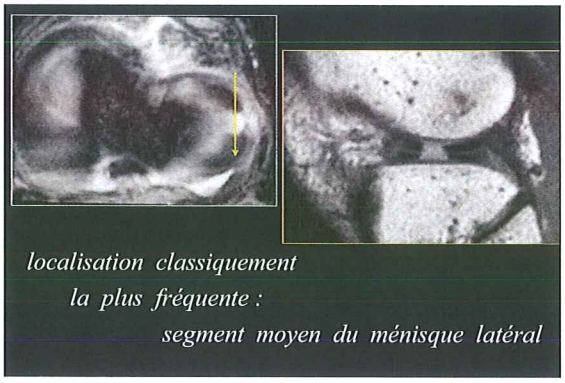
quelques mois plus tard ...



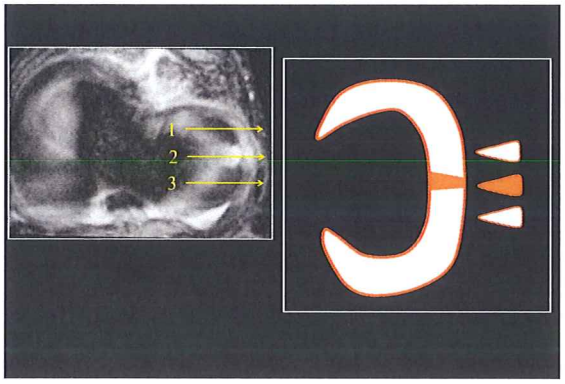


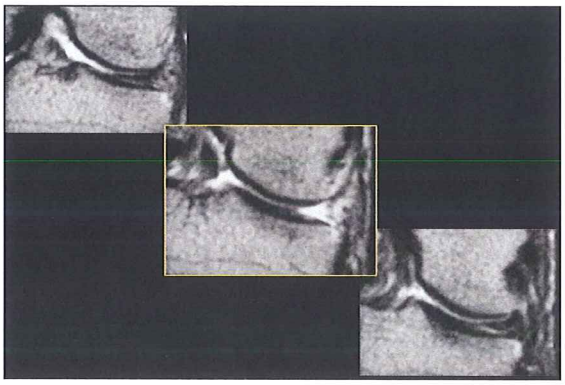
une lésion particulière

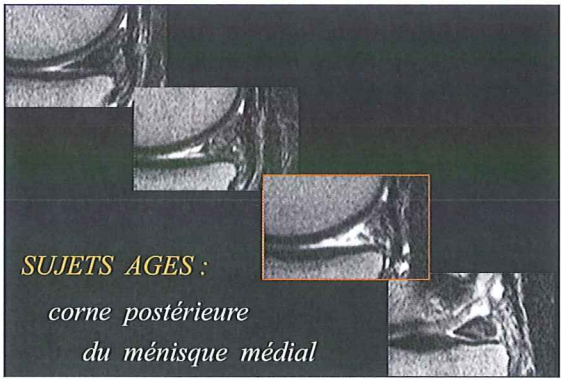
la rupture radiaire
de la corne postérieure
du ménisque médial



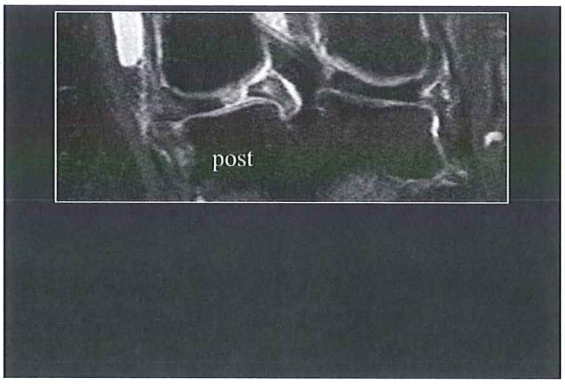
localisation classiquement
la plus fréquente :
segment moyen du ménisque latéral

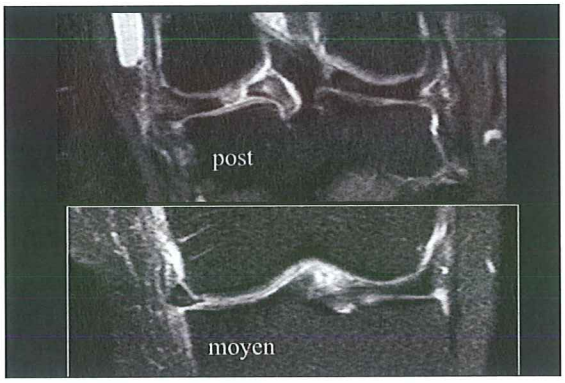


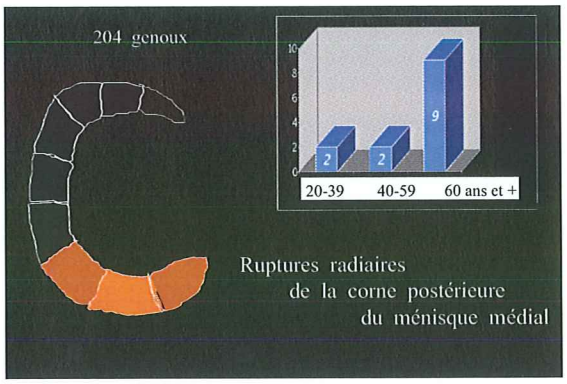


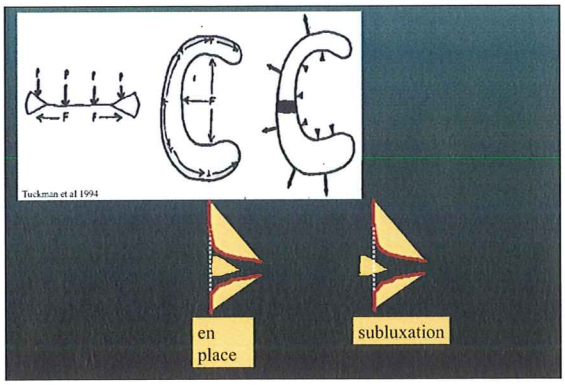


SUJETS AGES :
corne postérieure
du ménisque médial

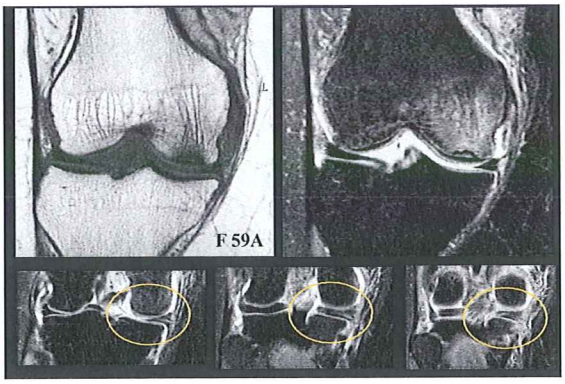



post
moyen


204 genoux
10
8
6
4
2
0
2
2
9
20-39
40-59
60 ans et +
Ruptures radiaires
de la corne postérieure
du ménisque médial


Tuckman et al 1994
en place
subluxation

Conséquence :
auto-méniscectomie
[Tuckman et al. 1994]
« augmentation des nécroses spontanées »
notre série rétrospective (13 ruptures radiaires)
4 « œdèmes »
1 « nécrose »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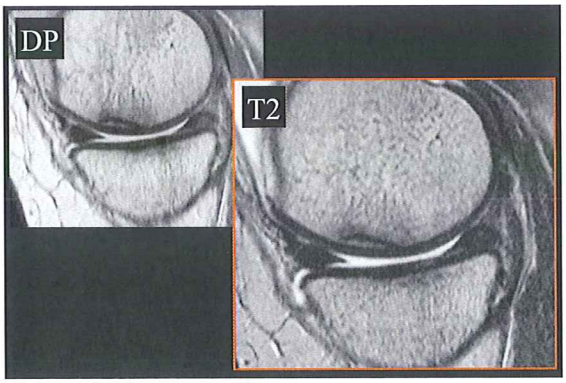
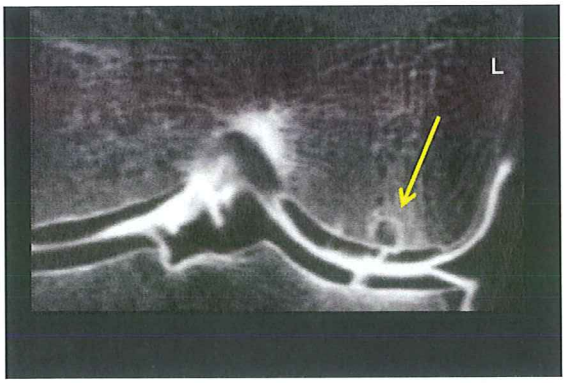
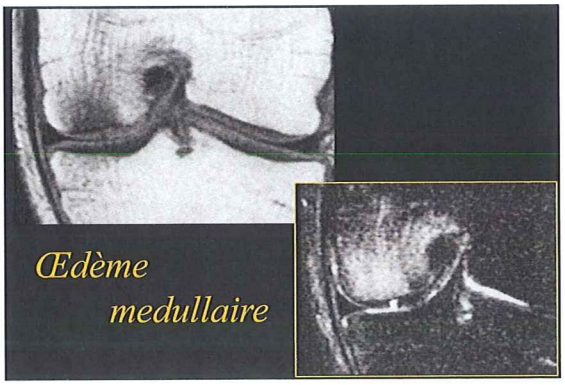

DP
T2

2ème partie: CARTILAGE

- interligne
- os sous-chondral

cf. topo précédent





Œdème medullaire

Marco Zanetti, MD
Elisabeth Bruder, MD
José Romero, MD
Juerg Hodler, MD

Radiology 2000

Bone Marrow Edema Pattern in Osteoarthritic Knees: Correlation between MR Imaging and Histologic Findings[1]

Œdème,
vous avez dit œdème ?

Marco Zanetti, MD
Elisabeth Bruder, MD
José Romero, MD
Juerg Hodler, MD

Radiology 2000

Bone Marrow Edema Pattern in Osteoarthritic Knees: Correlation between MR Imaging and Histologic Findings[1]

Zones d'œdème médullaire :

- 53 % tissu normal
- 11 % nécrose médullaire
- 8 % travées osseuses anormales
- 4 % fibrose médullaire
- 4 % œdème médullaire
- 2 % hémorragie

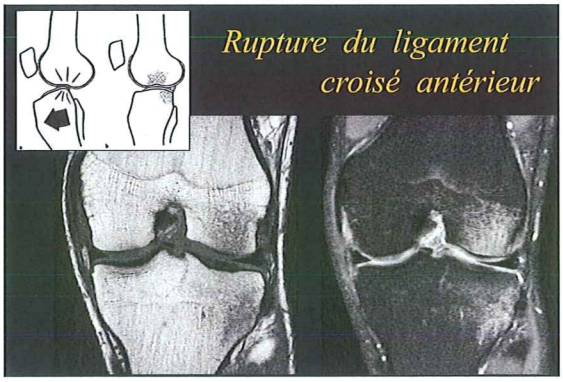
3ème partie : OS SOUS-CHONDRAL

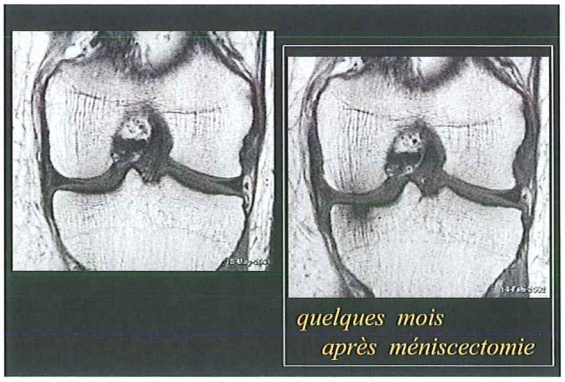
sans chondropathie

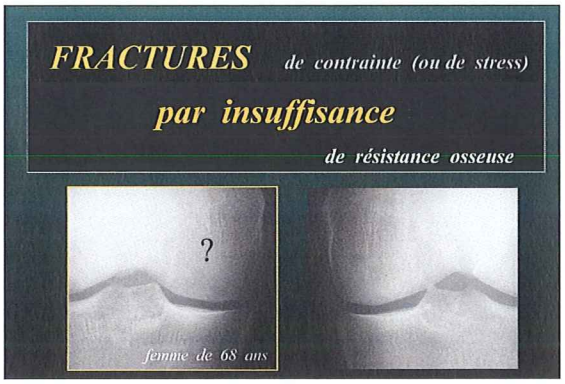
post-contusionnel

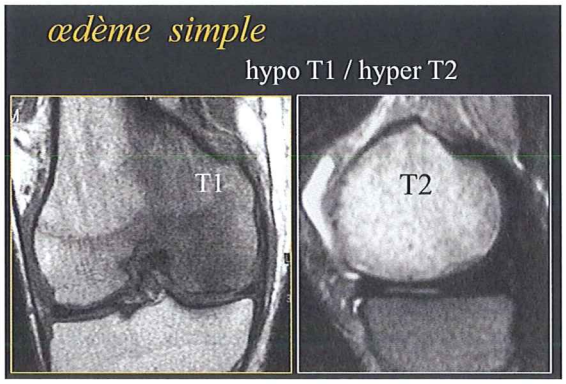
œdème transitoire « idiopathique »

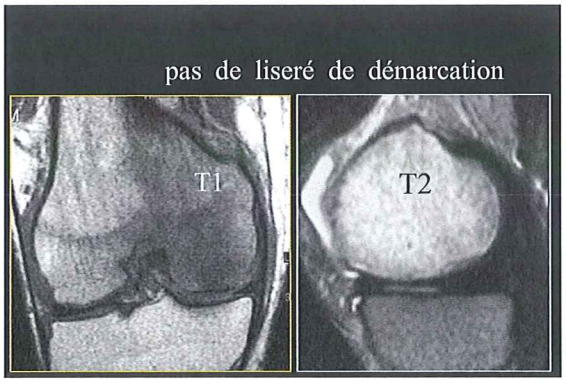
ostéonécrose

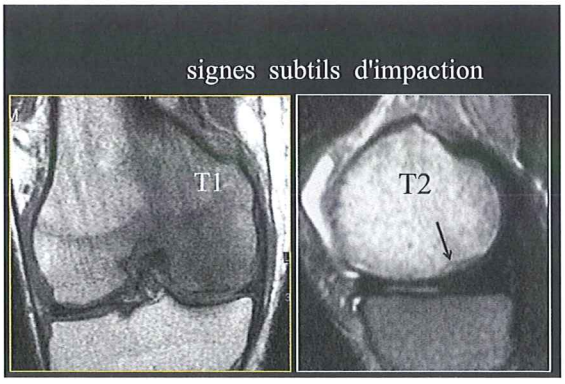

Rupture du ligament
croisé antérieur

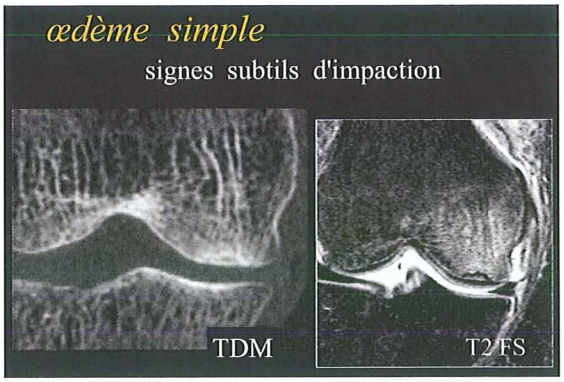

quelques mois
après méniscectomie

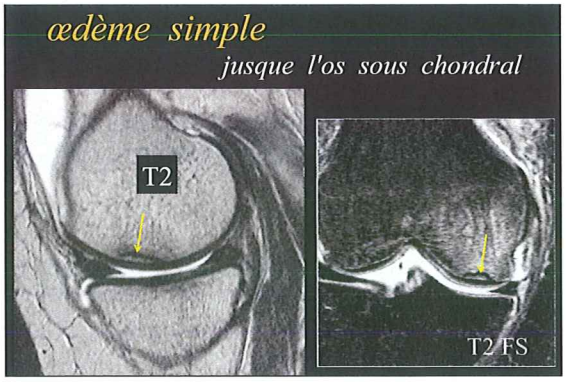

FRACTURES de contrainte (ou de stress)
par insuffisance
de résistance osseuse
?
femme de 68 ans

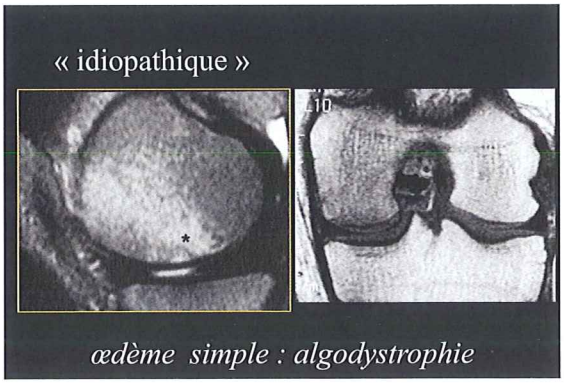

œdème simple
hypo T1 / hyper T2
T1
T2

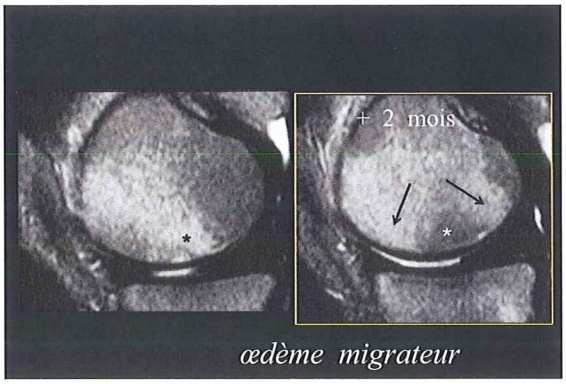

pas de liseré de démarcation
T1
T2

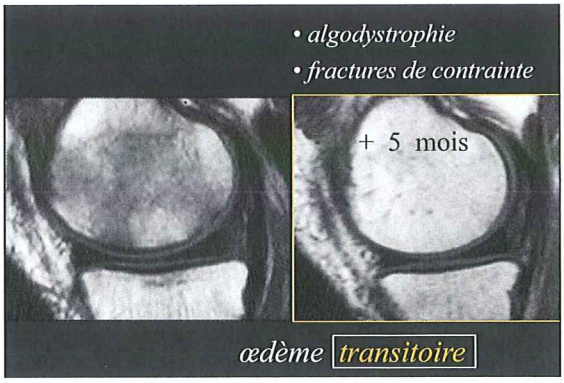

signes subtils d'impaction
T1
T2

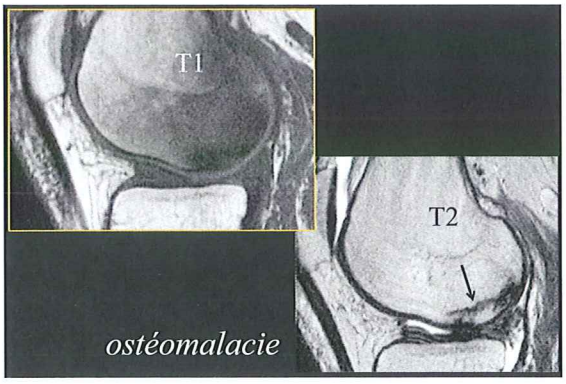

œdème simple
signes subtils d'impaction
TDM
T2 FS


œdème simple
jusque l'os sous chondral
T2
T2 FS


« idiopathique »
œdème simple : algodystrophie

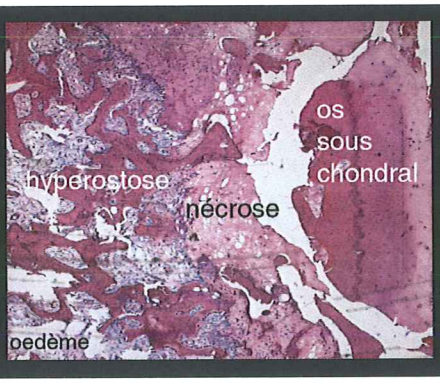

+ 2 mois
œdème migrateur

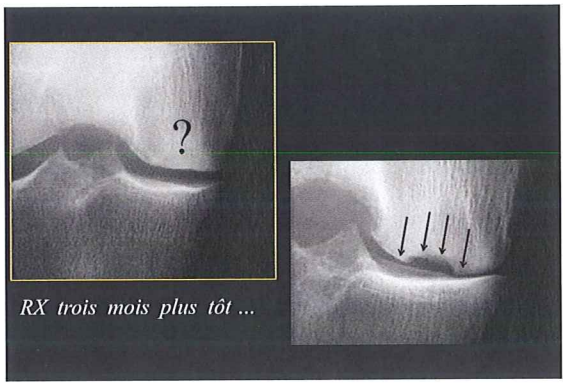

• algodystrophie
• fractures de contrainte
+ 5 mois
œdème transitoire

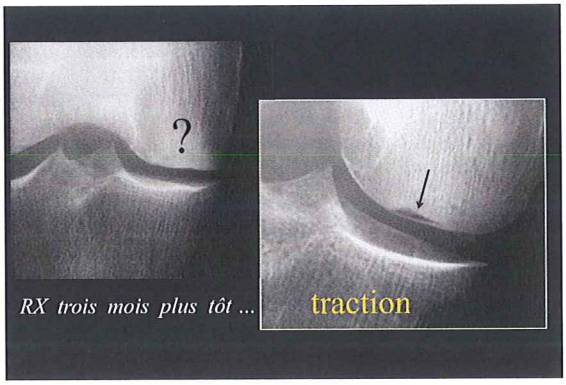

T1
T2
ostéomalacie

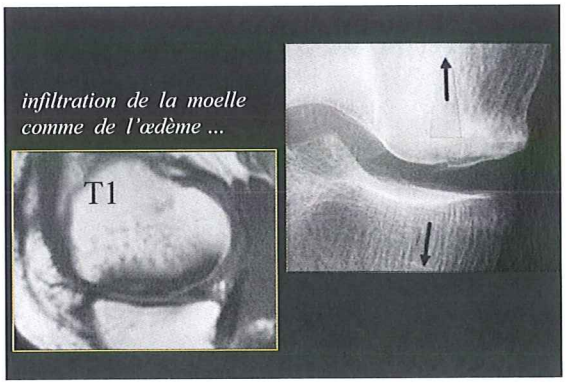
NECROSE SPONTANEE

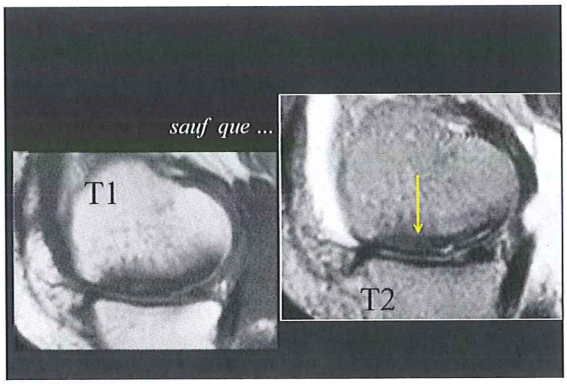
- *Albäch et al. 1968*
- condyle fémoral médial
- femmes > 60 ans (75% des cas)
- début souvent soudain
- association lésion méniscale, méniscectomie

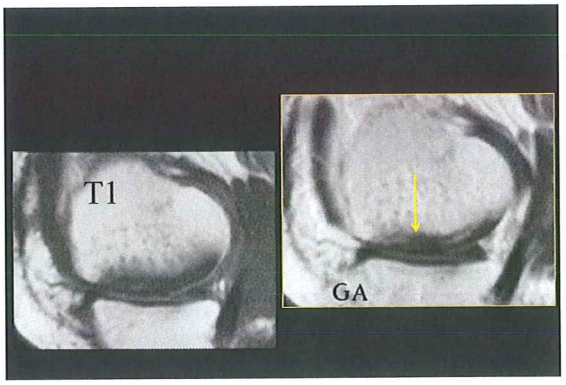


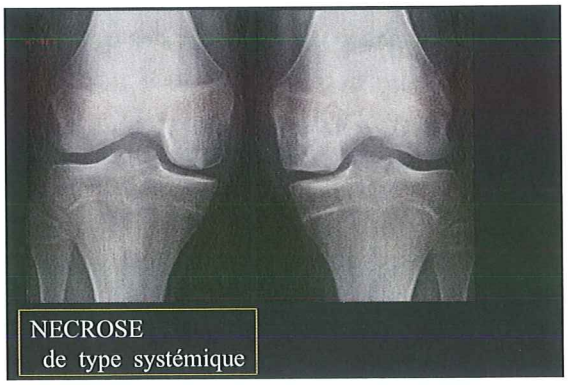


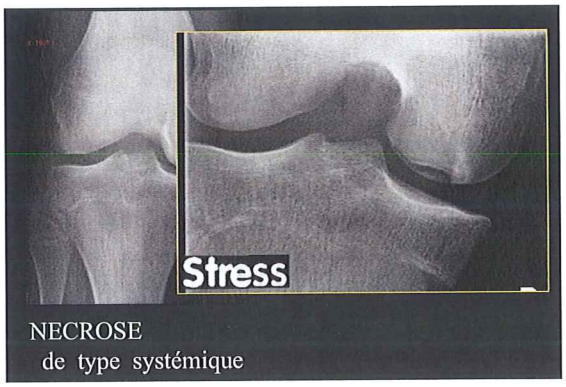


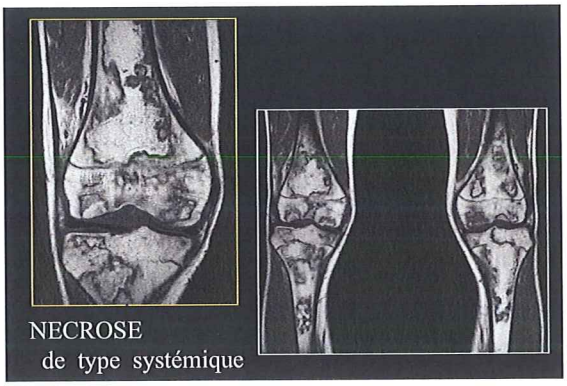


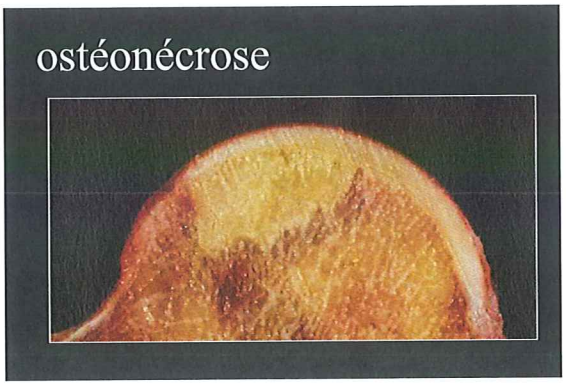


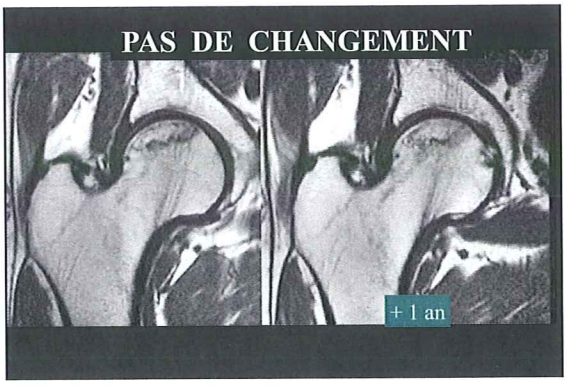

T1
GA

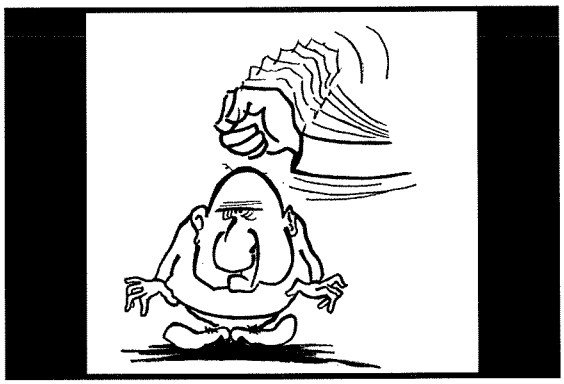

NECROSE
de type systémique

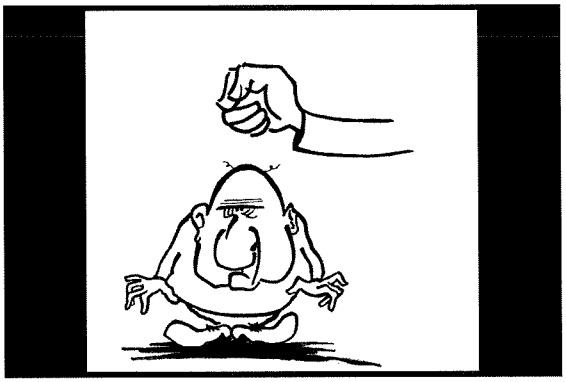

Stress
NECROSE
de type systémique

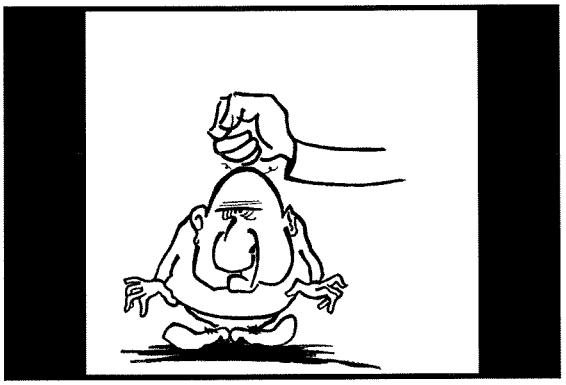

NECROSE
de type systémique

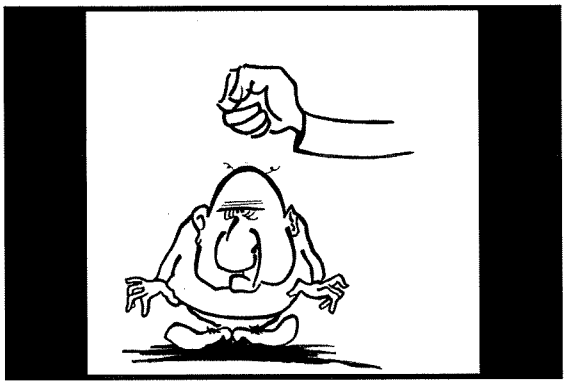

ostéonécrose

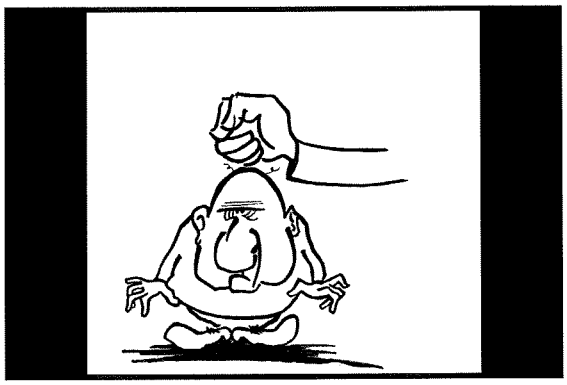

PAS DE CHANGEMENT
+ 1 an

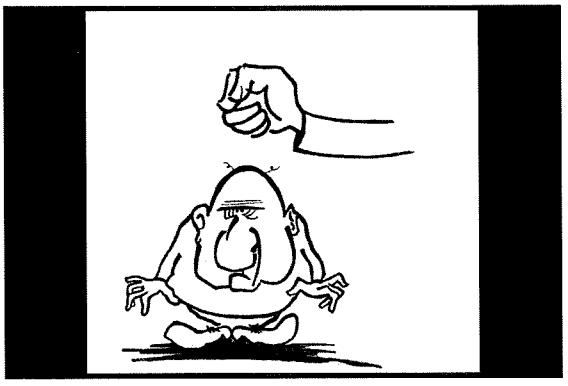


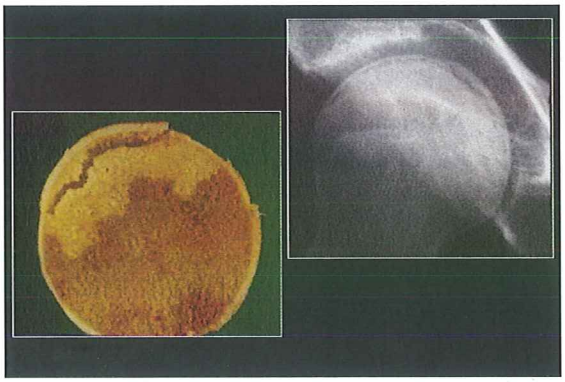










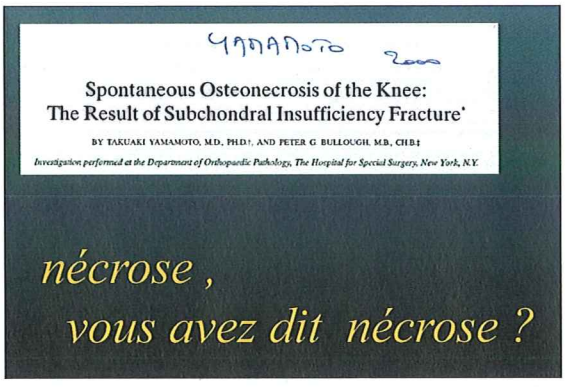


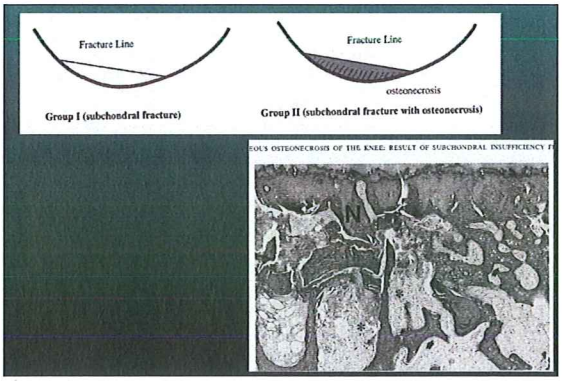
Nécrose épiphysaire

- *type « systémique »*
- *type « spontané »*
  ou mécanique

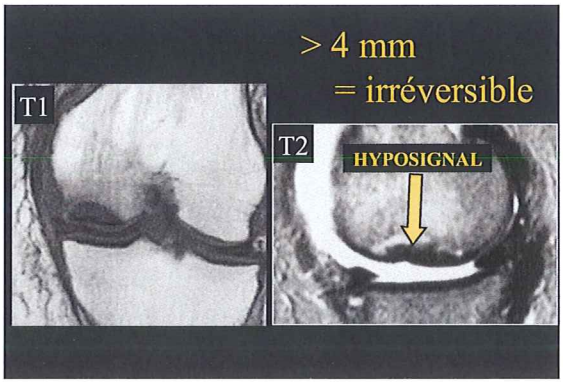
Nécrose épiphysaire

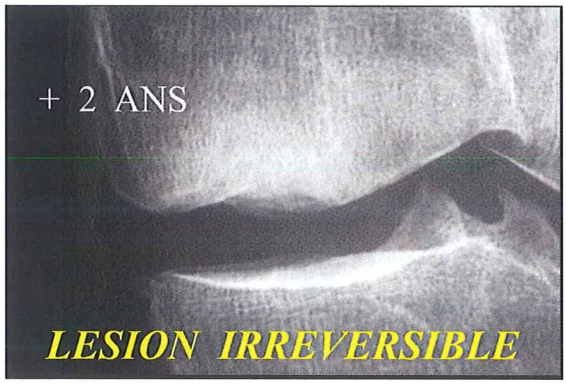
« on peut mourir
suite à un maladie
ou à un accident » !!!

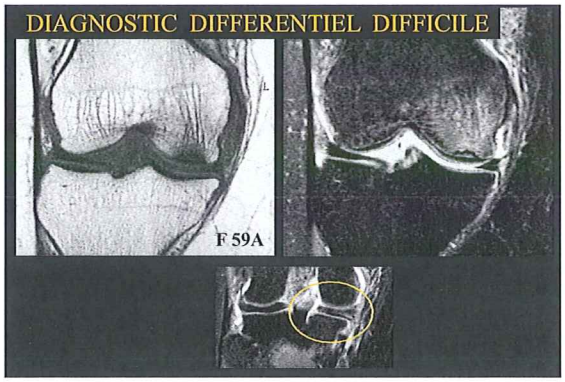


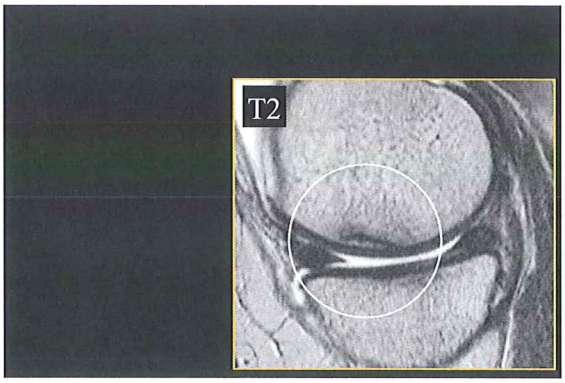

Fracture Line
Group I (subchondral fracture)
Fracture Line
osteonecrosis
Group II (subchondral fracture with osteonecrosis)

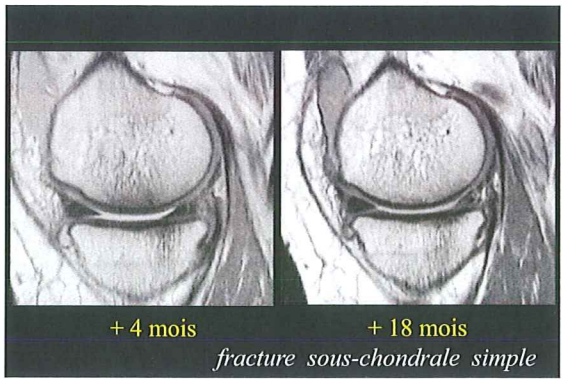
EN PRATIQUE
T1
Femme de 85 ans

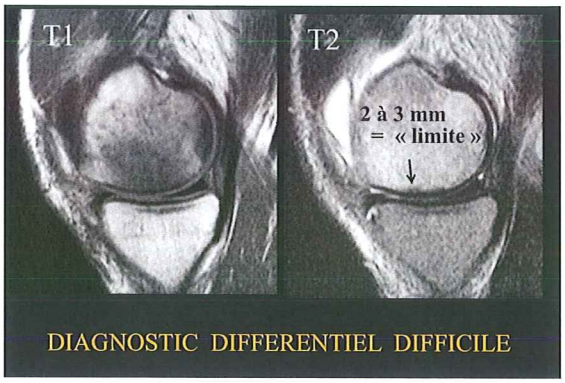

> 4 mm
= irréversible
T1
T2
HYPOSIGNAL

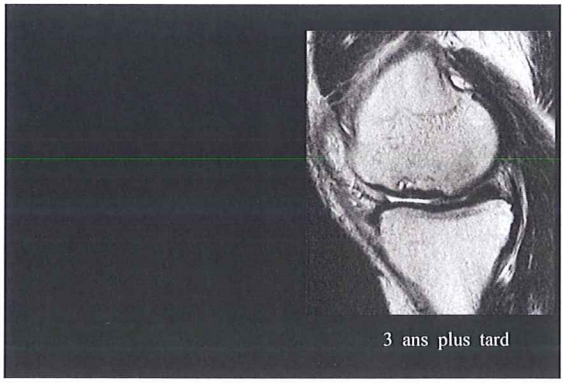

+ 2 ANS
LESION IRREVERSIBLE

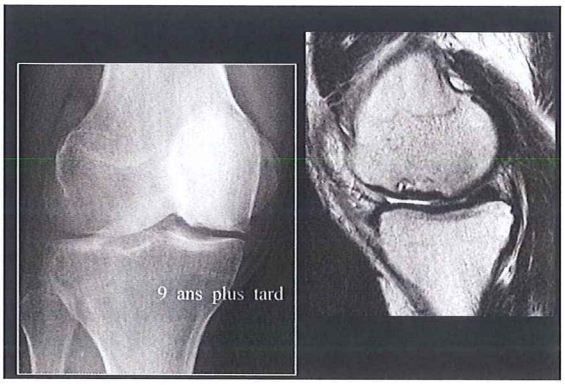

DIAGNOSTIC DIFFERENTIEL DIFFICILE
F 59A


T2









EN RESUME

NECROSE SYSTEMIQUES : liseré de démarcation

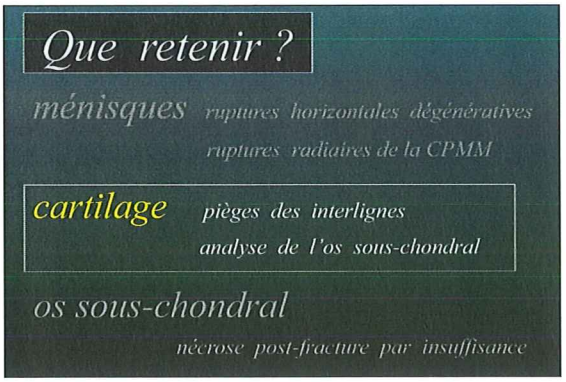
LESIONS SPONTANEES

oedèmes simples : hypo/hypersignal en T1/T2
fractures par insuffisance

nécroses spontanées : id. + hypo/hyposignal en T2 >4 mm
= fractures « qui tournent mal »

Que retenir ?

Que retenir ?
ménisques ruptures horizontales dégénératives
ruptures radiaires de la CPMM
cartilage pièges des interlignes
analyse de l'os sous-chondral
os sous-chondral
nécrose post-fracture par insuffisance


Que retenir ?
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Que retenir ?
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cartilage pièges des interlignes
analyse de l'os sous-chondral
os sous-chondral
nécrose post-fracture par insuffisance

Imagerie morphologique et fonctionnelle du cartilage

Patrick Omoumi

Department of Radiology
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Switzerland

Objectifs

- Imagerie morphologique du cartilage
  - Quelle impact des progrès récents sur la pratique?
- IRM: biomarqueur de la pathologie chondrale?
  - Imagerie fonctionnelle/ biochimique/ "compositionnelle" du cartilage
  - Où en est la recherche?

Imagerie morphologique: Définitions

Chondropathie vs. Arthrose

Définition arthrose à l'IRM

Présence de
(2 signes du groupe A)
OU
(1 des signes du groupe A + ≥2 signes du groupe B)

Groupe A	Groupe B
Ostéophyte certain	"Oedème" osseux sous-chondral à distance des insertions méniscales ou ligamentaires
Perte de substance chondrale complète (os sous-chondral dénudé)	Subluxation méniscale, rupture de type dégénérative
	Perte de substance cartilagineusepartielle
	Abrasion osseuse

Hunter DJ, Arden N, Conaghan PG, et al. *Osteoarthritis Cartilage* (2011)

Classifications

Grade	Arthroscopie	Imagerie en coupe
Grade 0	Normal	Surface régulière, épaisseur normale, signal normal
Grade 1	Fibrillation (sans perte de substance) and ramollissement cartilagineux	Irrégularités de surface (non visible avec les résolutions spatiale habituelles). Anomalie de signal intrinsèque du cartilage
Grade 2	Perte de substance de moins de 50% de l'épaisseur du cartilage	Perte de substance de moins de 50% de l'épaisseur du cartilage
Grade 3	Perte de substance de plus de 50% de l'épaisseur du cartilage, sans atteinte de l'os sous-chondral	Perte de substance de plus de 50% de l'épaisseur du cartilage, sans atteinte de l'os sous-chondral
Grade 4	Perte de substance complète (os sous-chondral dénudé)	Perte de substance complète (os sous-chondral dénudé, anomalies de l'os sous-chondral)

Quelle que soit la technique, on ne visualise de façon fiable que les pertes de substance chondrale (grade≥2).

Classifications

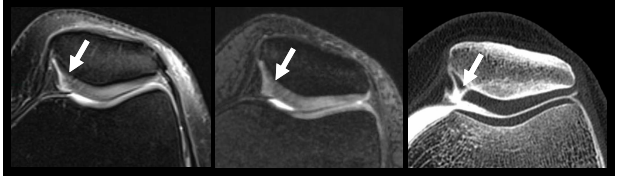
- Autres systèmes intégrant les ménisques, la synoviale, l'os sous-chondral, les ostéophytes, les ligaments.
- Approche globale de la maladie
- Recherche
- Ex: WORMS

Peterfy CG, Genant HK. *Osteoarthritis Cartilage* **(2004)**

Quelle technique?

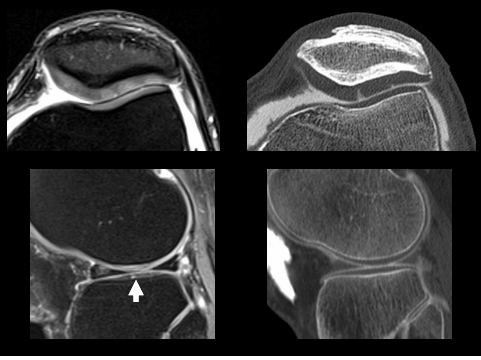
- Dépend du stade de la maladie cartilagineuse
- Arthrose: la radiographie reste la référence
- Maladie débutante:
  - IRM pour détecter la chondropathie infra-radiologique
  - IRM pour faire le bilan des pathologies articulaires (explication de la symptomatologie douloureuse)
- Cas particuliers: bilan pré-prothétique
  - IRM vs. arthro-CT

Quelle technique?



2D Int. FS | 3D DESS | Arthro-CT

Quelle technique?



1.5 vs. 3T?

- À 3T, on ne constate pas d'augmentation de la sensibilité de détection des lésions chondrales des séquences FSE conventionnelles (69 % à 1,5T contre 71 % à 3T),
- Mais une augmentation de la spécificité (78 % à 1,5T contre 86 % à 3T).

Kijowski R. Radiology. 2009

arthro-CT vs. IRM/arthro-IRM

	Se CT	Se MR	Sp CT	Sp MR
Vande Berg (2002) **2 / 1.5T**	85-94	76-91	94	84
Waldt (2005) **16 / 1.5T**	87	85	94	95
Li (2009) **64 / 3T**	84	87	99	97

arthro-CT vs. IRM/arthro-IRM

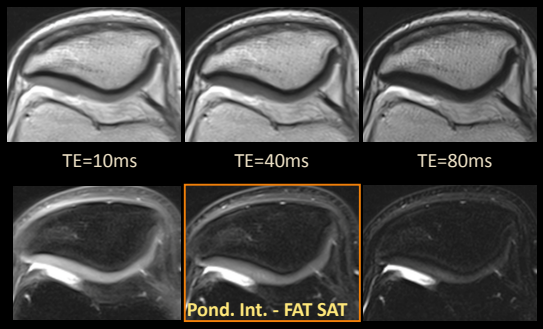
- En pratique clinique, l'arthro-scanner permet un niveau de confiance plus élevé pour la détection des lésions de surface grâce à:
  - artéfacts de mouvement moins nombreux (acquisitions plus rapides),
  - excellent contraste entre l'iode intra-articulaire hyperdense et le tissu cartilagineux hypodense.
- Va probablement évoluer grâce aux récentes avancées techniques de l'IRM qui ont notamment permis d'augmenter sa résolution.

Quelle séquence?

La séquence idéale:

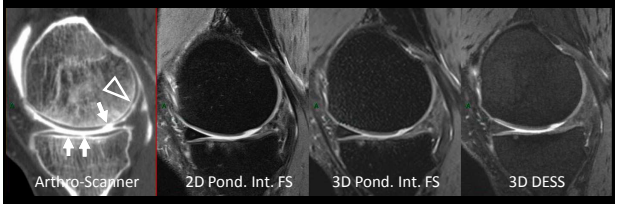
- bon contraste intra-chondral
- bon contraste cartilage/tissus avoisinants
- haute résolution (petites lésions, artéfact de troncature)
- acquisition 3D isotropique: s'adapte aux courbures de la surface cartilagineuse
- si possible permettre l'étude de l'ensemble des éléments de l'articulation.

Quelle séquence?



FAT SAT: • gamme dynamique cartilage, • artéfact déplacement chimique

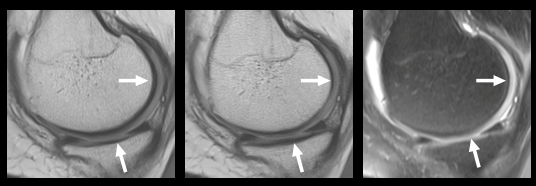
Quelle séquence?



En terme de performance diagnostique, la séquence 2D pond. Interm. FS reste la référence.

Reeder SB. AJR. 2003
Hargreaves BA. Magn Reson Med. 2003
Komaat PR. Osteoarthritis Cartilage. 2005
Jung JY. Radiology. 2013
Stevens KJ. Radiology. 2008
Gold GE. AJR Am J Roentgenol. 2007
Kijowski R. Radiology. 2009
Notohamiprodjo M. Invest Radiol. 2009
Van Dyck P. Skeletal Radiol. 2012

Artéfact de déplacement chimique



AP Tête-Pied

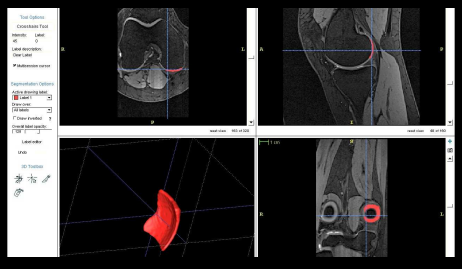
IRM: biomarqueur de la pathologie chondrale?

- Biomarqueur:

"Un biomarqueur est une caractéristique biologique mesurable, utilisé comme indicateur de processus biologiques normaux, pathologiques ou de réponses à une intervention thérapeutique."

IRM: biomarqueur de la pathologie chondrale?

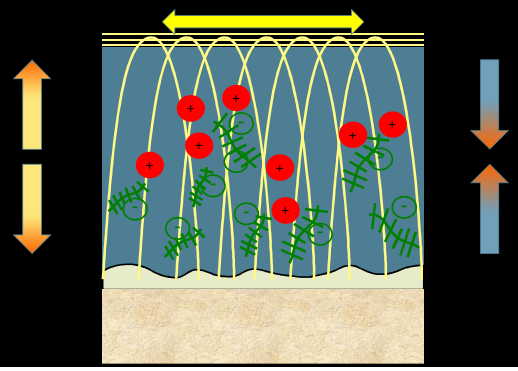
- Progression de la maladie
  - Evaluation volumétrique – segmentation



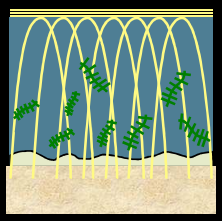
IRM: biomarqueur de la pathologie chondrale?

- Progression de la maladie
  - Evaluation volumétrique – segmentation
- Diagnostic au stade précoce de la maladie
  - Techniques d'IRM compositionnelle
    - T2 map
    - T1 rho
    - dGEMRIC
    - Na+ imaging
    - Diffusion imaging
    - CEST

Propriétés biomécaniques ←→ structure



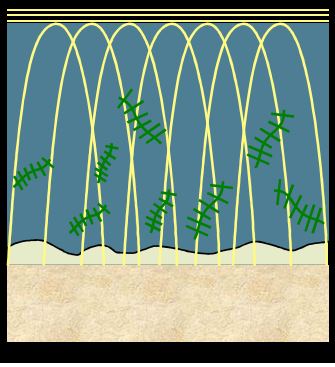
Dégénerescence du cartilage



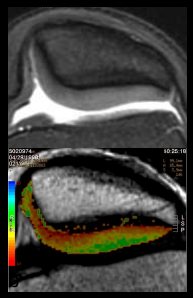
- Phase précoce: destruction et déplétion en protéoglycanes → augmentation de la mobilité et du contenu en H_2O
- Phase tardive: destruction et déplétion en collagène

Potter 2009; Mosher ISMRM 2009

ETUDE DU COLLAGENE



ETUDE DU COLLAGÈNE: cartographie T2

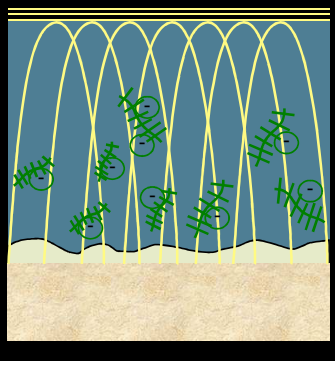


Le temps de relaxation T2 du cartilage dépend de
- contenu en eau et en collagène,
- organisation du collagène
- indépendant du contenu en protéoglycanes.

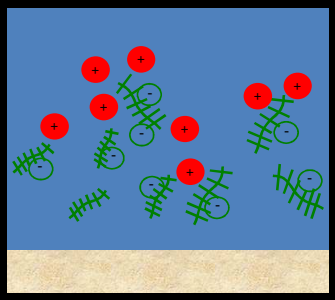
→marqueur sensible aux changements précoces du contenu en eau et de l'infrastructure en collagène.

Temps d'acquisition relativement courts, possible in vivo sur les IRM cliniques.

ETUDE DES PROTEOGLYCANES

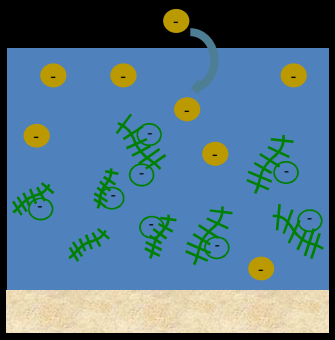


ETUDE DES PROTEOGLYCANES: IRM du sodium



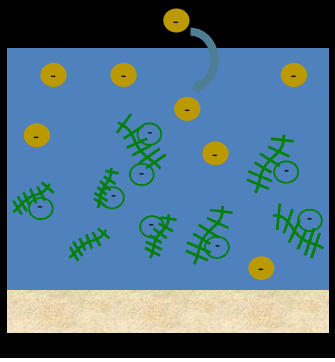
Limites techniques:
- matériel spécifique
- moindre rapport signal sur bruit comparé à l'IRM protonique (moindre densité du sodium comparée à l'hydrogène)
- temps d'acquisition longs

ETUDE DES PROTEOGLYCANES: dGEMRIC



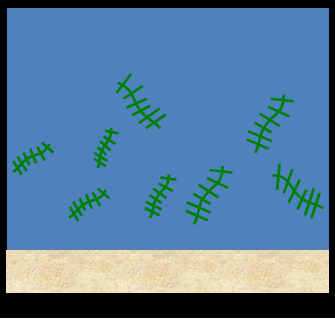
dGEMRIC (delayed Gadolinium Enhanced Magnetic Resonance Imaging):
- injection intraarticulaire
- diffusion dans le cartilage
- équilibre en quantité inversement proportionnelle à la charge négative fixe
- concentration locale de Gd-DTPA2- = principal déterminant du T1 → les mesures du T1 vont être le reflet du contenu en GAG à travers le cartilage

ETUDE DES PROTEOGLYCANES: dGEMRIC



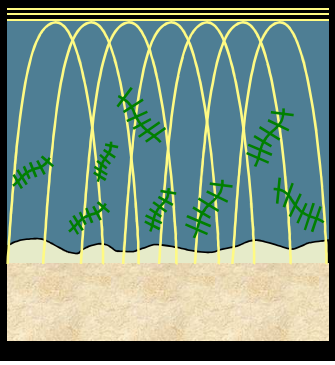
Limites:
- injection intraveineuse d'une double dose de produit de contraste
- mobilisation articulaire pendant 10 minutes
- long délai (de 30min à 3 heures en fonction de l'articulation) jusqu'à ce que le produit de contraste diffuse au sein du cartilage

ETUDE DES PROTEOGLYCANES: T1rho

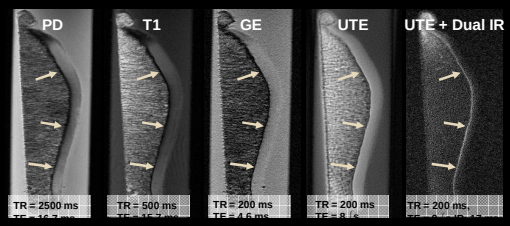


- temps de relaxation spin-réseau dans un plan rotatoire
- reflet des interactions à basse fréquence entre les molécules d'eau à mouvement restreint et les molécules de haut poids moléculaire telles que les PG
- spécifique des PG?

ETUDE DES COUCHES PROFONDES



ETUDE DES COUCHES PROFONDES: imagerie à TE ultra-court (UTE)



T2 variable en fonction de la profondeur:
- 30-40ms dans les couches superficielles
- 1-2ms dans les couches profondes

Couches profondes: rôle dans les phases précoces de la physiopathologie de l'arthrose + processus de réparation chondrales.

LITERATURE

- In vitro
- In vivo (T2 maps, dGemric)
  - Normal values
  - Age
  - Physical activity
  - Normal vs. OA

Roemer FW. Radiology (2011)
Crema MD. Magn Reson Imaging Clin N Am (2011)

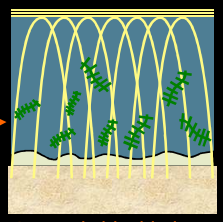
LIMITES

- Chronophage:
  - Acquisition
  - Post-processing
- Pas de validation entre techniques, entre plateformes, multicentriques

CONCLUSION

Imagerie morphologique

Imagerie du cartilage en pratique clinique= morphologique
•IRM: technique de choix, arthroCT si non réalisable
• mais stade irrévesible
•Rx: référence pour l'arthrose



Imagerie biochimique

Imagerie du cartilage en recherche= morphologique

→ diagnostic précoce / ttt préventif
→ suivi des techniques de réparation