

FRACTURES ET ENTHESOPATHIES DE STRESS DES SPORTIFS ET DES ADOLESCENTS

Dr E FUMIERE

CHU CHARLEROI *ULB*





Fractures de déséquilibre

Fractures de stress

Os: N
Force physique: aN

Fractures d'insuffisance

Os: aN
Force physique: N

Définition:

Fracture de contrainte : Forces > Résistance OS

F fatigue ou de stress : sur os normal , contraintes excessives

Nbx def : Mc Bryde (1976) :” *la fracture de fatigue est une fracture complète ou partielle d'un os , incapable de supporter des contraintes non-violentes , exercées de façon rythmée, répétée et avec une intensité inférieure au seuil fracturaire .*”

F par insuffisance osseuse : sur os fragilisé , contraintes normales ou légèrement excessives

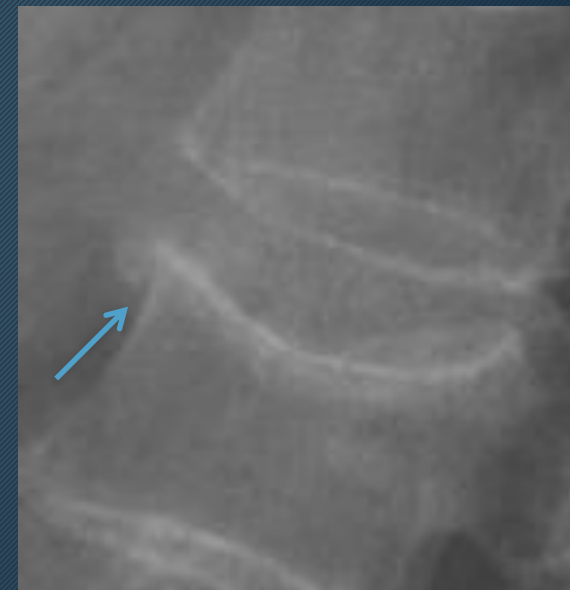
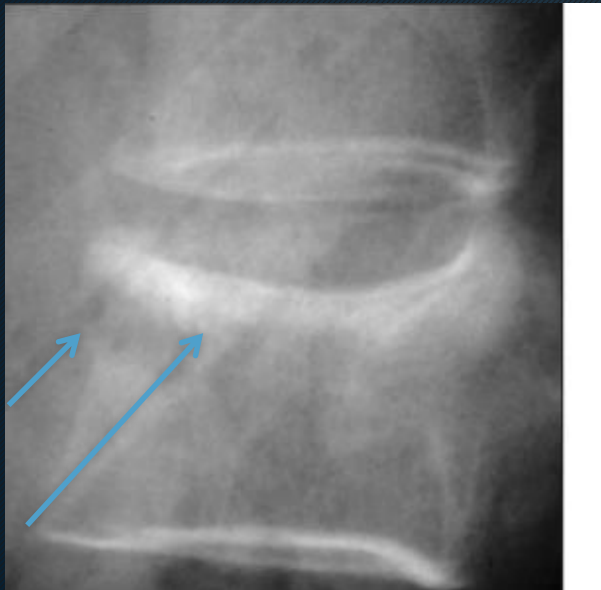
Colonne vertébrale:

TASSEMENT RECENT:

- Interruption corticale
- Decrochage cortical
- Densification sous corticale
- Œdème en IRM
- Fixation scintigraphique

TASSEMENT ANCIEN (cfer old exam!):

- continuité corticale
- Eventuelle ostéophytose
- Absence densification sous corticale
- Signal graisseux en IRM
- Pas/peu fixation scintigraphique



AJR:183, October 2004, 949-958 **Diagnosis of Osteoporotic Vertebral Fractures: Importance of Recognition and Description by Radiologists**
Leon Lenchik¹, Lee F. Rogers^{1,2}, Pierre D. Delmas³, Harry K. Genant⁴

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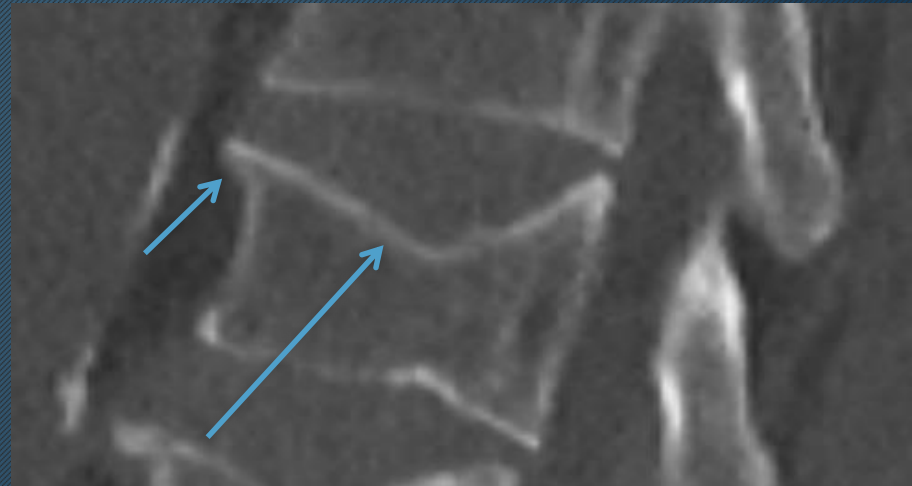
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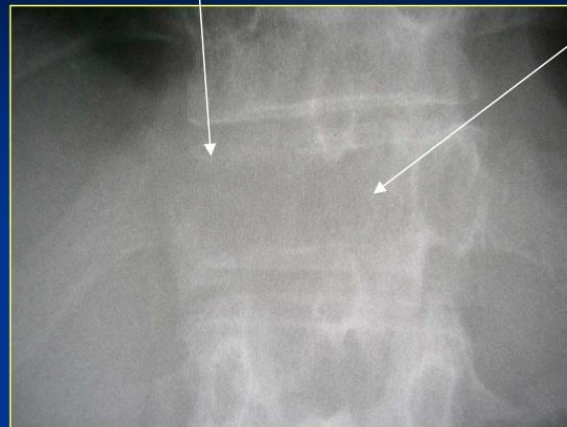
TASSEMENT BENIN:

- Siège dorso lombaire
- Multiple, avec anciens
- Atteinte centrale et symétrique
- Respect des corticales
- Conservation du mur postérieur
- Respect de l'arc postérieur
- Spongieux d'aspect normal en dehors de la FV
- Clarté gazeuse au sein de la fracture
- Absence de fuseau para vertébral

TASSEMENT MALIN:

- Au dessus de T5
- Souvent unique
- FV >50% de la hauteur vertébrale
- FV latéralisée sur le cliché de face
- Effacement des corticales osseuses
- Rupture du mur postérieur
- Lyse de l'arc postérieur (vertèbre borgne)
- Spongieux lysé à distance du foyer de FV
- Masse para vertébrale

Vertèbre borgne: atteinte d'un pédicule



Rarefaction spongieuse

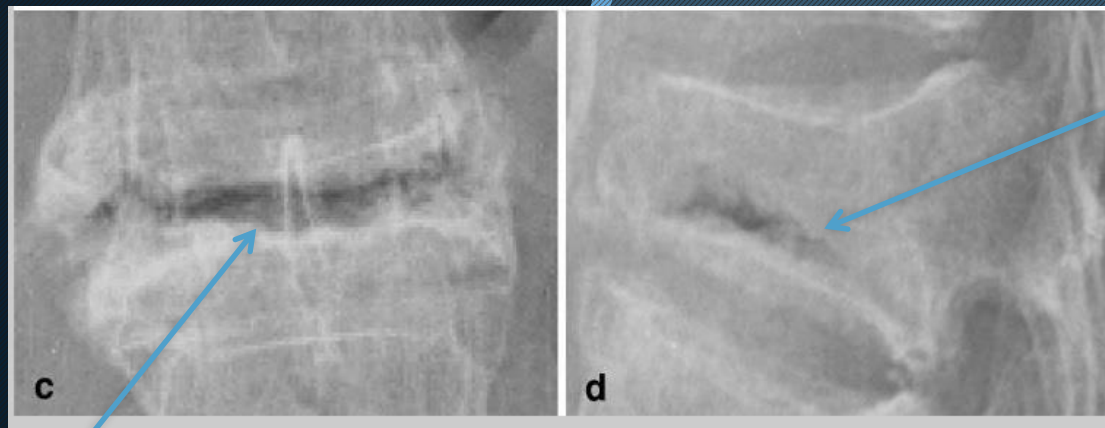
Colonne vertébrale:

TASSEMENT BENIN:

- Densité aérique intrafracturaire
- Décrit en 1891 par Herman Kümmell
- Entité tassement différencié post trauma sur ostéonécrose
- Mentionné par d'autres auteurs dont Maldague comme post nécrose
- Signe décrit comme argument bénin

TASSEMENT MALIN:

- « Pas de densité aérique »
- Shang-Wen Feng: revue
 - 328 ostéoporoses
 - 317 infections vertébrales
 - 302 métastases
 - 325 Myélomes multiples
 - Occurrence vacuum: 18,9%
 - 1! Infection
 - 0 M+
 - 6,4% MM



Eur Spine J (2011) 20:1341–1348 . Are intravertebral vacuum phenomena benign lesions?
Shang-Wen Feng , Ming-Chau Chang , Hung-Ta Wu , Jung-Kuang Yu •, Shih-Tien Wang •, Chien-Lin Liu

Radiology 1978;1 29:23-29. The intra- vertebral cleft sign of ischemic vertebral collapse.
Maldague BE, Noel HM, Malghem JJ.

Colonne vertébrale: IRM

TASSEMENT BENIN:

- Siège dorso lombaire
- Multiple, avec anciens
- Conservation du mur postérieur
- Respect de l'arc postérieur
- Spongieux d'aspect normal en dehors de la FV
- Pas de masse paravertébrale
- Liséré fracturaire visible en T2



TASSEMENT MALIN:

- Envahissement corporel global hypoT1++(inf disque)
- Effacement des corticales osseuses
- Rupture ou convexité du mur postérieur
- Envahissement de l'arc postérieur
- Masse para vertébrale



Colonne vertébrale: IRM

TASSEMENT MALIN VERSUS BENIN:

- Diffusion: ADC supérieur qd bénin (mais overlap...)
- Séquence Out-In phase (chute plus importante out si bénin car graisse persistante)
- Perfusion: +G (perfusion ↗ si malin)



AJR:199, November 2012; 1083-92. **Comparison of Qualitative and Quantitative Evaluation of Diffusion-Weighted MRI and Chemical-Shift Imaging in the Differentiation of Benign and Malignant Vertebral Body Fractures** T. Geithl, G. Schmidt, A. Biffar, O. Dietrich, H.R. Dürr, M. Reiser, A. Baur-Melnyk

AJNR 27 (6) 2006, 1183–1188. **The utility of in-phase/opposed-phase imaging in differentiating malignancy from acute benign compression fractures of the spine.** W.K. Erly, E.S. Oh and E.K. Outwater,

AJR:200, June 2013; 635-43. **Quantitative Analysis of Acute Benign and Malignant Vertebral Body Fractures Using Dynamic Contrast-Enhanced MRI.** T. Geithl, A. Biffar, G. Schmidt, S. Sourbron, H. R. Dürr, M. Reiser

Colonne vertébrale: Spondylolyse

Plusieurs étiologies incriminées:

- Dysplasique congénital (type I)
- Fracture de stress (type II)
- Dégénératif discal (type III)
- Traumatique (typ IV)
- Pathologique, néo, infect (type V)

Prévalence 3 à 6%

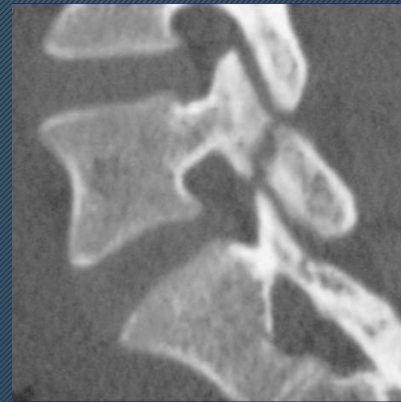
Prévalence 17,7% chez athlètes

Selon sport (plongeurs 63%, haltérophiles 36%, gymnaste 33%, lutteurs 33%

Prédominance masculine

Augmenté par la lordose

Augmenté par pente sacrée



Eur Spine J:2007;16:821-828. Lumbar spondylolysis: a life long dynamic condition? A cross sectional survey of 4151 adults Stig Sonne-Holm, al.

Global Spine J.: 2016;6:615-625. Athletic population with spondylolysis: review of outcomes following surgical repair or conservative management Pavlos Panteliadis, al.

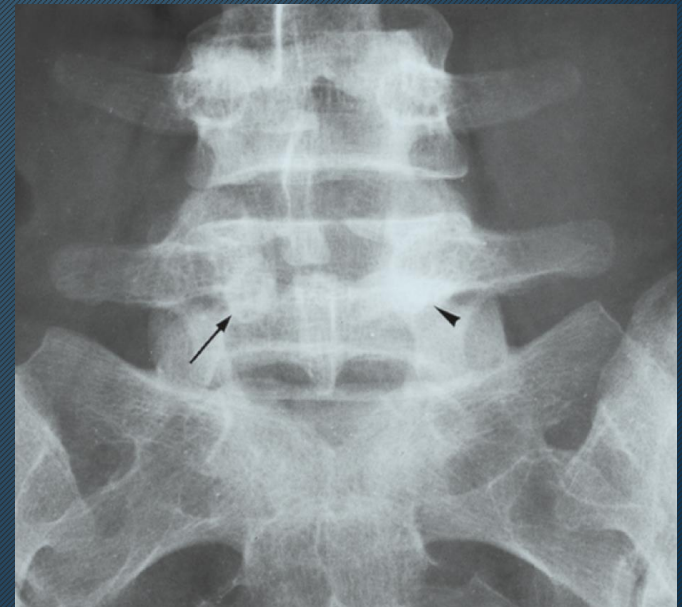
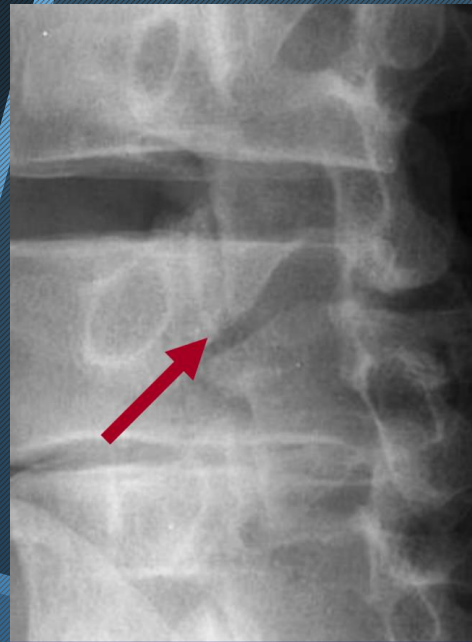
Colonne vertébrale: Spondylolyse

Signes directs:

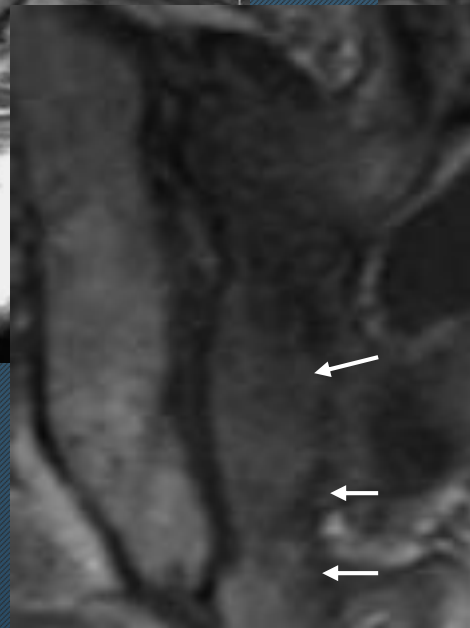
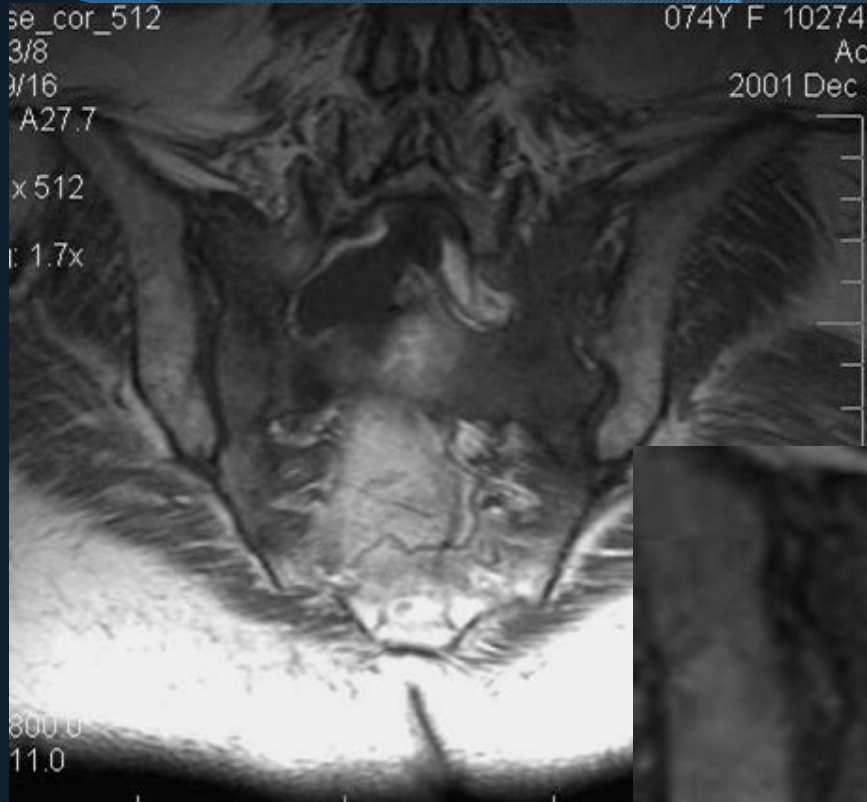
visualisation trait fracture CT
ou RX face-3/4

Signes indirects:

anisocorie pédiculaire par
condensation isthmique,
déviation épineuse,
élargissement distance mur
post- lame, hypersignal STIR

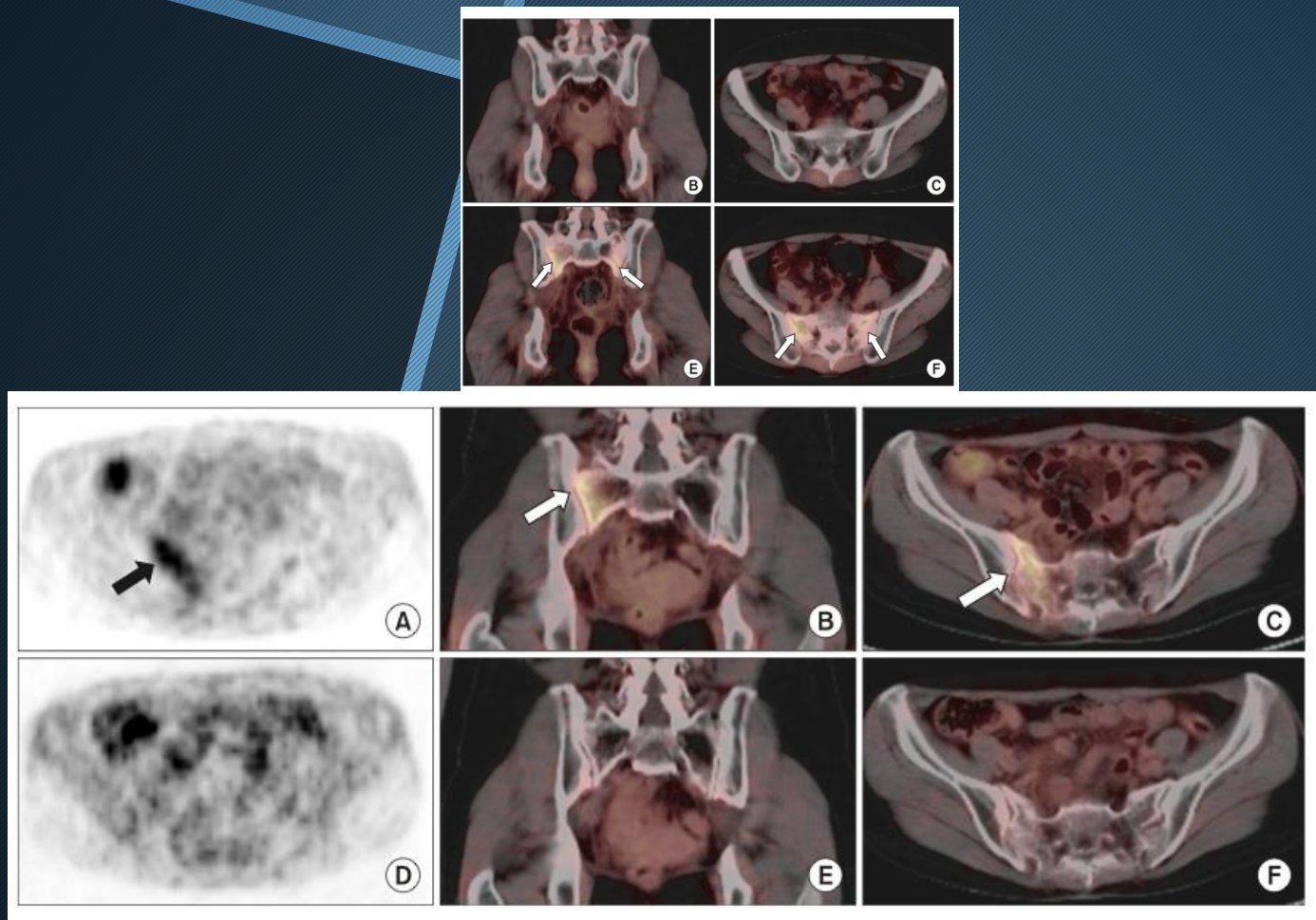


Fracture d'insuffisance du sacrum



AJR:45, September 1985;601-6. **Pubic and Sacral Insufficiency Fractures: Clinical Course and Radiologic Findings.** A. De Smet, J. R. Neff

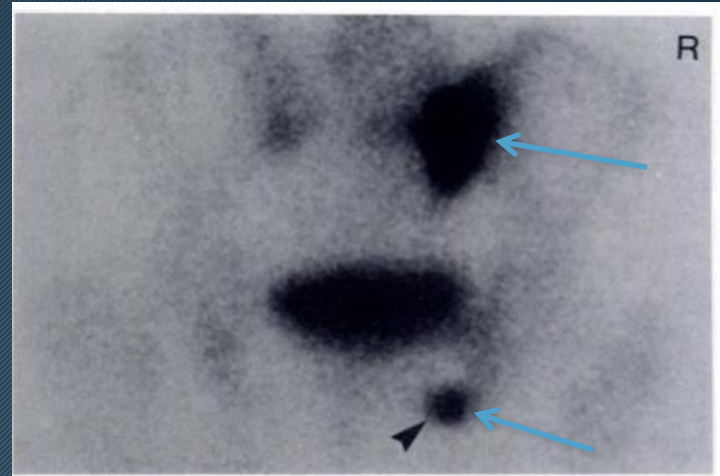
Pelvis:



Radiat Oncol J 2011;29(4):269-276 :Pelvic insufficiency fracture after radiotherapy in patients with cervical cancer in the era of PET/CT

Shin-Hyung Park, MD, Jae-Chul Kim, MD, Jeong-Eun Lee, MD, In-Kyu Park, MD

Pelvis:

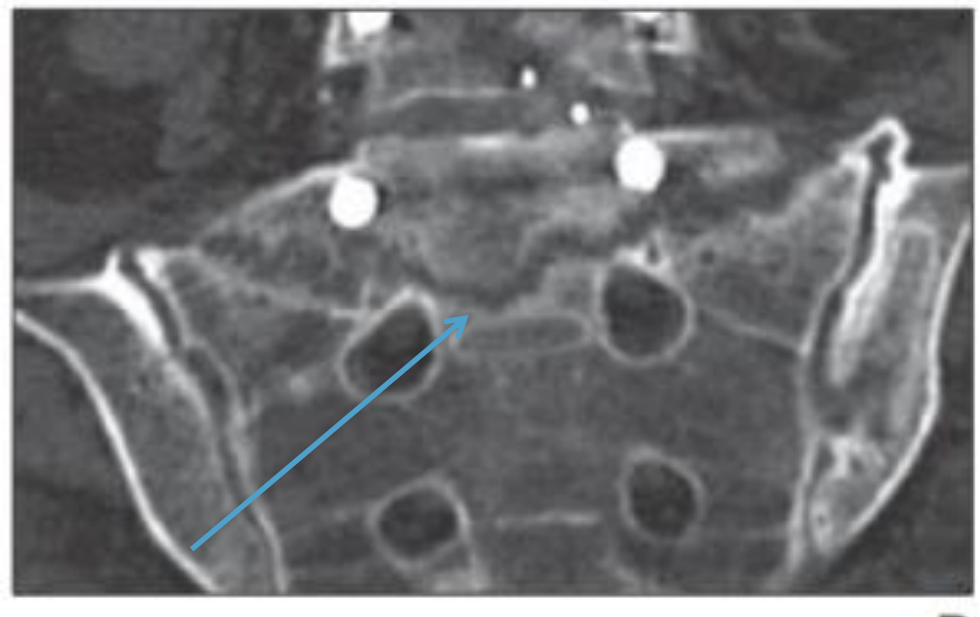
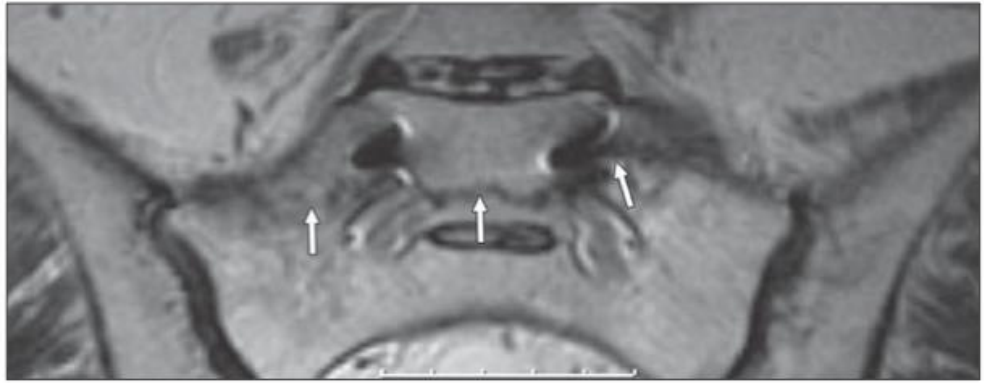


Skeletal Radiol 2009 Jan;38(1):43-9. Radiological features of superomedial iliac insufficiency fractures: a possible mimicker of metastatic disease. Donovan Al, Schweitzer ME, Rafii M, Lax A

Skeletal Radiol 1995 Jan;24(1):31-5.

Vacuum phenomena in insufficiency fractures of the sacrum. Stäbler Al, Beck R, Bartl R, Schmidt D, Reiser M

Pelvis:



AJR:197, July 2011; 184-88. **Sacral Fractures After Lumbosacral Fusion: A Characteristic Fracture Pattern.** G.E. Wilde, T. T. Miller, R. Schneider, F.P. Girardi

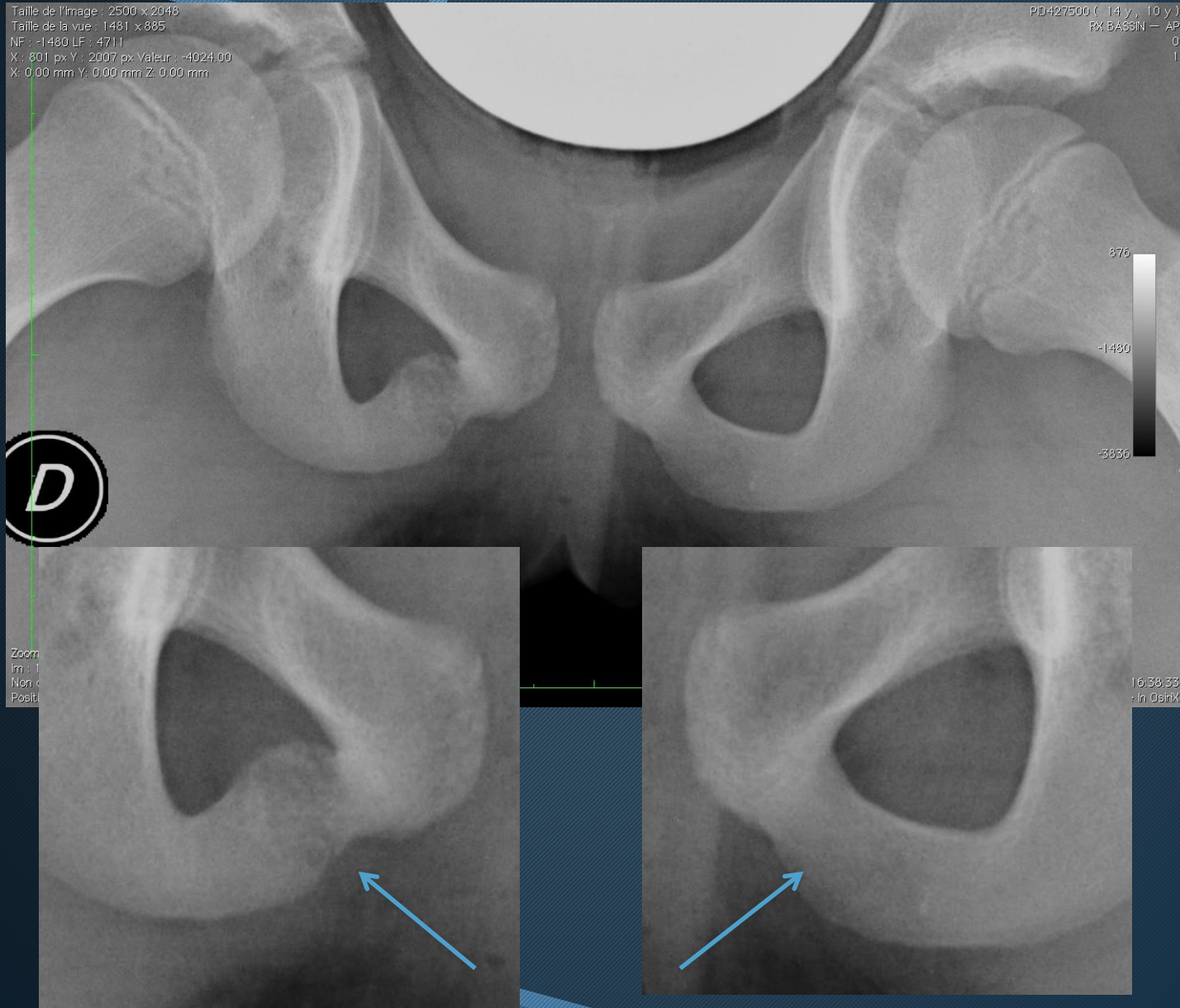
Pelvis:



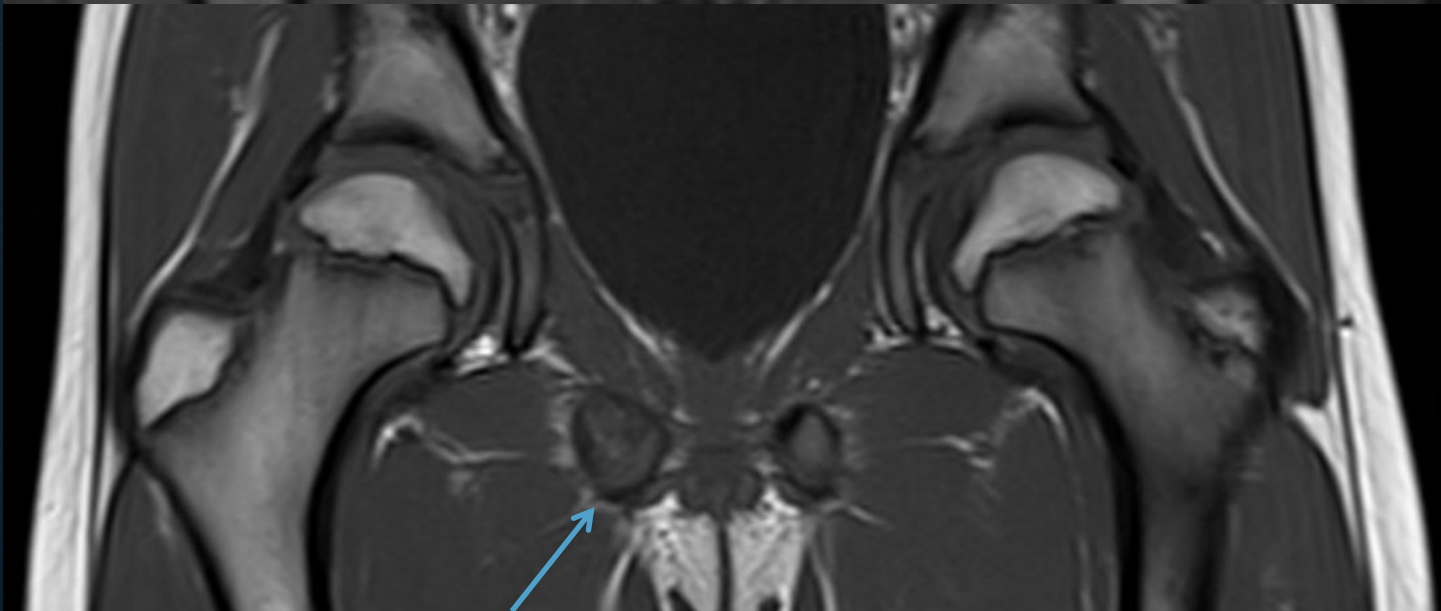
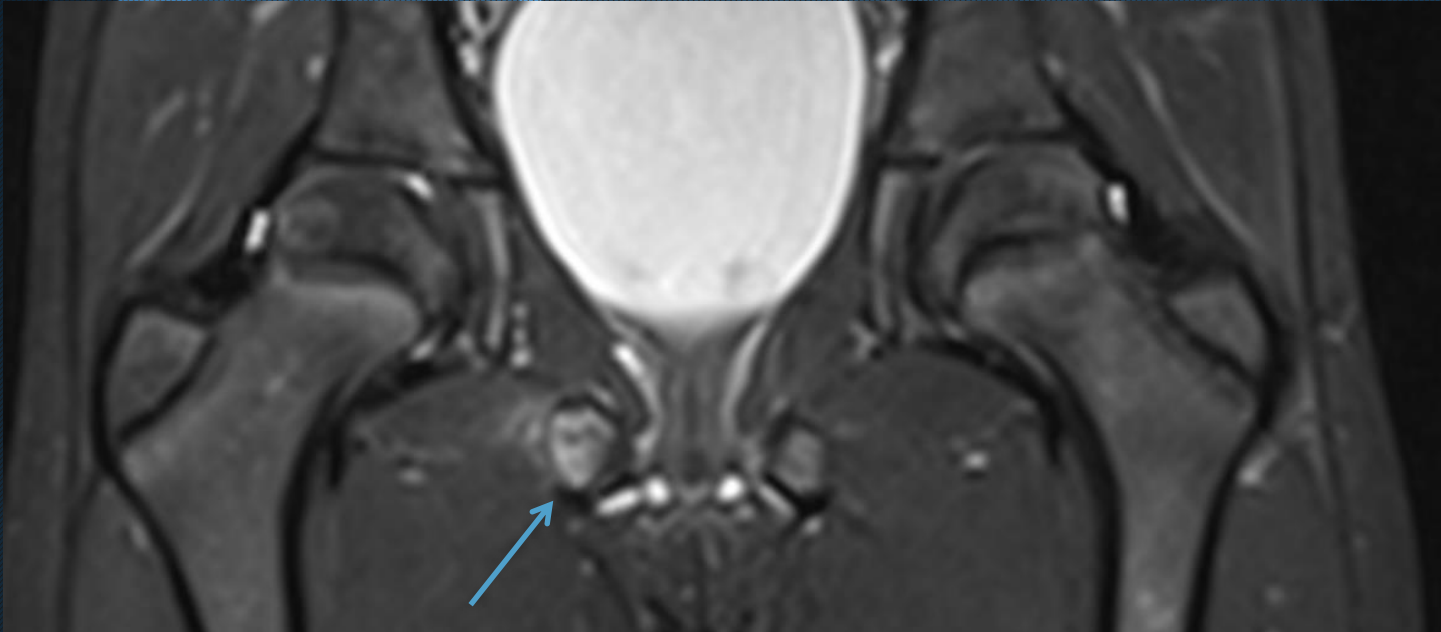
AJR: 174, March 2000; 727-29. **Sacral Stress Fractures in Long-Distance Runners.** N. M. Major, C. A. Helms

Pelvis:

Enfant de 10 ans: gymnaste

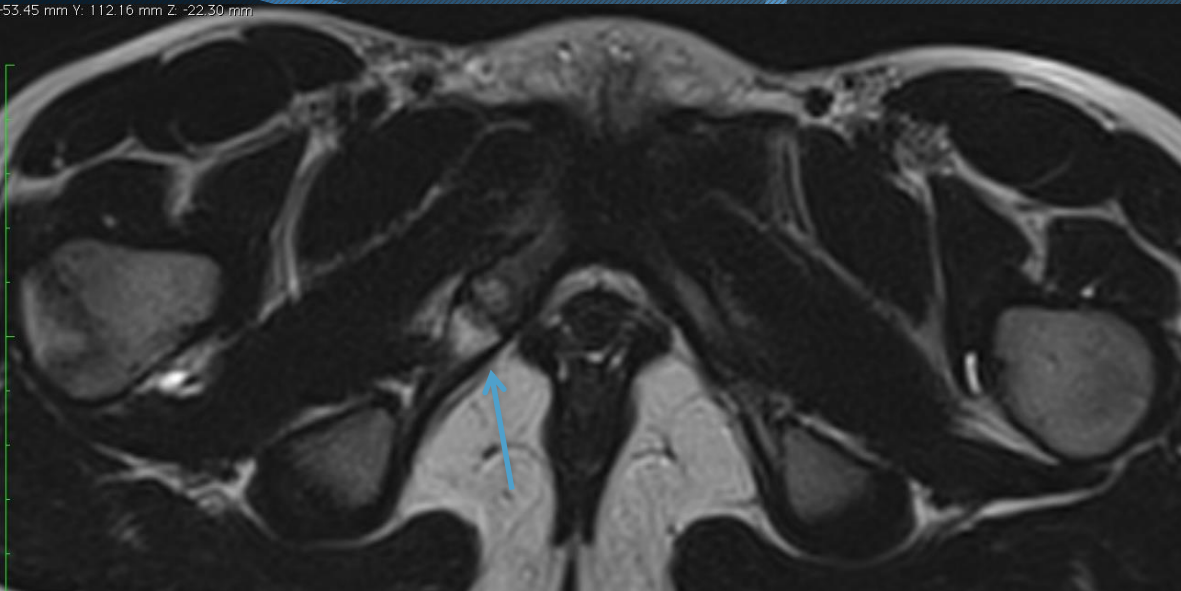


Pelvis:

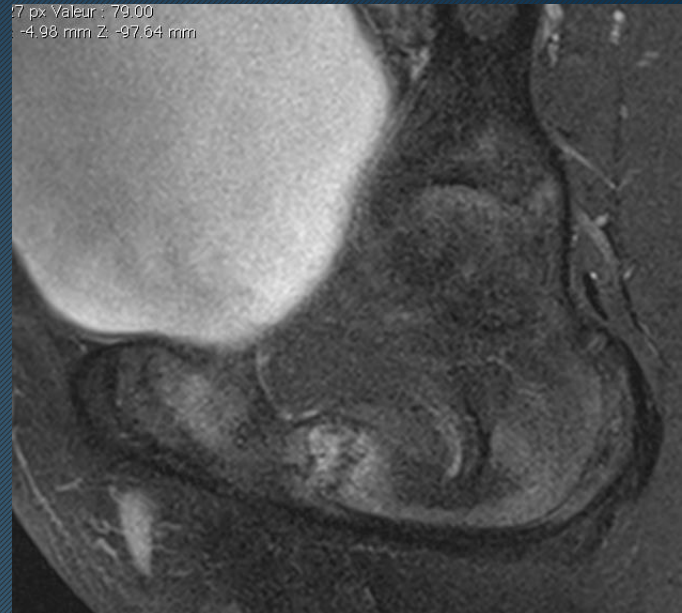


Pelvis:

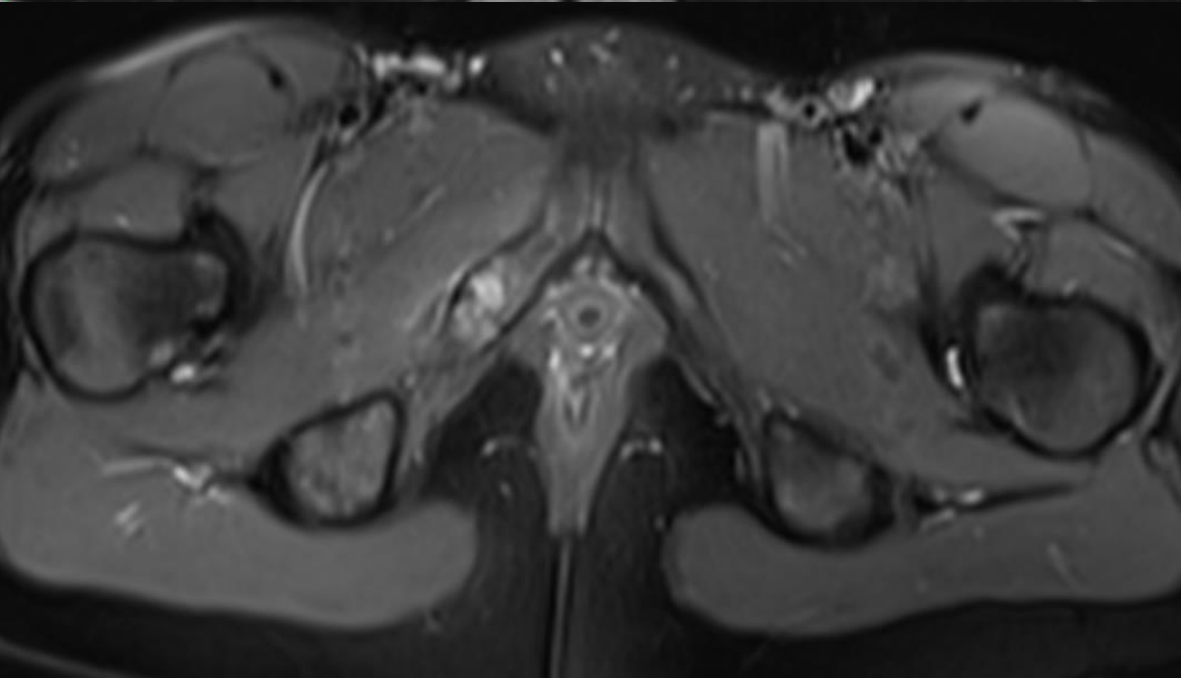
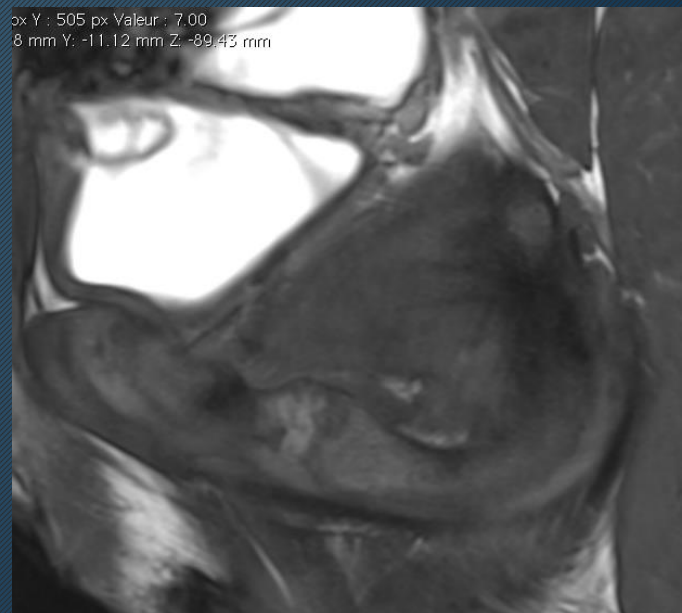
-53.45 mm Y: 112.16 mm Z: -22.30 mm



7 px Valeur : 79.00
-4.98 mm Z: -97.64 mm



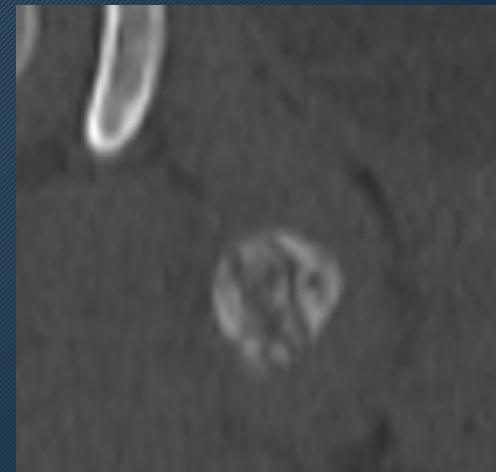
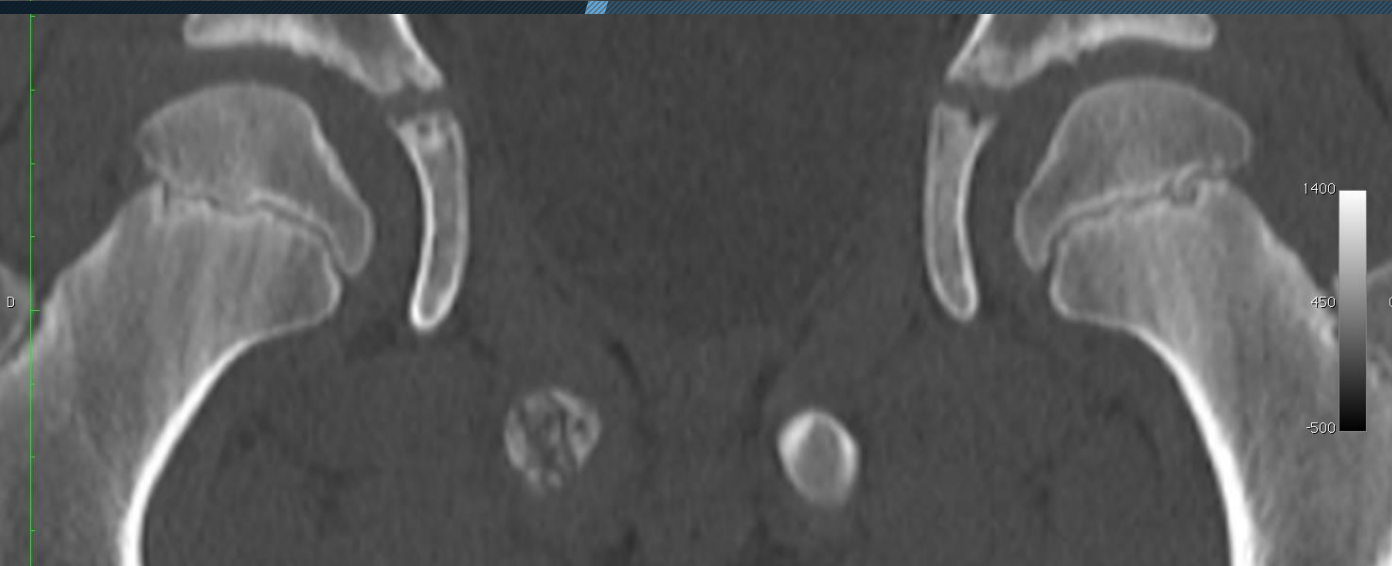
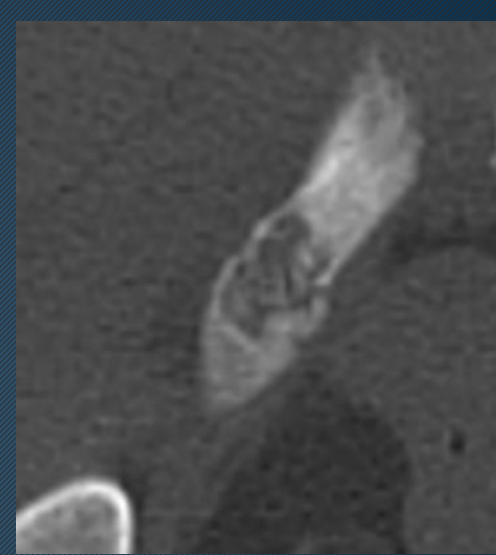
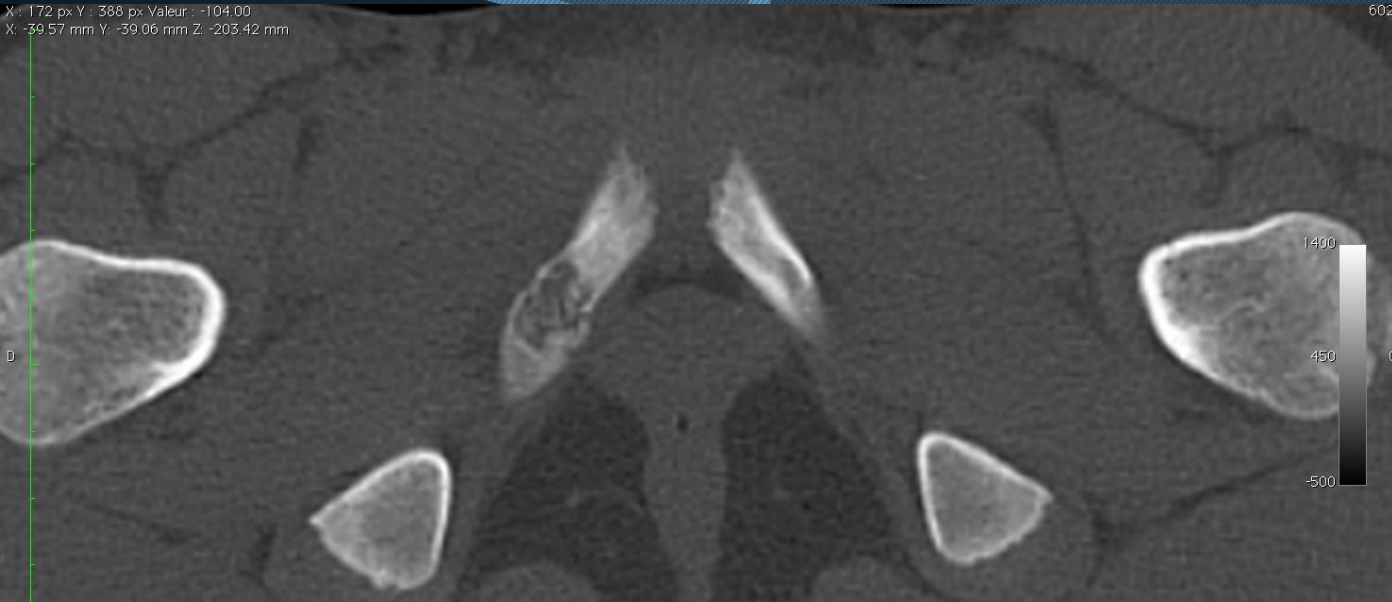
px Y : 505 px Valeur : 7.00
8 mm Y: -11.12 mm Z: -89.43 mm



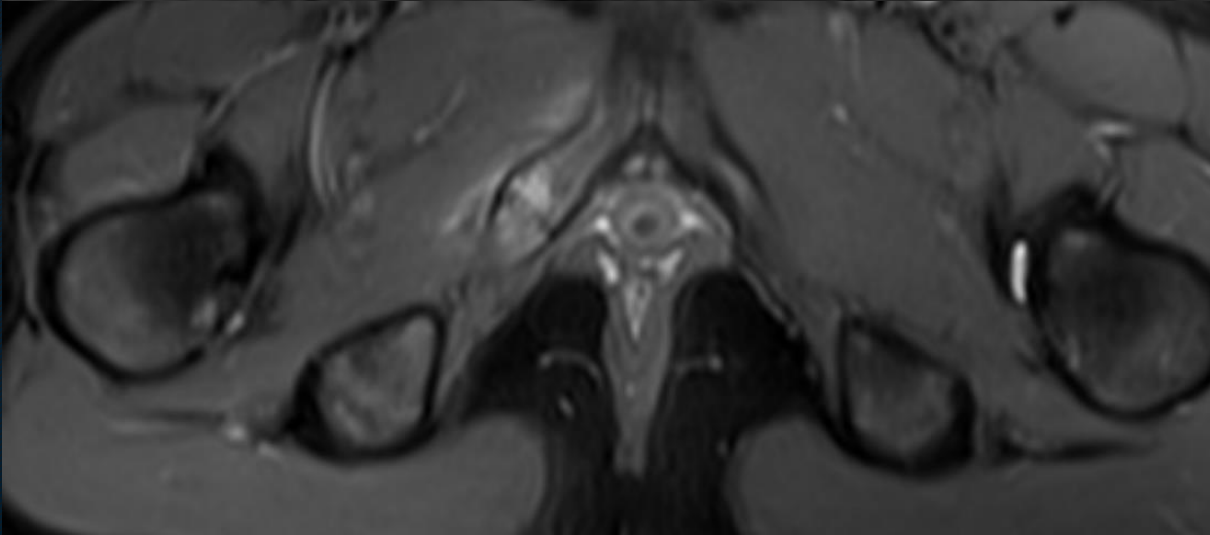
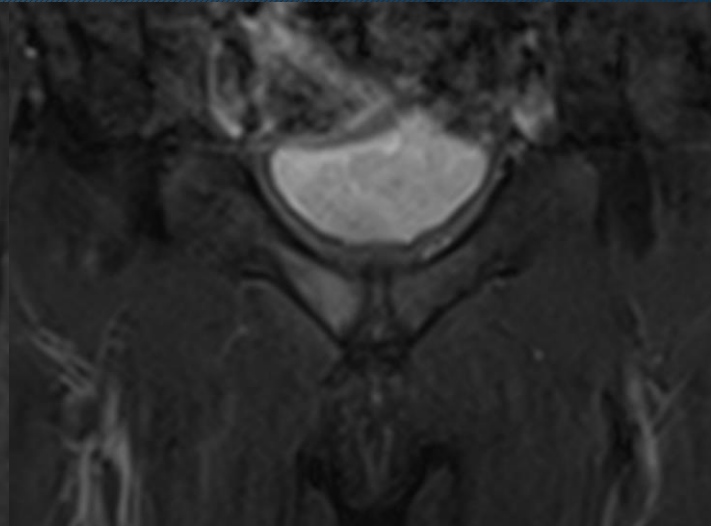
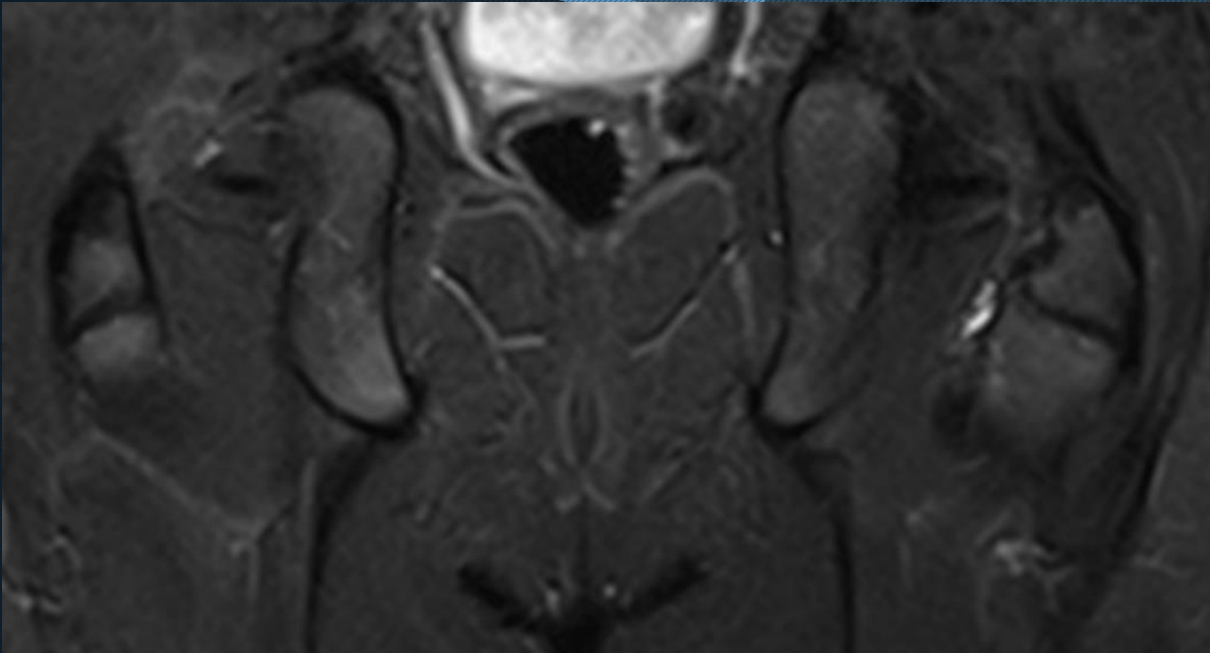
Pelvis:

X: 172 px Y: 388 px Valeur: -104.00
X: -39.57 mm Y: -39.06 mm Z: -203.42 mm

602



Pelvis:



Pelvis:

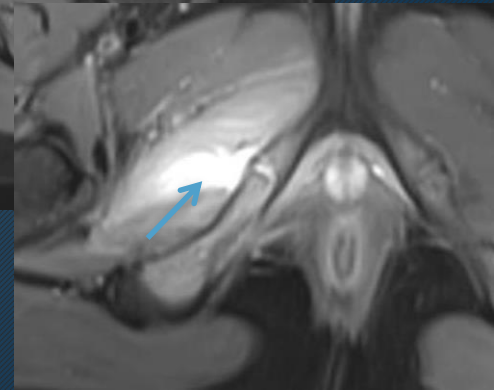
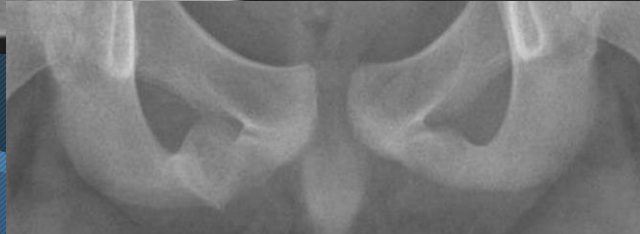
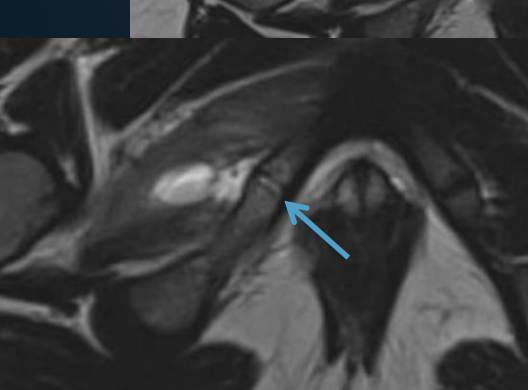
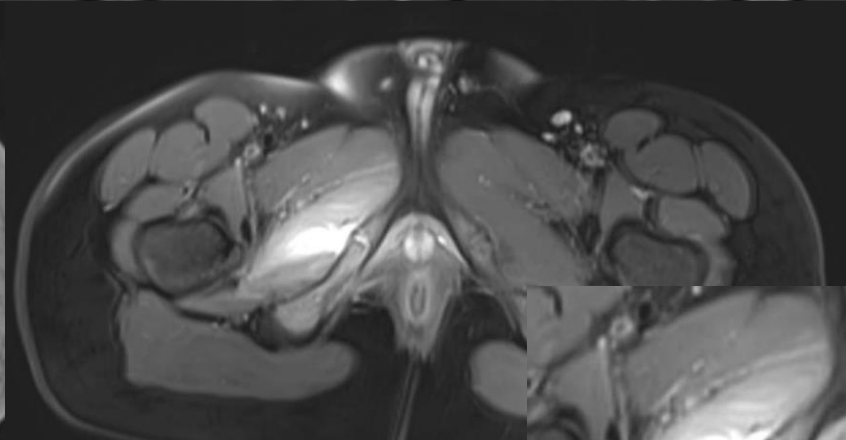
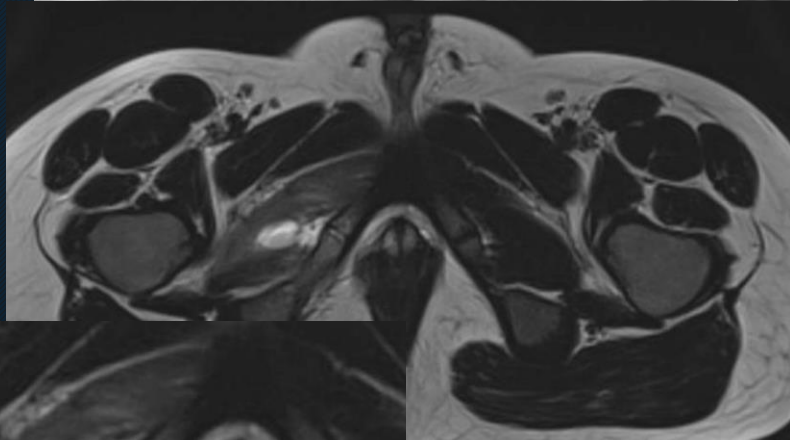
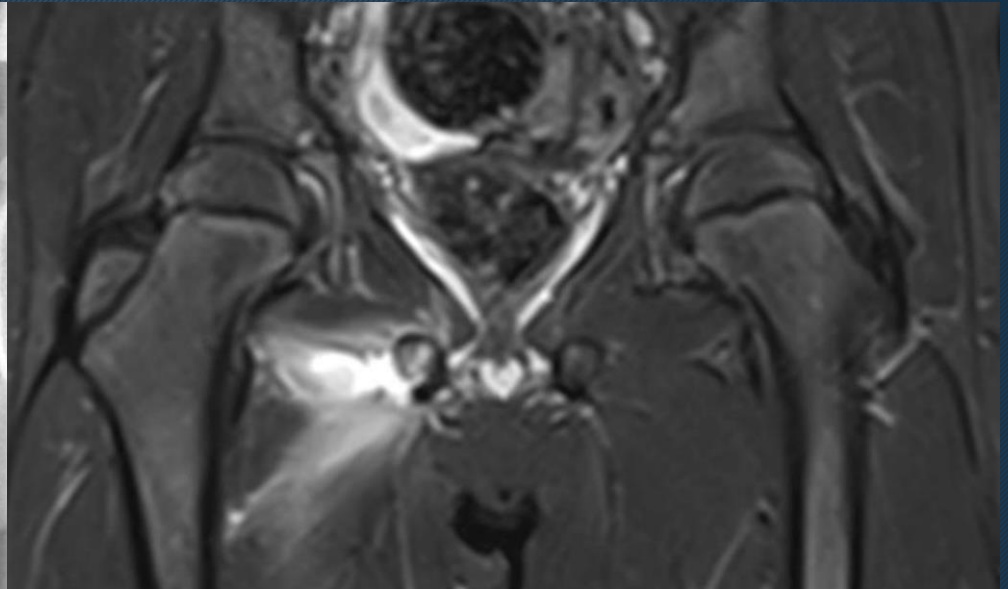
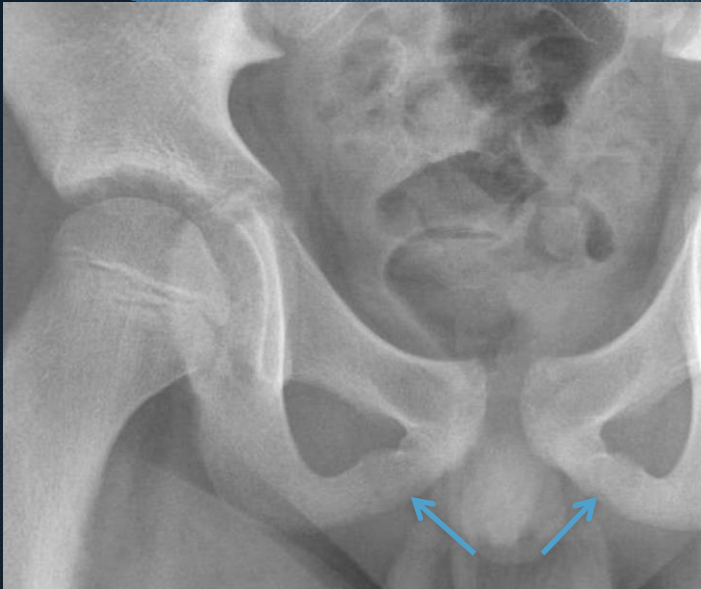
OSTEOCHONDROSE DE VAN NECK:

- Affection bénigne de l'enfant
- Hyperostose de la synchondrose ischiopubienne
- Confondu avec tumeur, ostéomyélite
- 20 patients entre 4-12 ans (moy:7ans)
- 10 ostéomyélites et 10 OVN
- En IRM, si ostéomyélite myosite, liquide ou abcès de voisinage pas dans OVN, biologie et clinique infectieuse ds ostéomyélite, plus d'hyperostose ds OVN

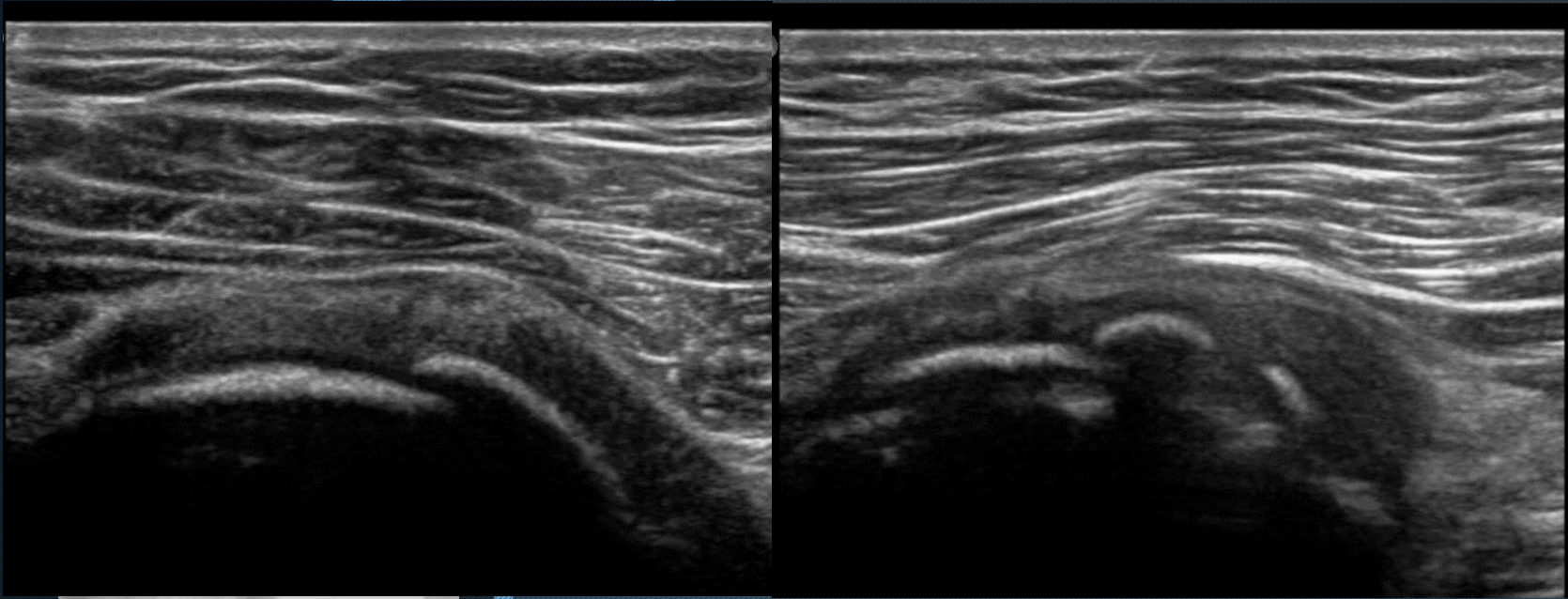
J Pediatr Orthop 2011 Jul-Aug;31(5):520-4

Van neck disease: osteochondrosis of the ischiopubic synchondrosis. Wait Al, Gaskill T, Sarwar Z, Bush M

Pelvis: OSTEOCHONDROSE DE VAN NECK VERSUS OSTEITE

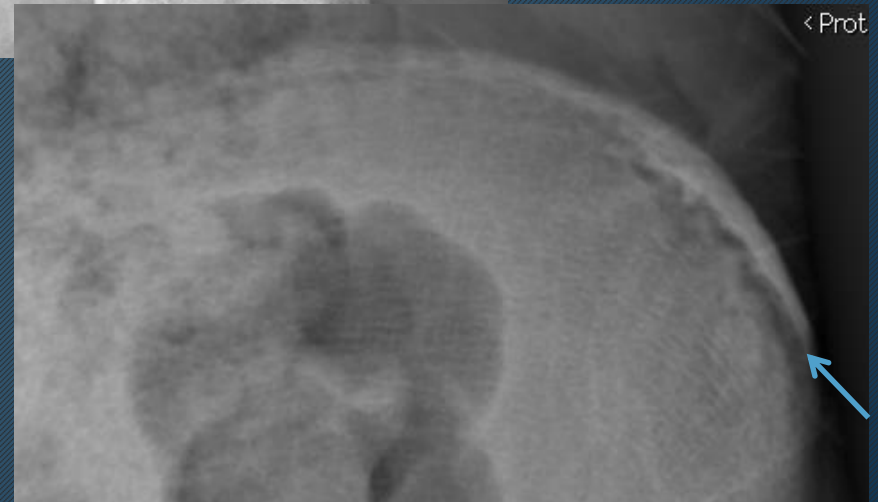
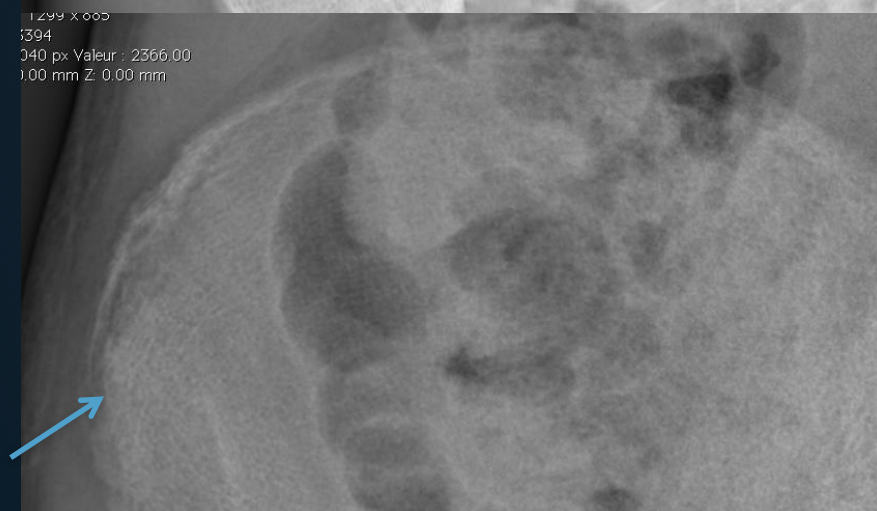
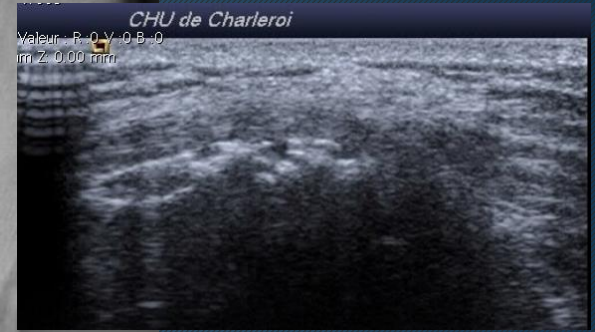


Pelvis:



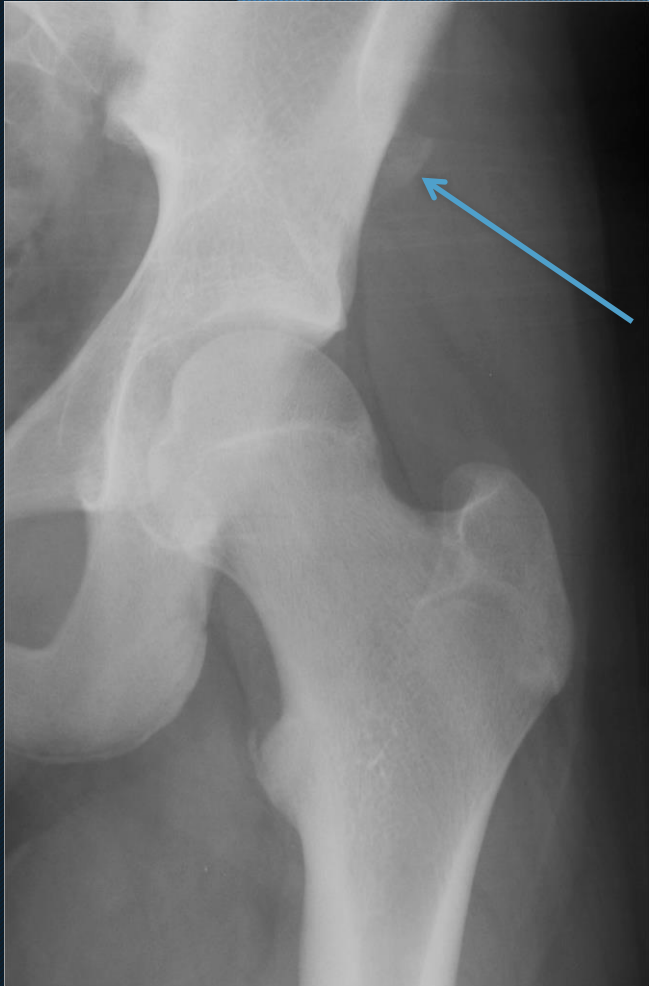
Enthésopathie ischion: tennis (US:
chronique, gymnaste (RX: aigu-avulsion)

Pelvis:



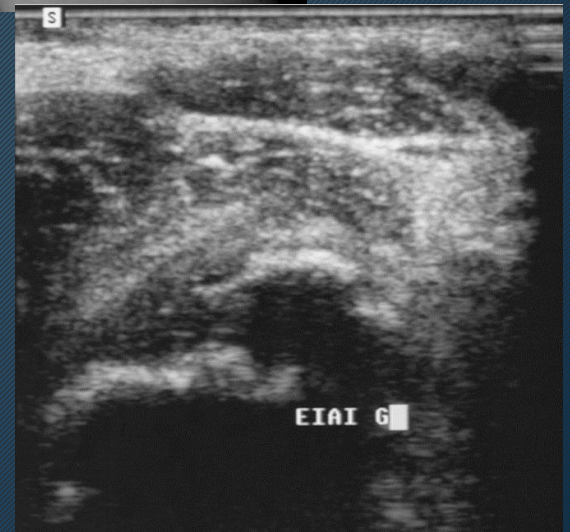
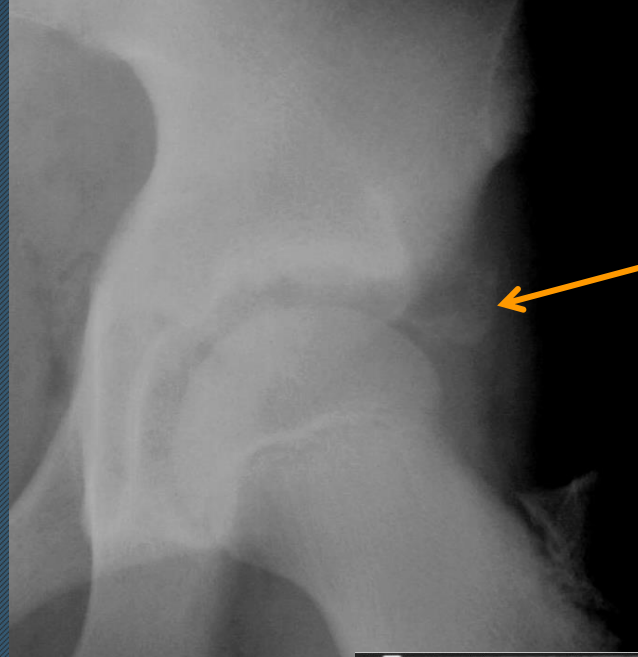
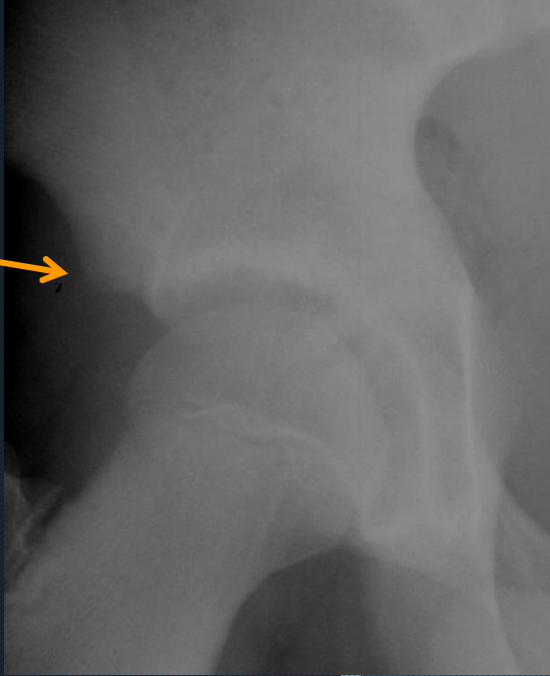
- Jeune footballeur.
- Insertion tenseur fascia lata sur aile iliaque

Pelvis-hanche:



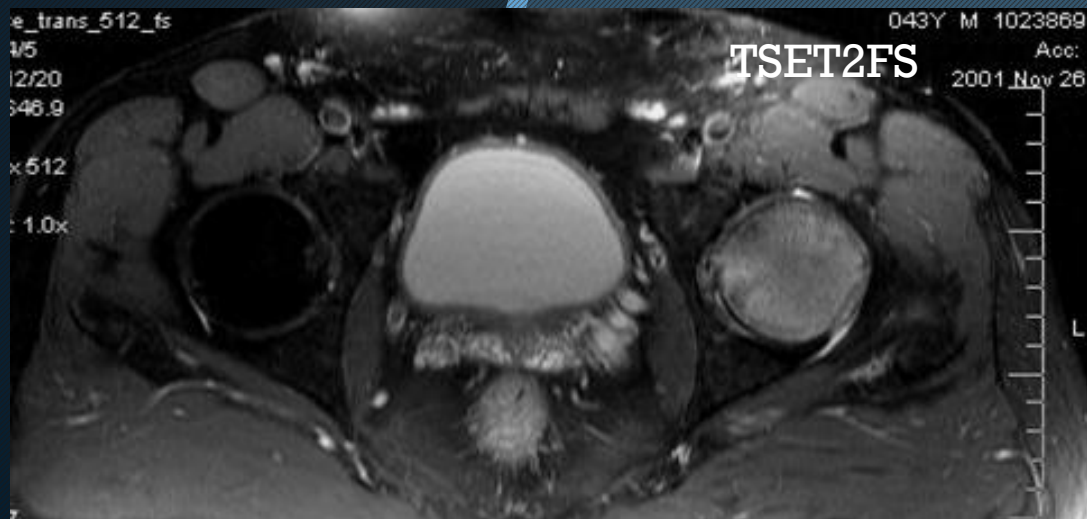
- Jeune footballeur.
- Insertion couturier sur EIAS

Hanche:



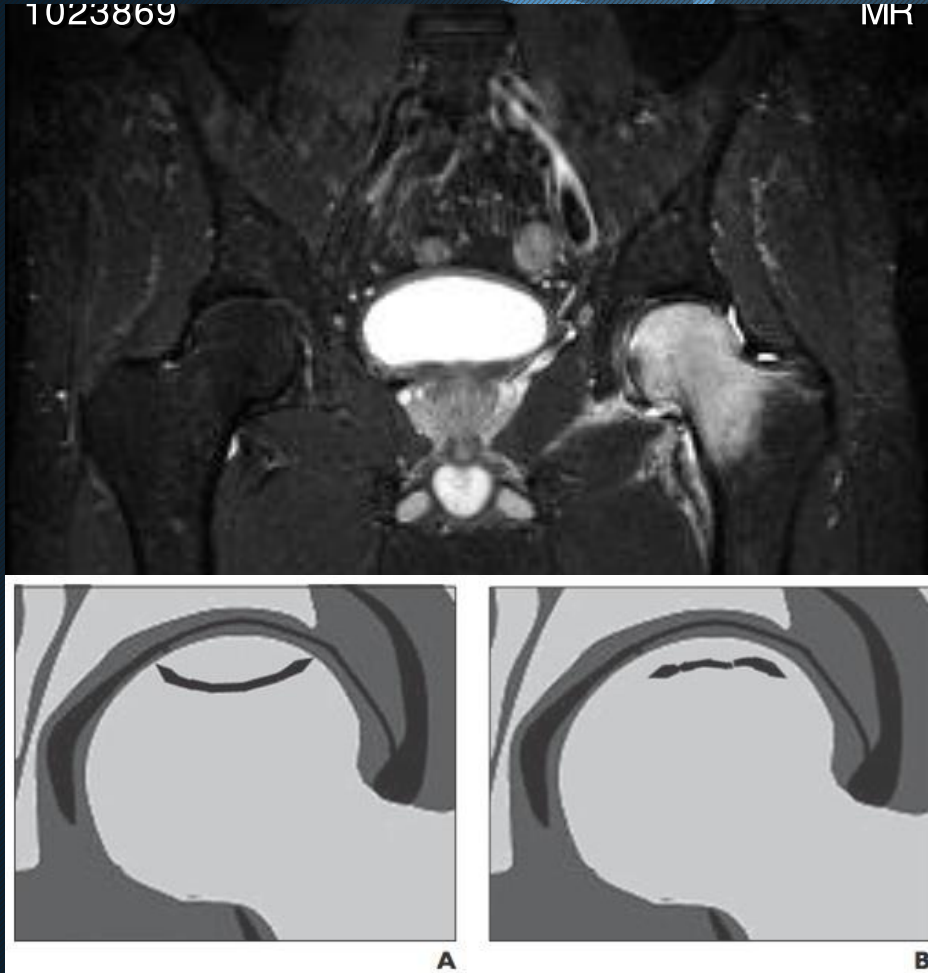
- Jeune footballeur.
- Insertion droit antérieur sur EIAI

Hanche:



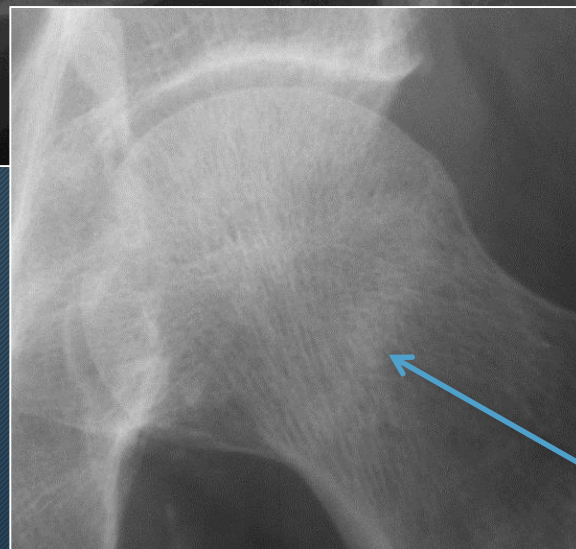
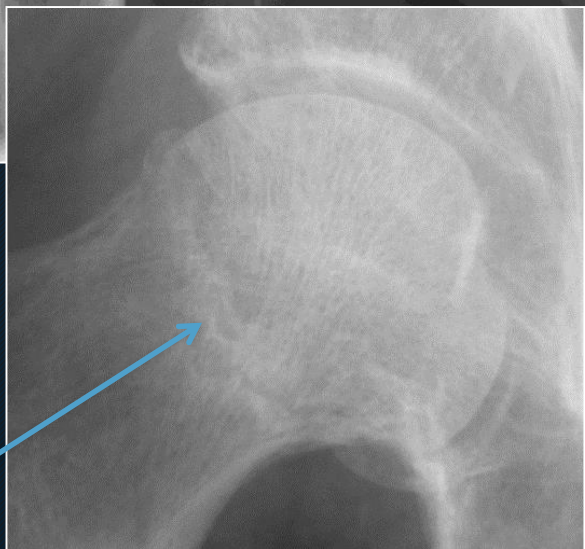
Oedème
transitoire de
la hanche

Hanche: œdème transitoire

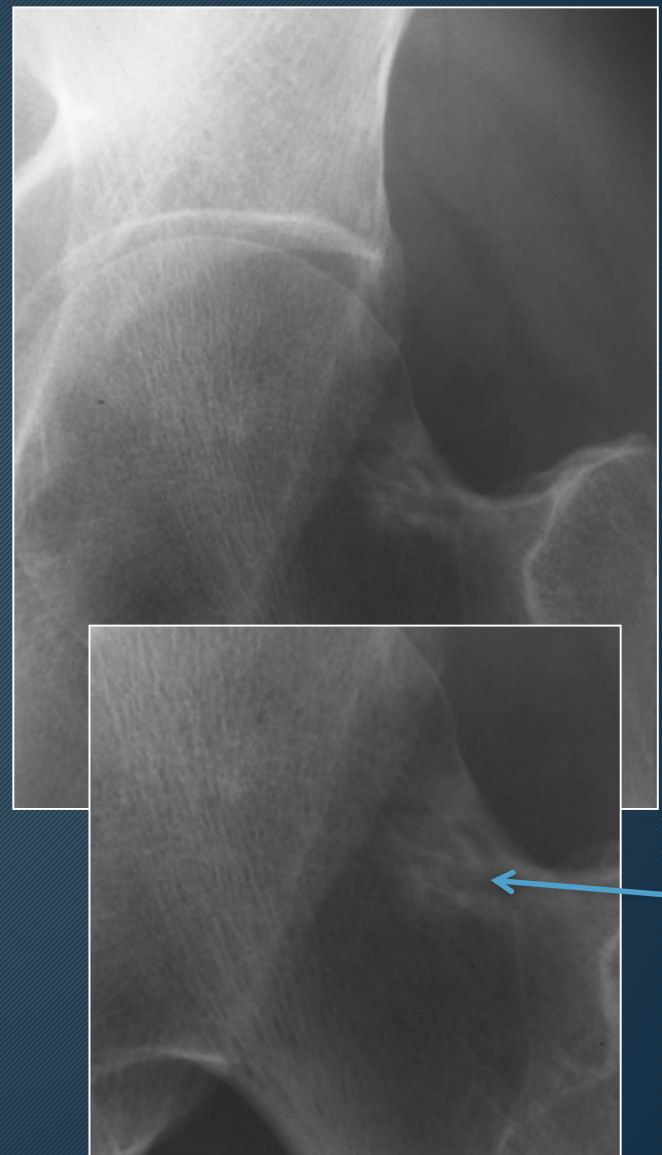


- Réversible
- Décrit 3^{ème} trimestre grossesse et post partum
- Aussi dénommé ostéoporose transitoire hanche
- Mécanisme inconnu: trauma microvasculaire, stress, trouble métabolique, hormonal

Hanche:

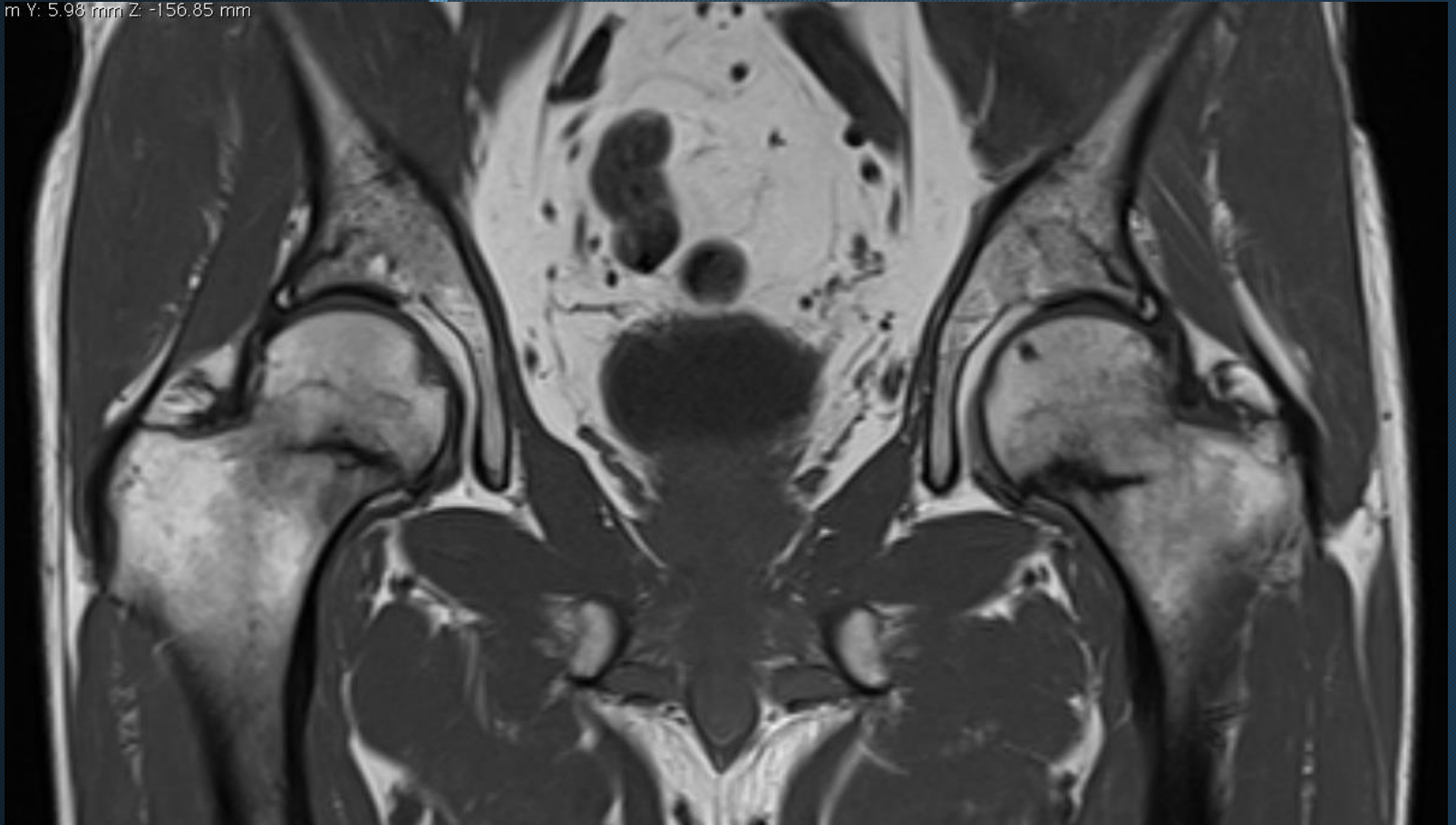


Hanche:

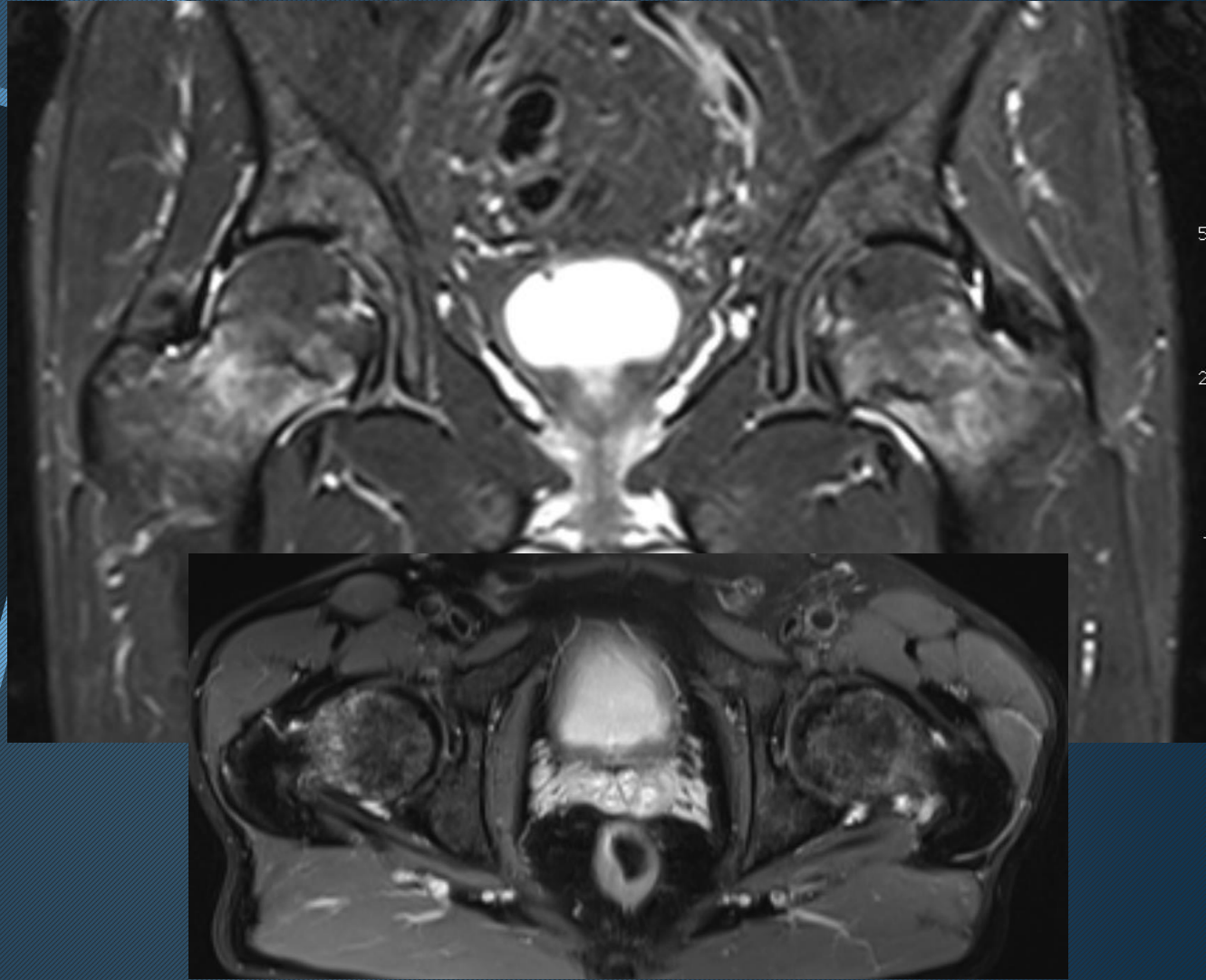


Hanche:

m Y: 5.98 mm Z: -156.85 mm



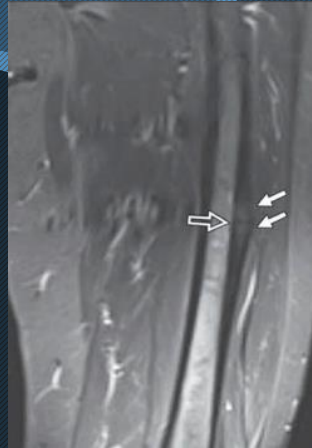
Hanche:



- Fracture de fatigue (+) ou d'insuffisance
- Résolution œdème en 6 mois

AJR:168, May 1997; 1295-99. Resolution of Abnormal MR Signal Intensity in Patients with Stress Fractures of the Femoral Neck. K A. Slocum, J.D.Gorman, M.L. Puckett, S.B.Jones

Hanche-Femur:

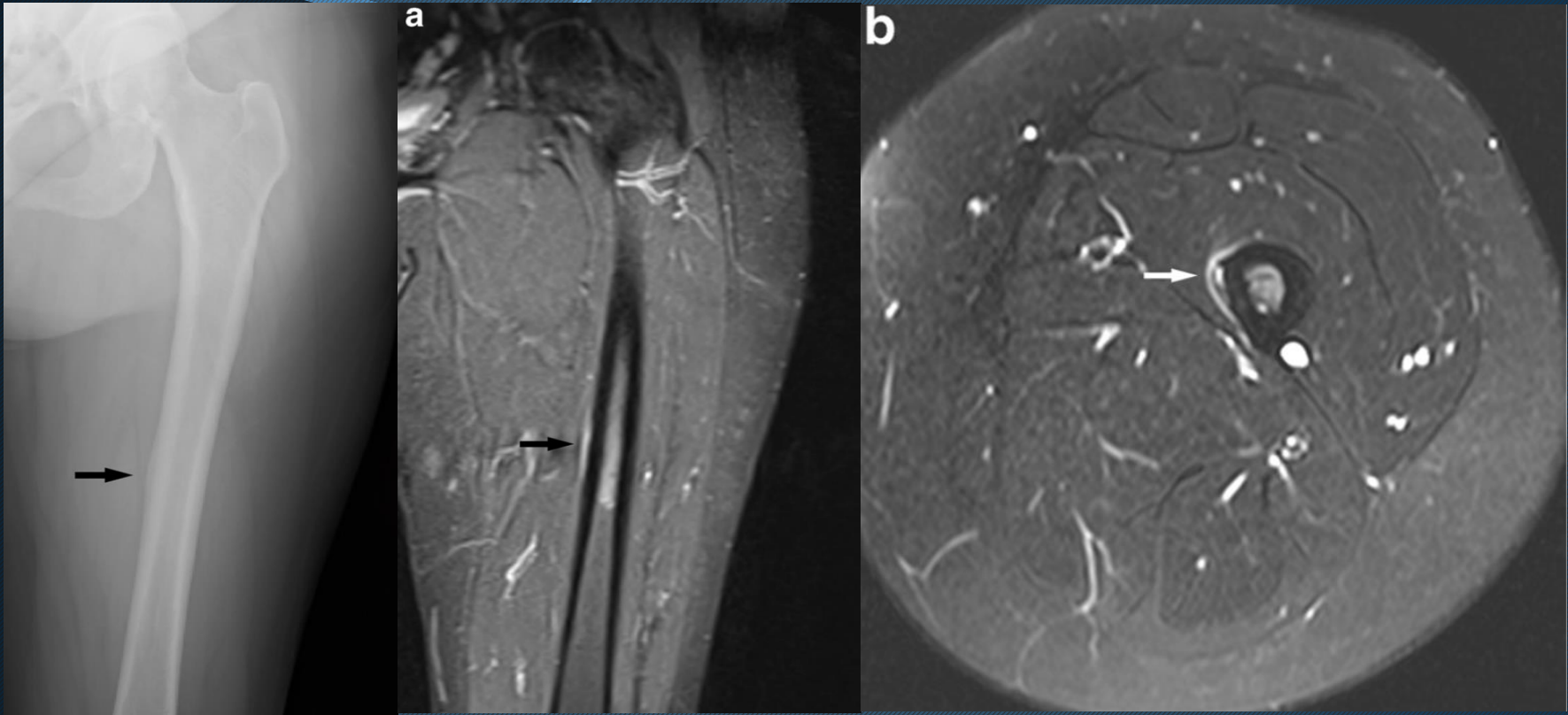


- Complication traitement à long terme au Biphosphonate
- Classique, rare (1% BiPh/0,002%OP)
- Article récent suggère une fréquence plus élevée (2% chez 100 patients traités asymptomatiques)
- Stress fracture rare, décrit chez jeune militaire mais corticale interne (adduct)

AJR:198, May 2012; 1144-51. **Frequency of Incomplete Atypical Femoral Fractures in Asymptomatic Patients on Long-Term Bisphosphonate Therapy.** R. La Rocca et al.

AJR:194, April 2010;1061-64. **Diagnosis of Proximal Femoral Insufficiency Fractures in Patients Receiving Bisphosphonate Therapy.** J.A. Porrino et al.

Hanche-Femur:



- Stress fracture rare, décrit chez jeune militaire mais corticale interne (adduct)

AJR:198, May 2012; 1144-51. **Frequency of Incomplete Atypical Femoral Fractures in Asymptomatic Patients on Long-Term Bisphosphonate Therapy.** R. La Rocca et al.

AJR:194, April 2010;1061-64. **Diagnosis of Proximal Femoral Insufficiency Fractures in Patients Receiving Bisphosphonate Therapy.** J.A. Porrino et al.

Genou:

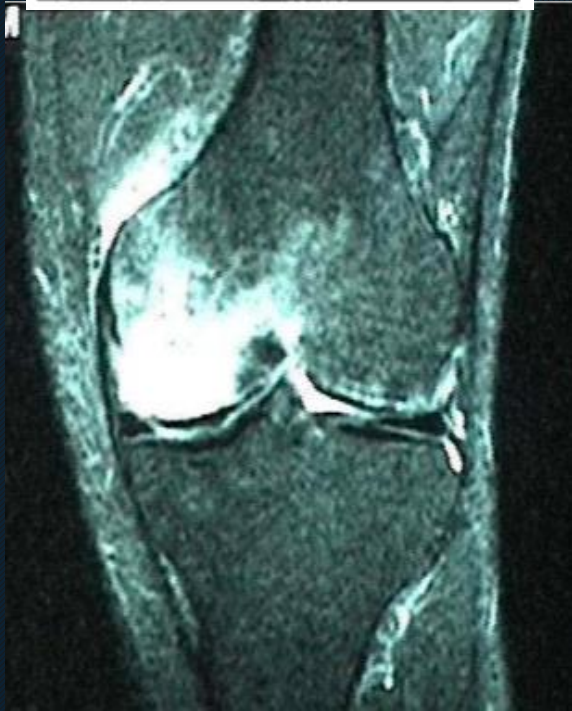
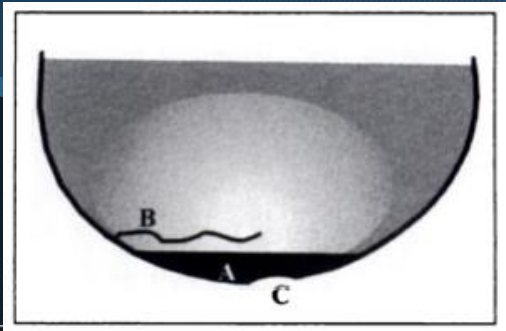


AJR:140, June 1983; 1211-15. Insufficiency Fractures of the Tibial Plateau. L. G. Manco, Robert Schneider, H. Pavlov

Genou:

Œdème transitoire-fracture stress DD ostéonécrose débutante:

- Hyposignal sous chondral T2 épaisseur sup à 4 mm ou long de plus de 14 mm
- Déformation-méplat condyle
- Ligne d'hyposignal T1 à distance de la corticale



AJR:170, June 1998; 71-77. Irreversible Versus Transient
Femoral Condyles: Pronostic value of Subchondral Bone and Marrow Changes on MR
Imaging. F.E.Lecouvet et al.

Genou:

Osgood-Schlatter:

- Décrit séparément par Osgood et Schlatter en 1903
- D+ TTA
- 12-15 ans garçons
- 8-12 ans fille
- Gravité ↗ si BMI ↗

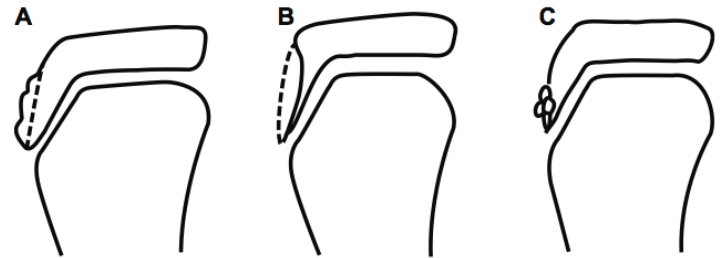
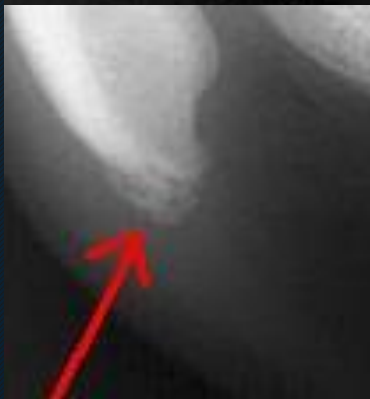


Figure 1 The severity of Osgood-Schlatter disease in the epiphyseal stage on radiographic findings. (A) Grade I, upheaval or slight elevation of the tibial tuberosity; (B) grade II, radiolucency of the tibial tuberosity; (C) grade III, fragmentation of the tibial tuberosity.

Journal of Sports Medicine 2012;3 17–20. Relationship between the clinical findings and radiographic severity in Osgood-Schlatter disease. M. Hanada, H. Koyama, M. Takahashi, Y. Matsuyama

Genou:



Sinding-Larsen-Johansson:

- Décrit en 1921 par Sinding-Larsen et Johansson
- Plus rare qu'osgood
- 10-14 ans (G>F)
- Sportif (foot, course, basket,...)



Journal of Ultrasound (2012) 15, 127-129. Sinding-Larsen-Johansson syndrome: A case report . M. Valentino, C. Quiligotti, M. Ruggirello

Genou:



Ostéocondrose du pôle sup rotule:

- Bcp plus rare qu'Osgood et Sinding
- Batten Melenaus 6 cas en 1985 (d+ chronique)
- Grogen 7 cas en 1990 mais post trauma...
- 2 cas Tyler
- Insertion plus large du tendon quadricipital sur pôle sup

Genou:



Fracture de stress de la rotule:

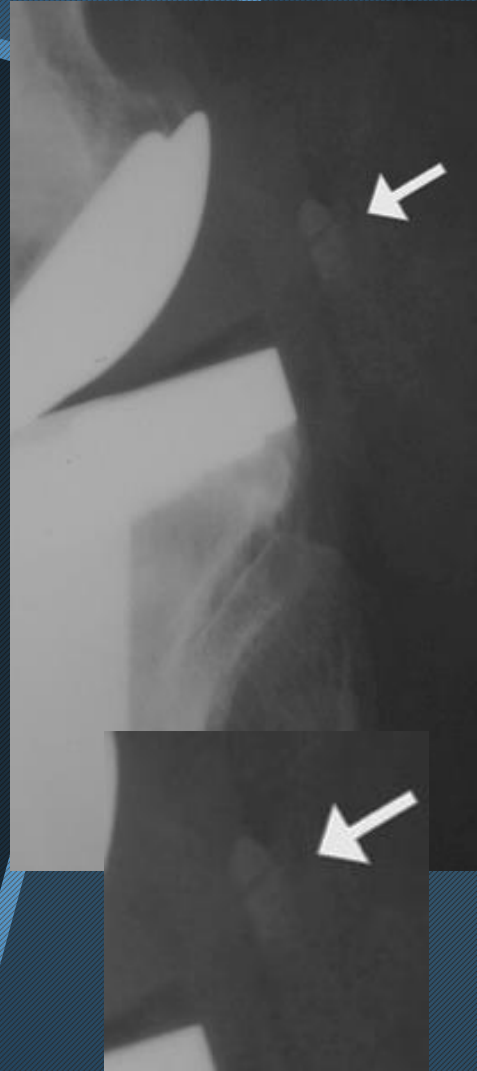
- Rare (21 cas dans la littérature anglosaxonne)
- Sportif type basket

Sports Med., Arthroscopy, Rehabilitation, Therapy & Technology 2009, **1:15** Case report: Iliotibial band release as an adjunct to the surgical management of patellar stress fracture in the athlete: a case report and review of the literature. A. Keeley, P. Bloomfield, P. Cairns, R. Molnar

Genou:

Fracture de stress de la fabella:

- Sésamoïde du jumeau externe
- Fracture extrêmement rare (choc direct)
- Fracture de stress encore + rare (1 cas décrit par Woo en 1988)
- Fracture de stress semble plus fréquente post PTG
- Hypothèse: malposition varus-valgus post PTG (nécrose moins car bord antérieur)



AJR:185, November 2005; 1141-44. Painful Stress Fractures of the Fabella in Patients with Total Knee Arthroplasty. S. J. Theodorou, D. J. Theodorou, D. Resnick

Jambe:

Fractures de stress tibiales multiples chez un jeune footballeur

TABLE 1: Fredericson MRI Classification System for Tibial Stress Injuries

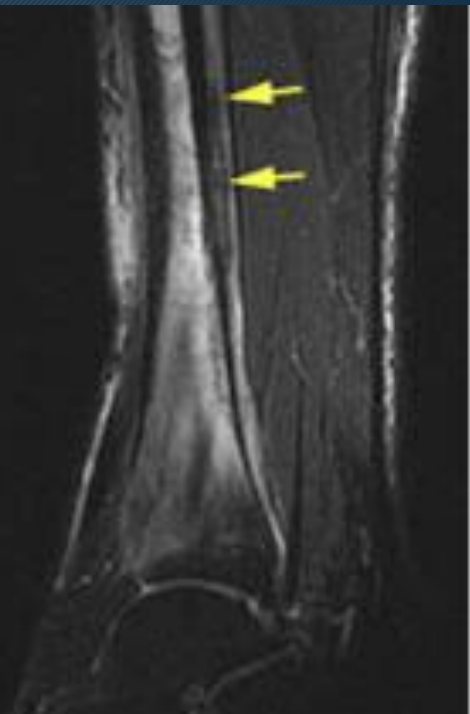
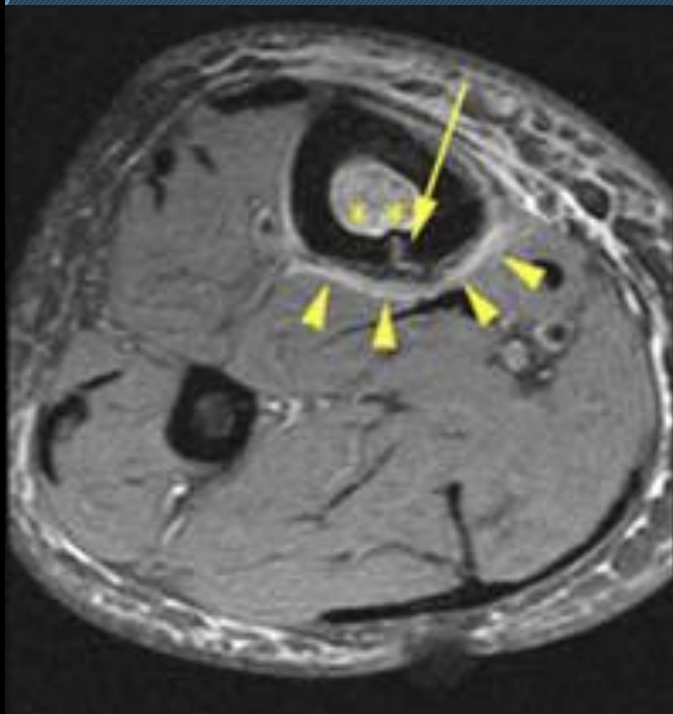
Grade of Stress Injury	MRI Findings
0	No abnormality
1	Periosteal edema with no associated bone marrow signal abnormalities
2	Periosteal edema and bone marrow edema visible only on T2-weighted images
3	Periosteal edema and bone marrow edema visible on both T1-weighted and T2-weighted images
4a	Multiple focal areas of intracortical signal abnormality and bone marrow edema visible on both T1-weighted and T2-weighted images
4b	Linear areas of intracortical signal abnormality and bone marrow edema visible on both T1-weighted and T2-weighted images

TABLE 3: Time to Return to Sports Activity for Patients With Each Fredericson Grade of Stress Injury

Grade of Stress Injury	Time to Return to Sports Activity			
	Time Range (d)	Median Time (d)	Mean Time (d)	SD (d)
1	3–20	20	15.6	9.2
2	14–65	43	39.4	12.8
3	18–90	46	48.4	19.7
4a	40–50	42	43.5	4.4
4b	30–157	64	70.6	33.2

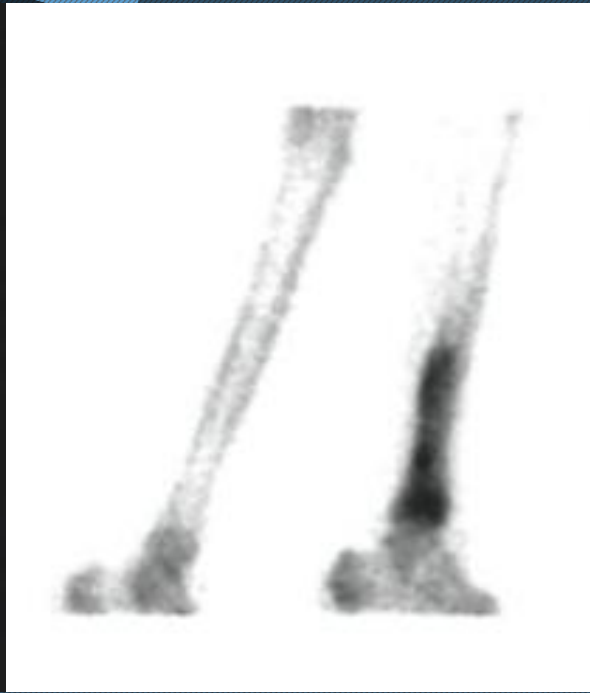
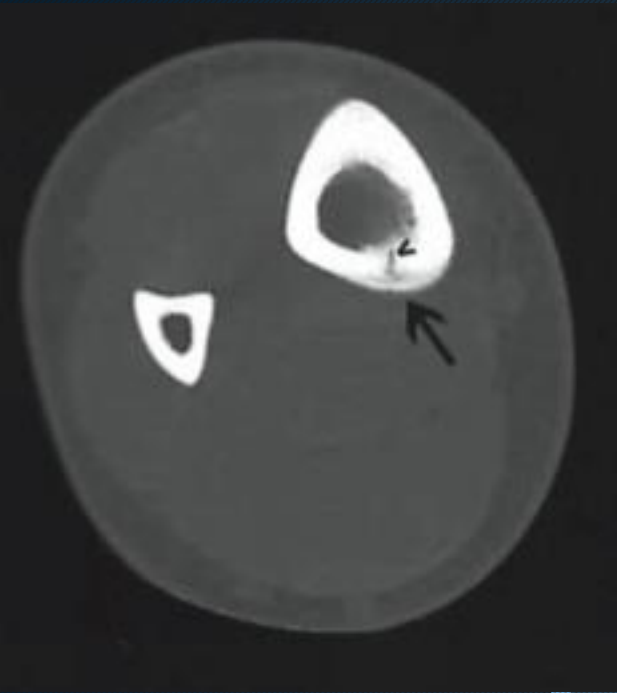


Jambe:



Fracture longitudinale du tibia: classique, rare, stress

Jambe:



IRM + sensible œdème (aspect pseudoagressif),
CT mieux pour objectiver ligne corticale

Eur Radiol. 1998;8(4):598-602. **Longitudinal stress fractures of the tibia: comparative study of CT and MR imaging.** Feydy A, Drapé J, Beret E, Sarazin L, Pessis E, Minoui A, Chevrot A.

Cheville:

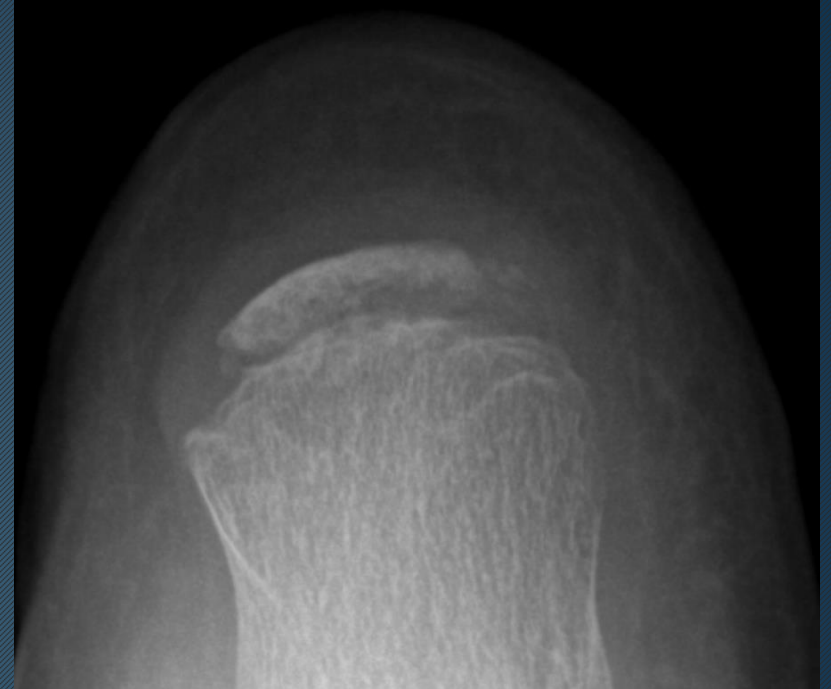


Pied et cheville:



Pied et cheville:

372.00
mm

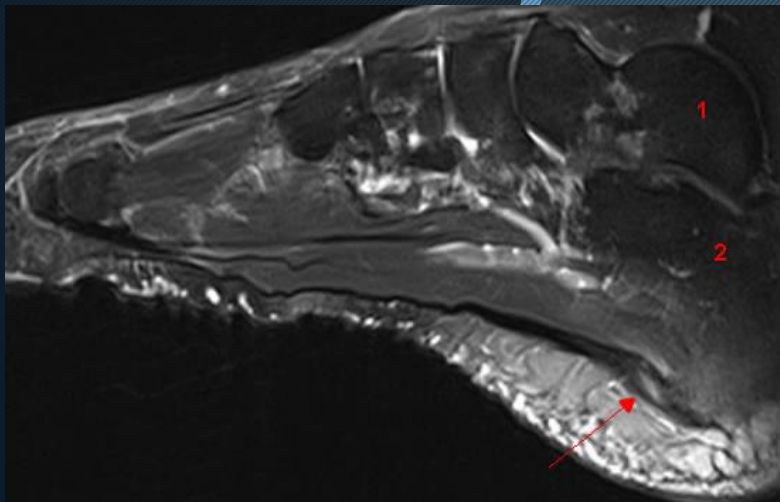
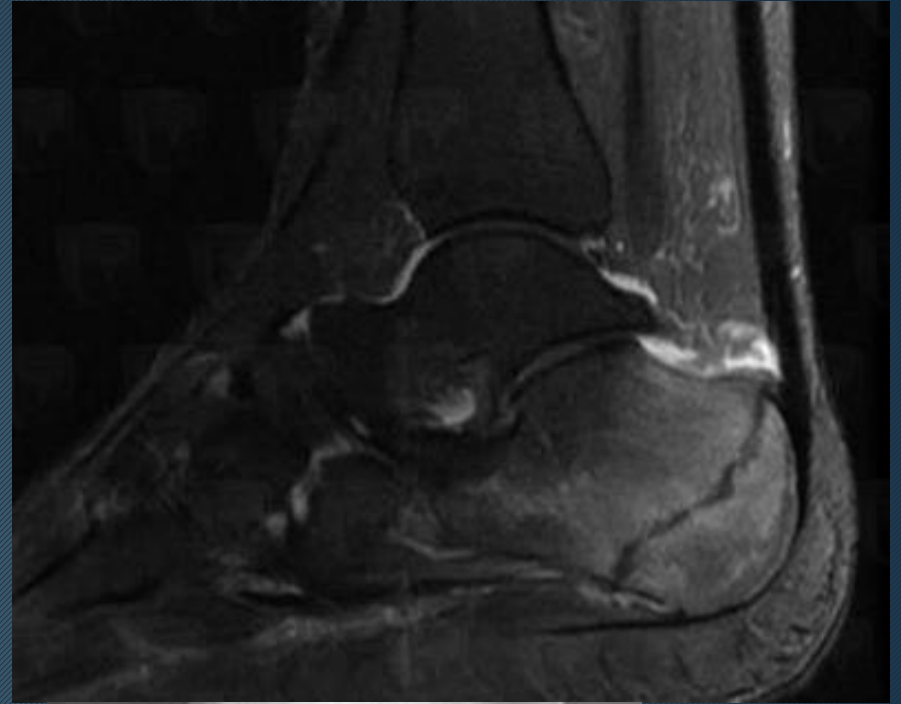
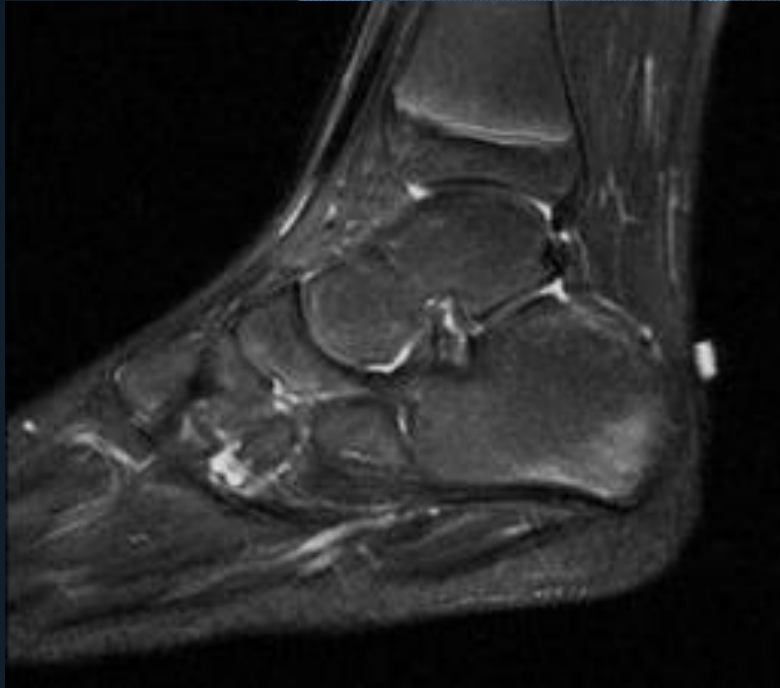


Maladie de Sever:

- adolescent sportif 8-15 ans (tennis)
- Fréquente (2-16% consult med sportive)
- DD Enthésopathie-déchirure aponévrose (basket), réelle fracture stress calcanéum

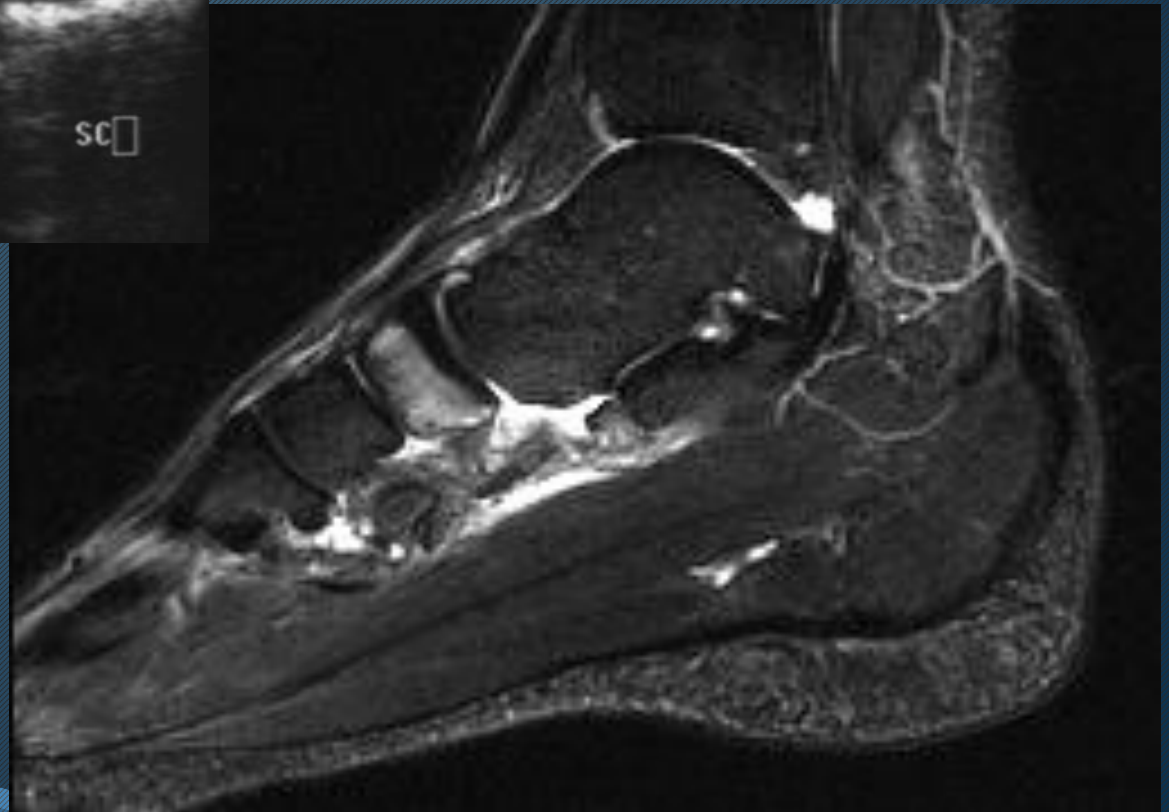
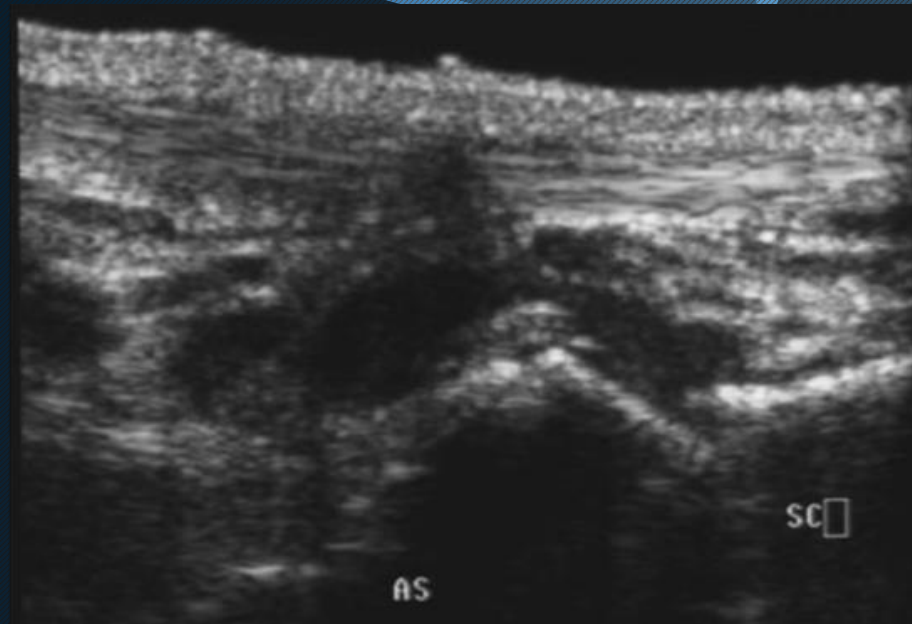
Journal of Foot and Ankle Research 2013, 6:16. Effectiveness of interventions in reducing pain and maintaining physical activity in children and adolescents with calcaneal apophysitis (Sever's disease): a systematic review. A. M James, C. M Williams, T. P Haines

Pied et cheville:

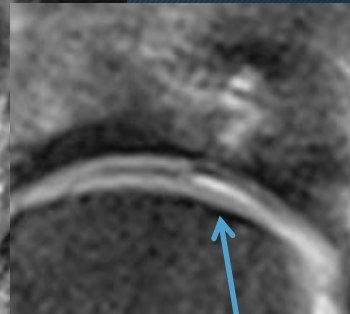
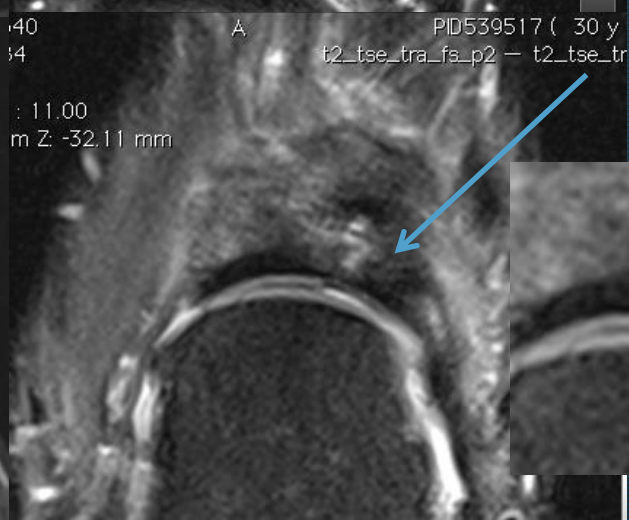
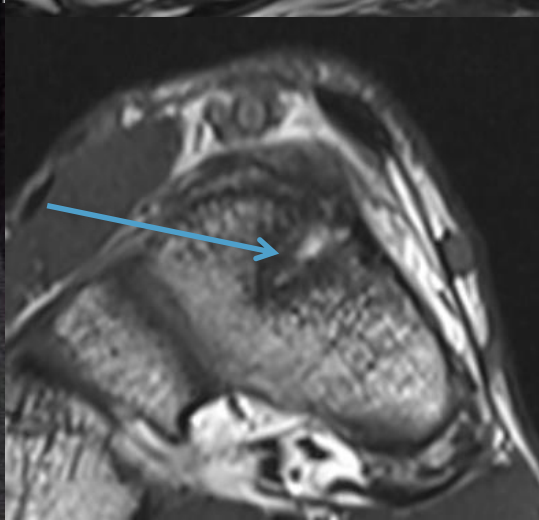
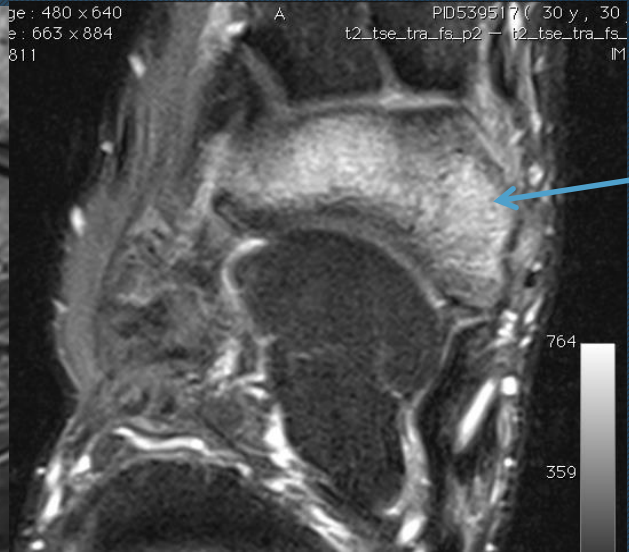
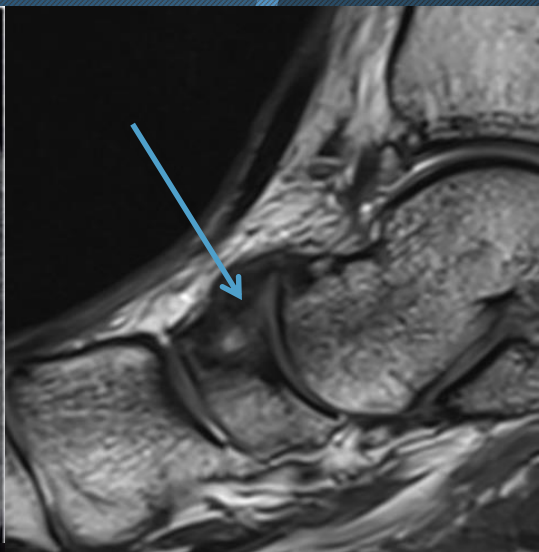
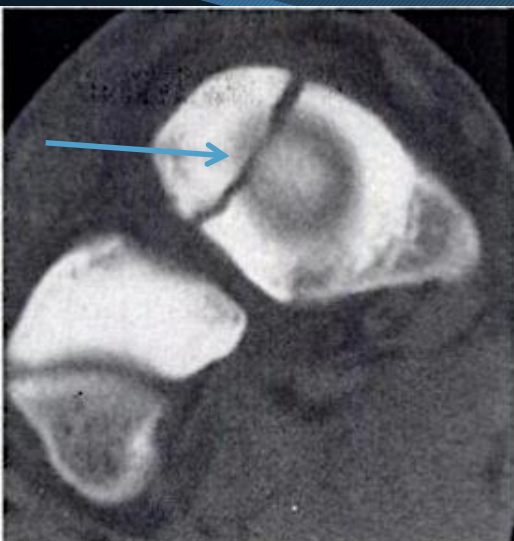


Pied et cheville:

- Basketteur
- Epanchement articulation astragalo-scaphoïdienne à l'écho



Pied et cheville:



Fracture de stress du scaphoïde: Face articulaire proximale, versant dorsal

AJR:160, January 1993; 11-115. Stress Fractures of the Tarsal Navicular CT Findings in 55 Cases . Z. S. Kiss, K. M. Khan, P.J. Fuller

Pied et cheville:

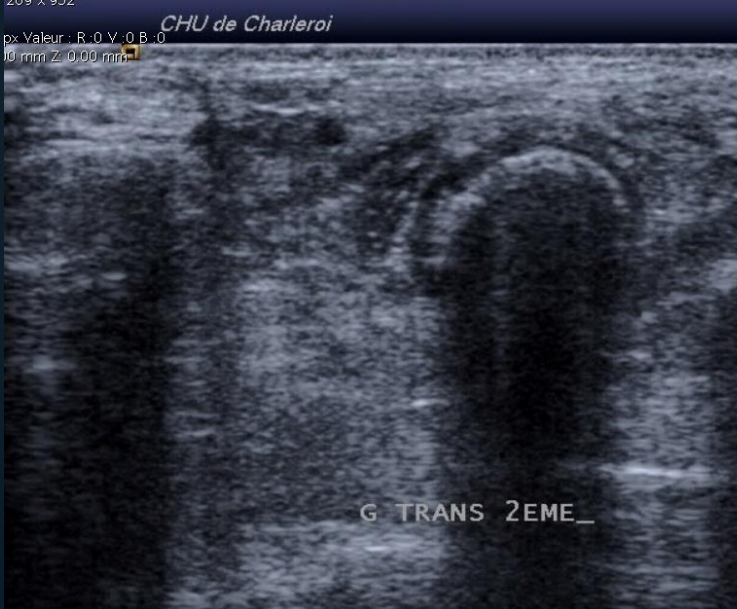
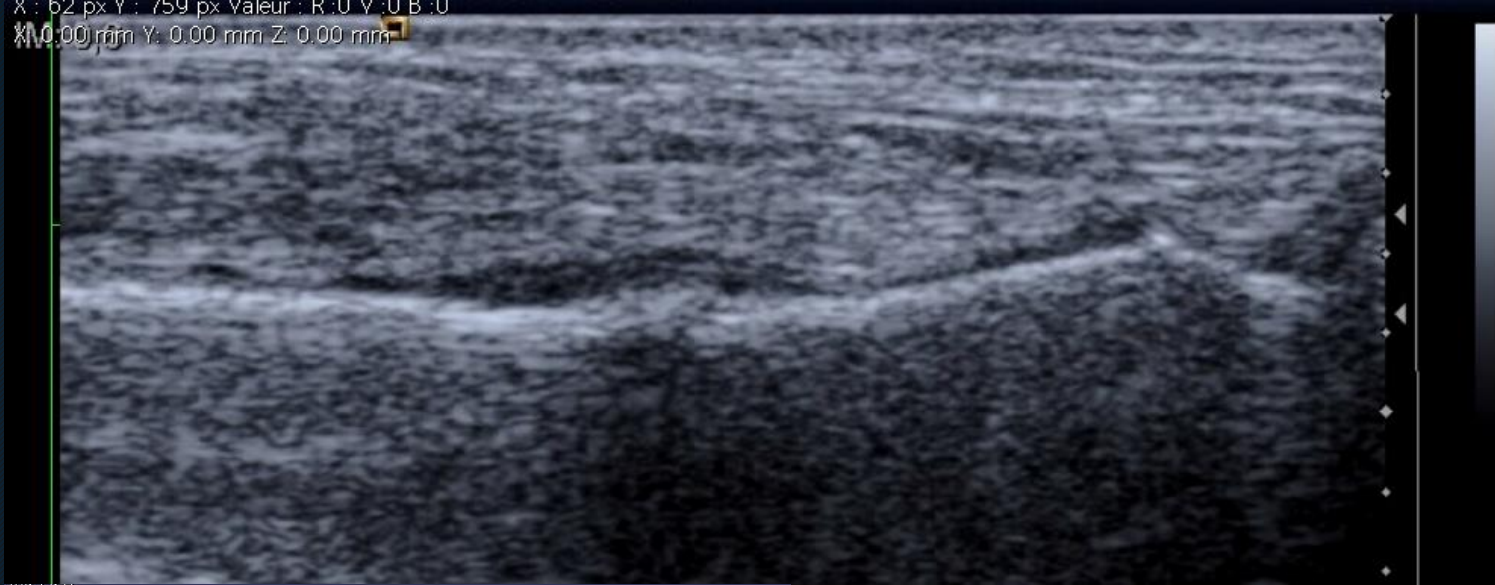


TABLE i
Incidence of Stress Fractures

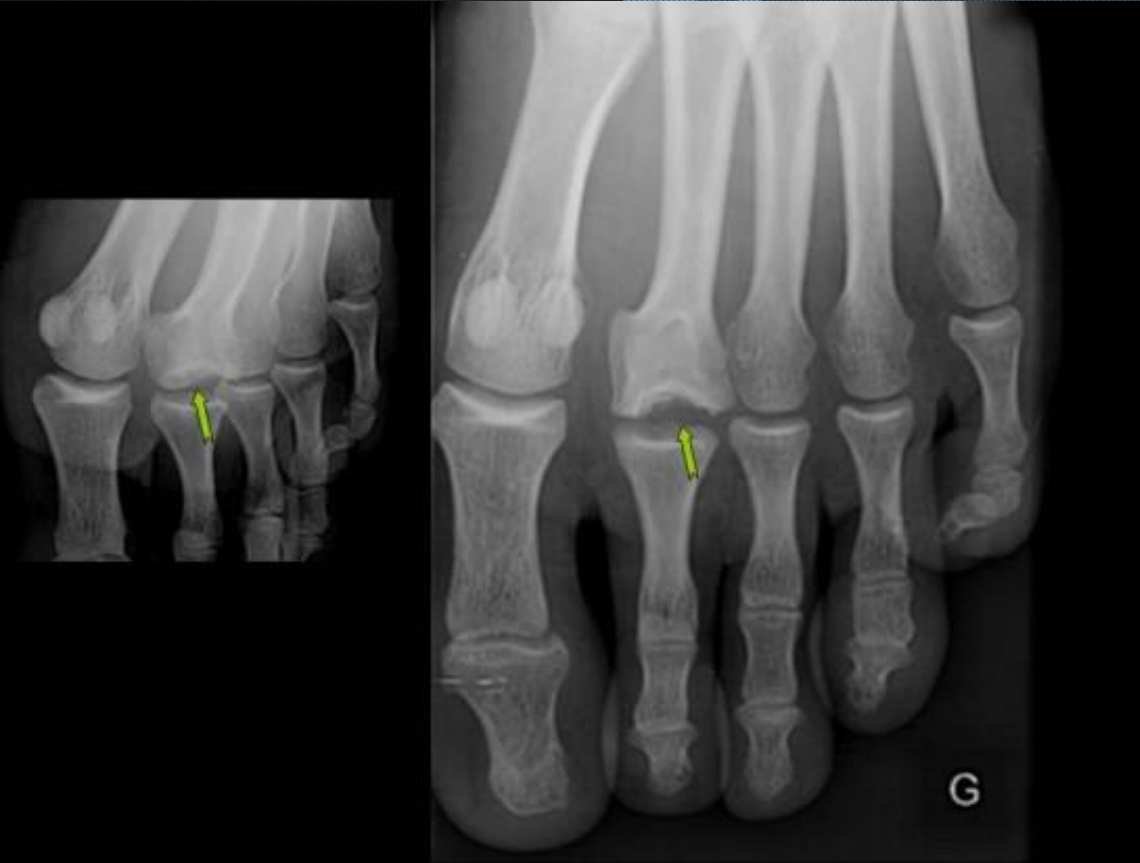
Location	No.	%
Calcaneus	39	27.5
Metatarsal:		
First	8	7.8
Second	54	52.4
Third	36	34.9
Fourth	3	2.9
Fifth	2	1.9
Subtotal	103	72.5
Total	142	100.0

Pied et cheville:

X : 62 px Y : 759 px Valeur : R:0 Y:0 B:0
X: 0.00 mm Y: 0.00 mm Z: 0.00 mm



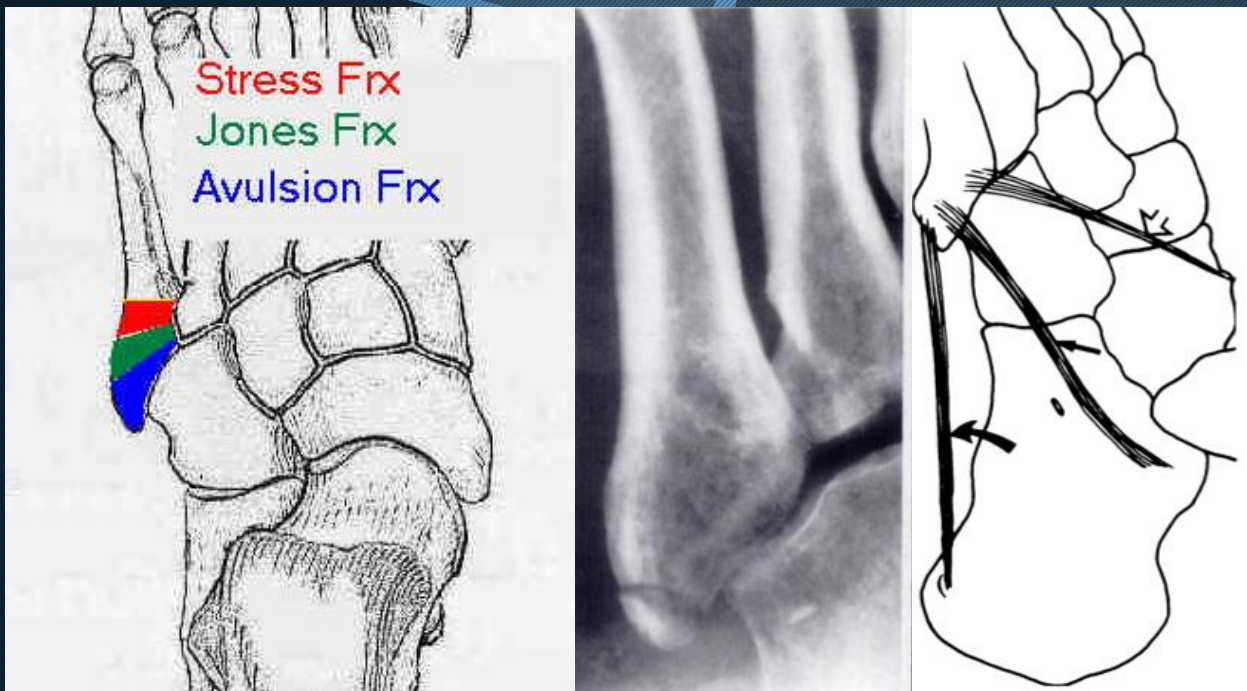
Pied et cheville:



Maladie de Freiberg:

- Ostéochondrite, osteonécrose, de stress
- Décrite en 1914
- F>H
- Tête 2^{ème} (70%), 3^{ème} (25%), rare 1,2

Pied et cheville:



- avulsion: corde latérale a plantaire
- Jones (1902) fracture aigüe transversale metaphyso-diaphysaire proxi par abduction avant-pied et flexion plantaire cheville
- Fracture de stress:diaphysaire proximale

Clin Orthop Relat Res (2008) 466:1966–1970. Distinguishing Jones and Proximal Diaphyseal Fractures of the Fifth Metatarsal. B. Chuckpaiwong , R. M. Queen, M.E. Easley, J. A. Nunley

AJR 143:889-891, October 1984. Avulsion Fracture of the Fifth Metatarsal: Experimental Study of Pathomechanics. W. Richli, D.I. Rosenthal

Membre supérieur: rare, 3 à 8% des fractures de stress



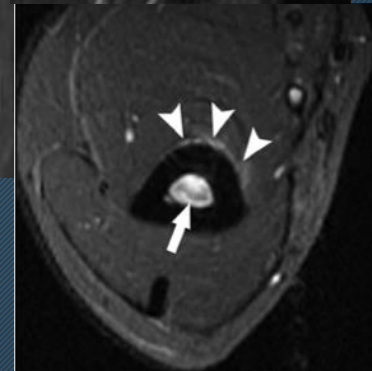
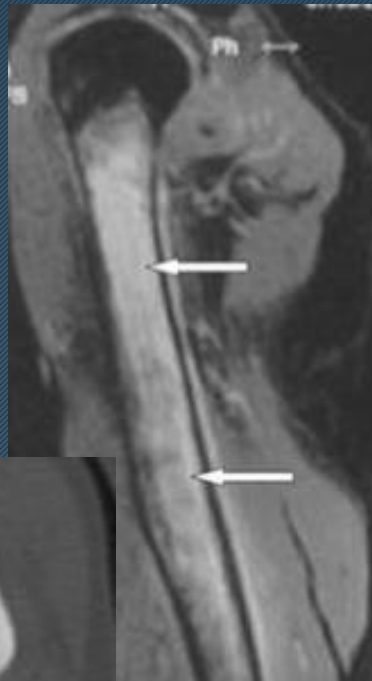
Little League Shoulder:

- Apophysite tête humérale
- 5 cas décrit en 1966 chez jeune joueurs de baseball
- 1 cas plus récent joueur cricket

CALIFORNIA MEDICINE JULY 1966:105; 22-25. Little League Shoulder. Osteochondrosis of the Proximal Humeral Epiphysis in Boy Baseball Pitchers. J. E. ADAMS,

Br J Sports Med 2004;38. Little league shoulder syndrome in an adolescent cricket player . W R Drescher, A Falliner, T Zantop, K Oehlert, W Petersen, J Hassenpflug

Membre supérieur:

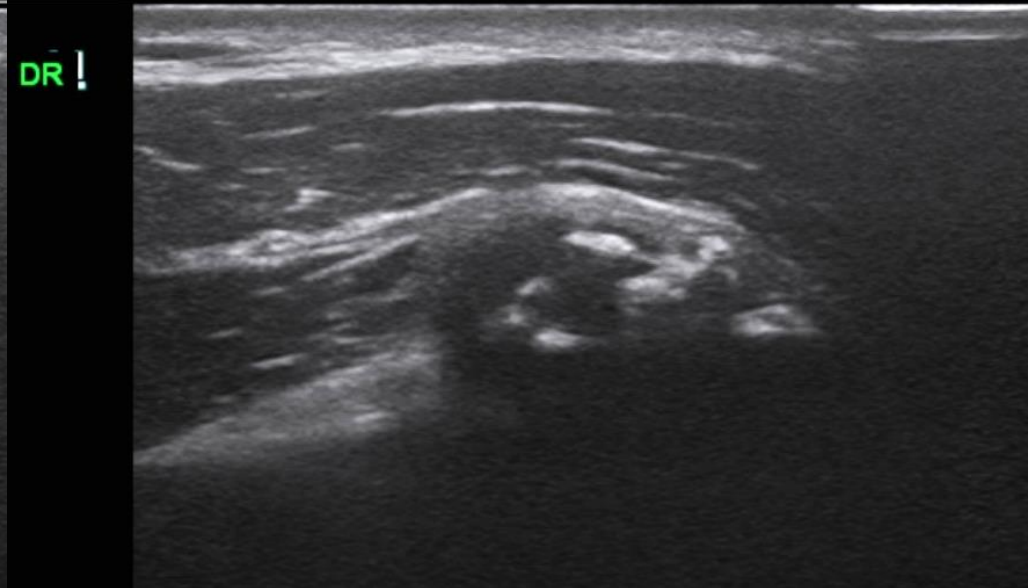
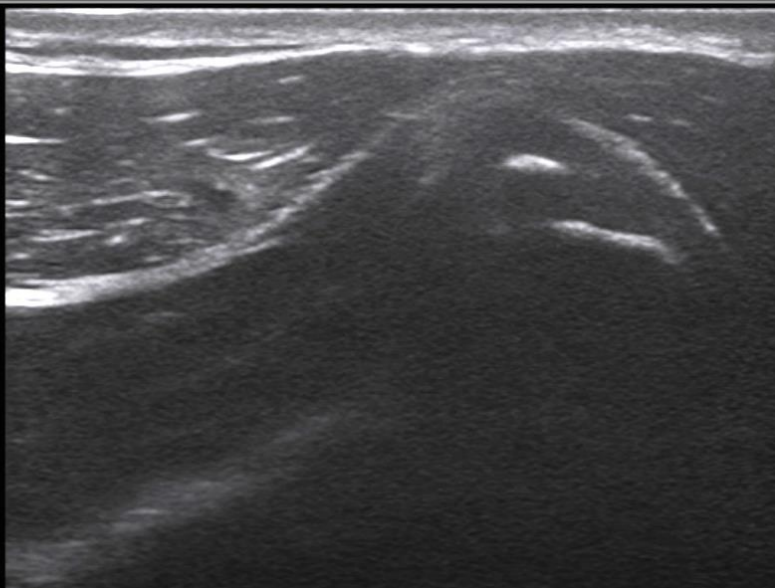


- 1^{er}: DEVAS en 1960
- tennis, baseball, volley, ...

AJR:187, October 2006;901-4. MRI of Stress Reaction of the Distal Humerus in Elite Tennis Players. J.C. Lee, F. A. Malara, T. Wood, G. Hoy, A. Saifuddin, D. A. Connell

Clin Orthop Relat Res (2009) 467:3351–3355. Longitudinal Stress Fracture of the Humerus . C. J. McMahon , S. K. Shetty, M. E. Anderson , M.G. Hochman

Membre supérieur:



2 cas personnel: 2 jeunes joueurs tennis élite avec
enthésopathie a coracoide

Membre supérieur:



Fracture de stress du 2^{ème} métacarpien: joueurs tennis en relation avec prise western

Médecins du sport: janvier 2014; 27:114. Fracture de fatigue et lésions de stress du membre supérieur du joueur de tennis. J.Parier, B. Montalvan

Membre supérieur:

Aussi décrits:

Fracture de stress clavicule

Fracture de stress omoplate

Fracture de stress scaphoïde (...)

Fracture de stress du radius et cubitus

Fracture de stress du semilunaire

...

Conclusion:

- Grande variété de présentation des fractures de contraintes
- Connaître ses « classiques » pour les rechercher là où il faut
- Ne pas confondre avec lésion maligne (anamnèse, images et examens antérieurs...)