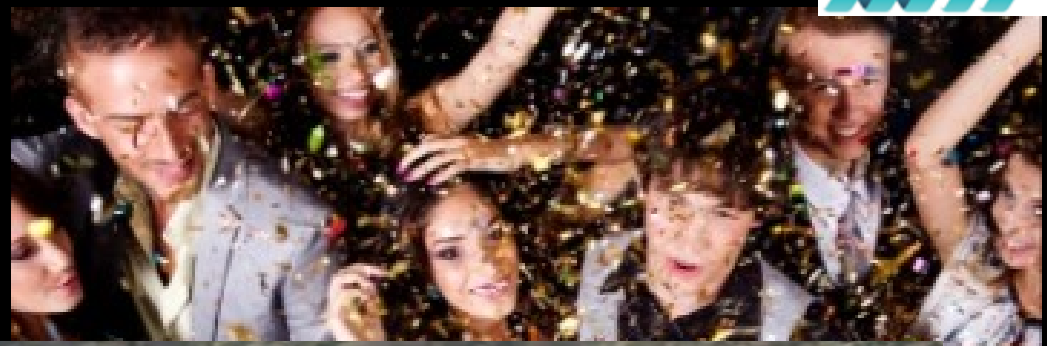
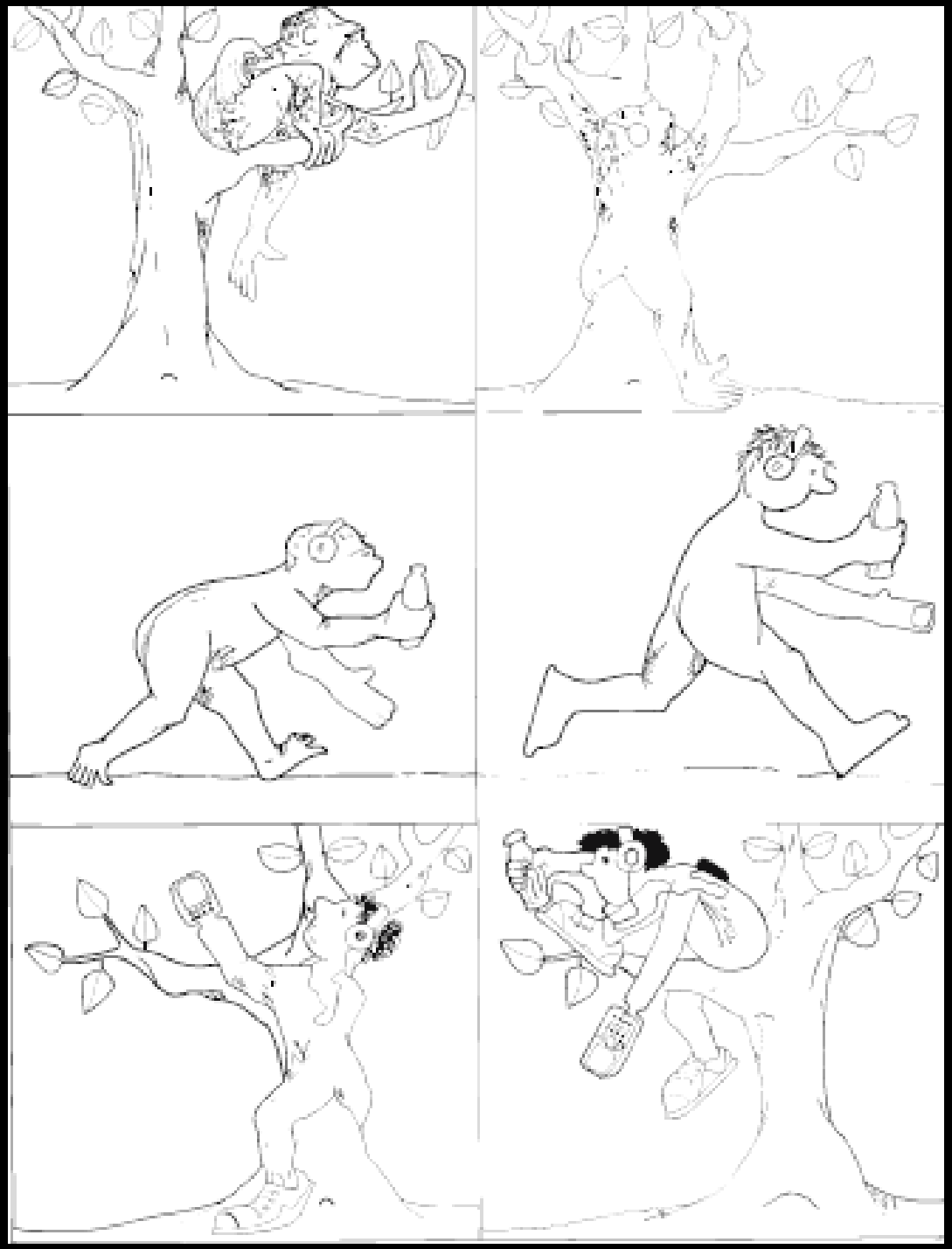
# La patologia ortopedica in pediatria: quali altre possibilità oltre le radiazioni ionizzanti ?

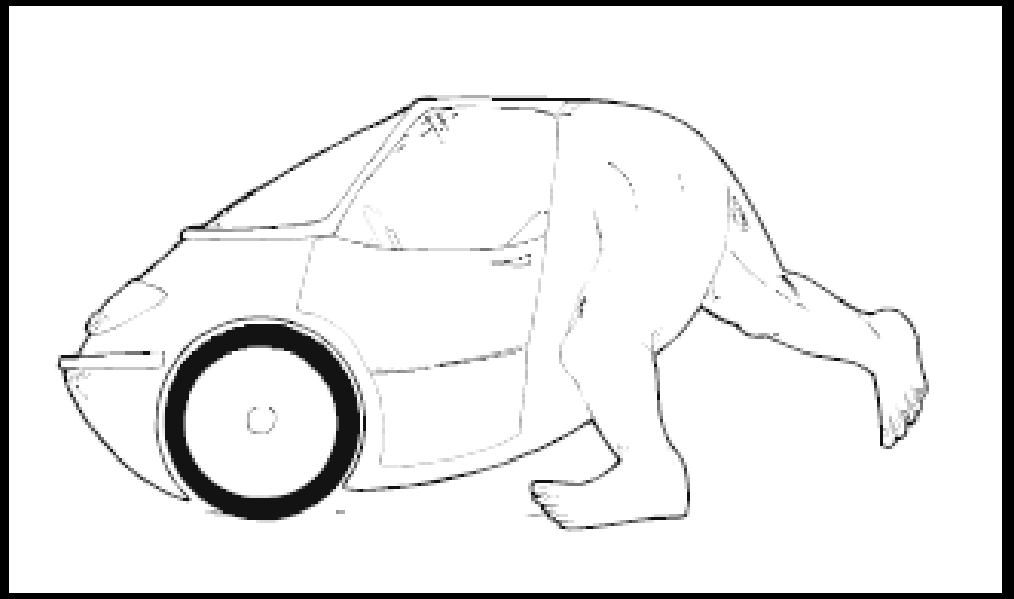
**Guindani Nicola**
**PG23 _ Ortopedia e Traumatologia (Dir. Dr Chiodini)**
**nguindani@asst-pg23.it**

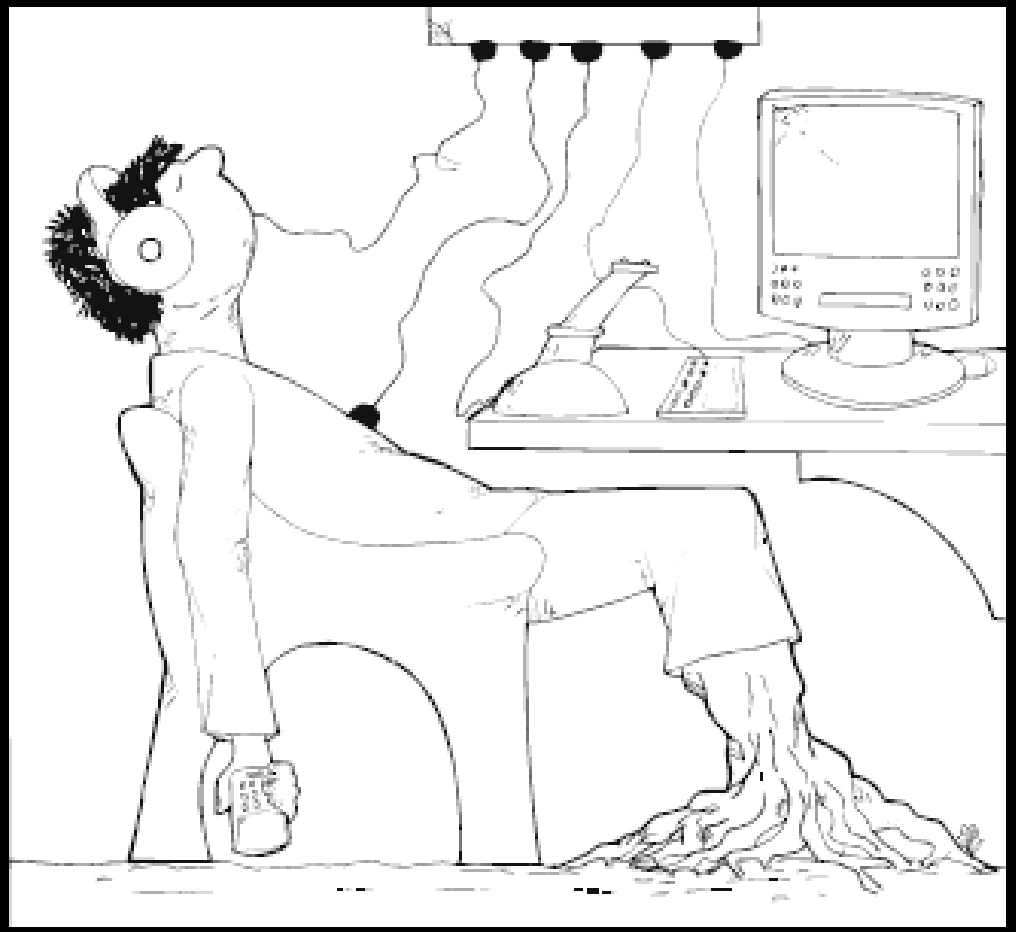

LINKS +2cm
stehend



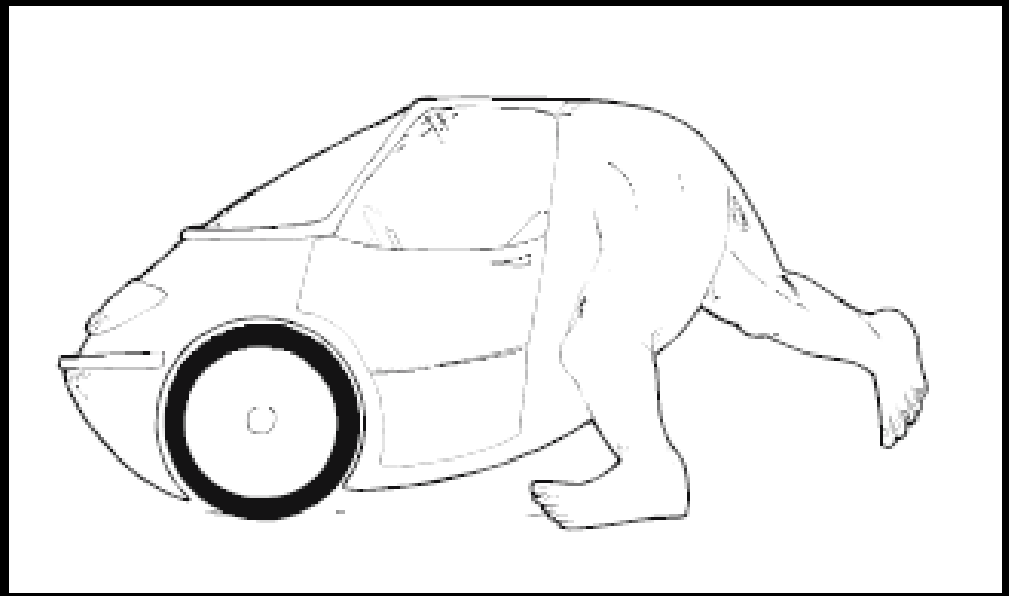


# …EVOLVING PERCEPTION OF PROBLEMS, NEEDS AND STANDARDS

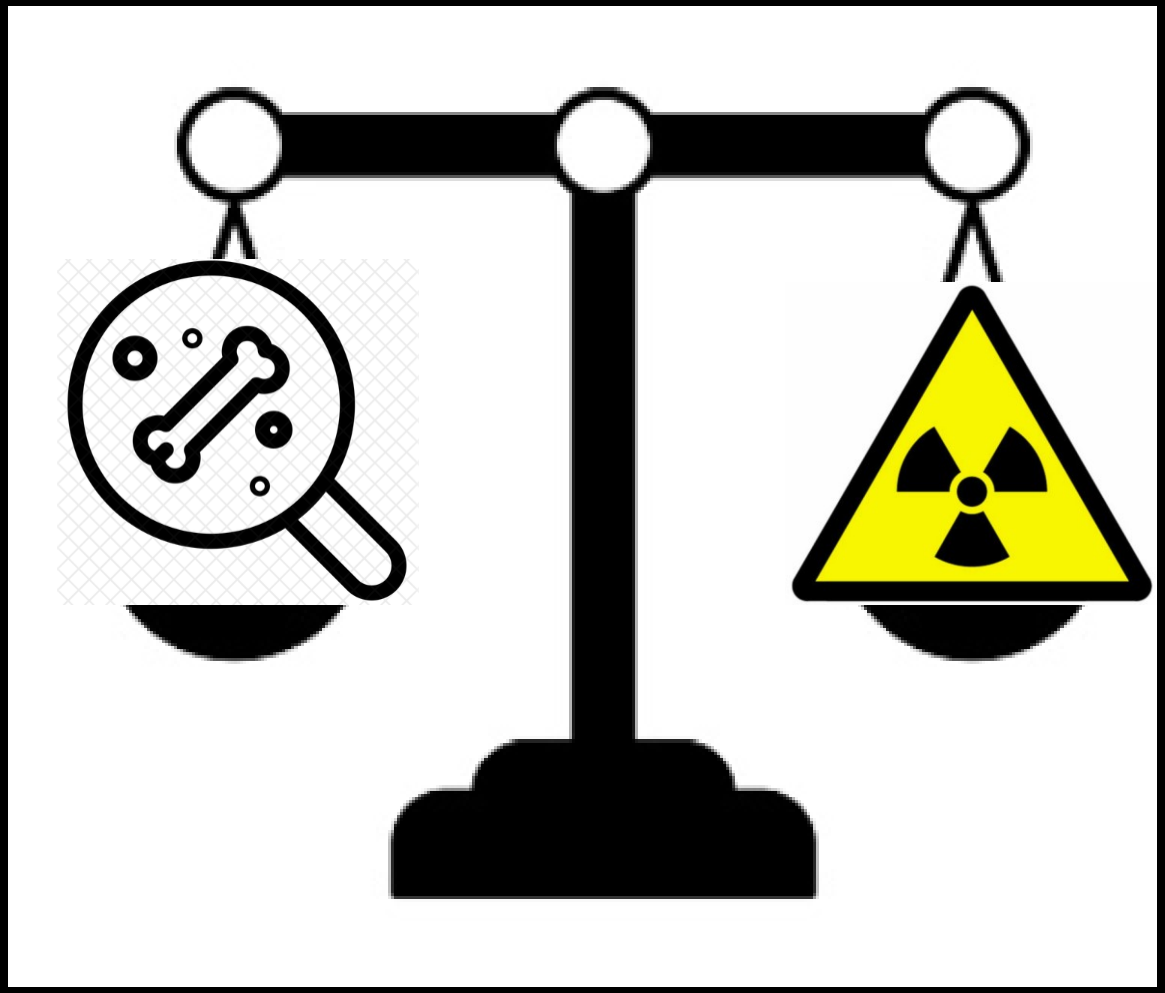




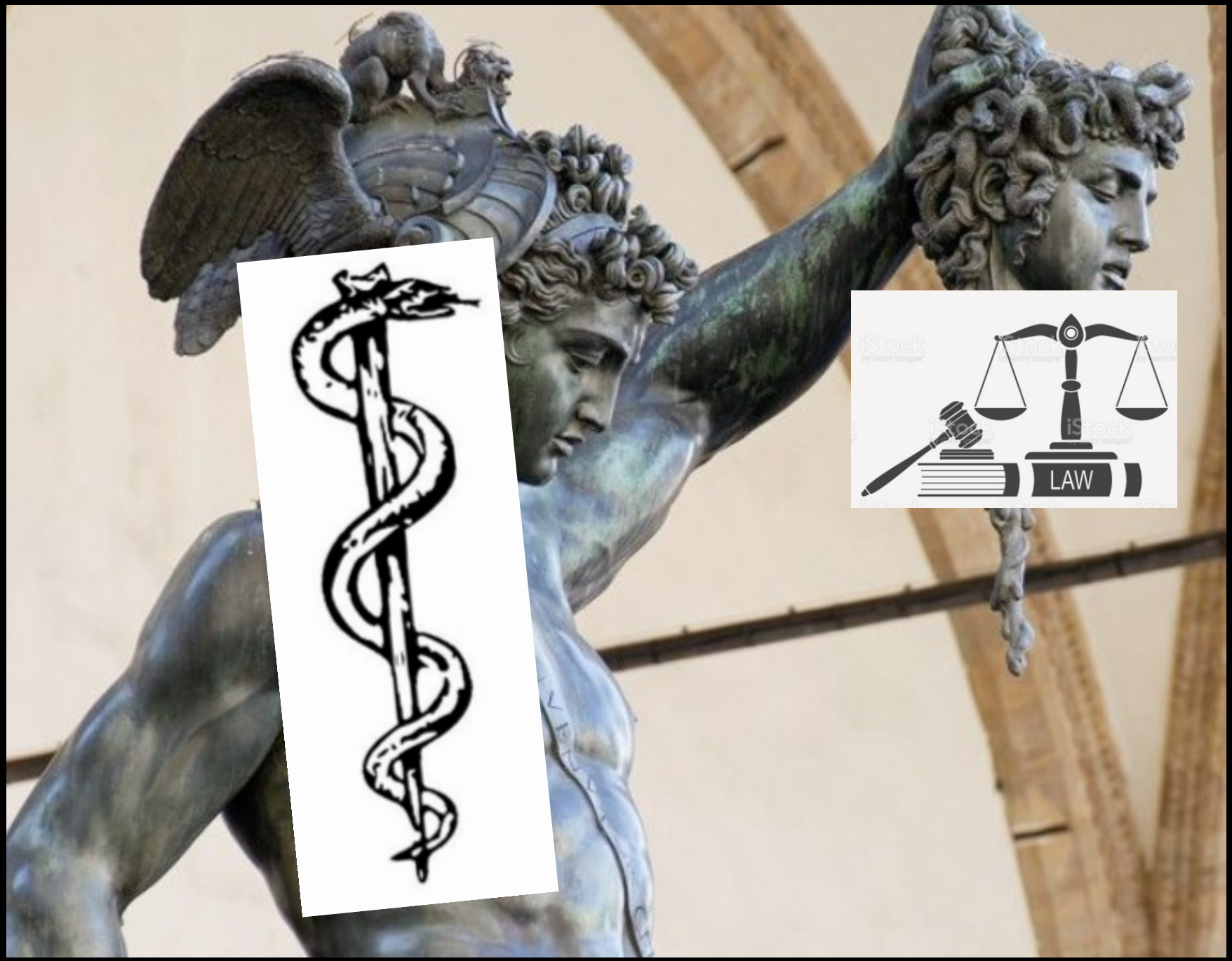
# …EVOLVING PERCEPTION OF PROBLEMS, NEEDS AND STANDARDS




LAW




THINK
GREEN


LAW

# Radiation Reduction Strategies in Pediatric Orthopaedics

Sawyer, Jeffrey R. MD

Author Information

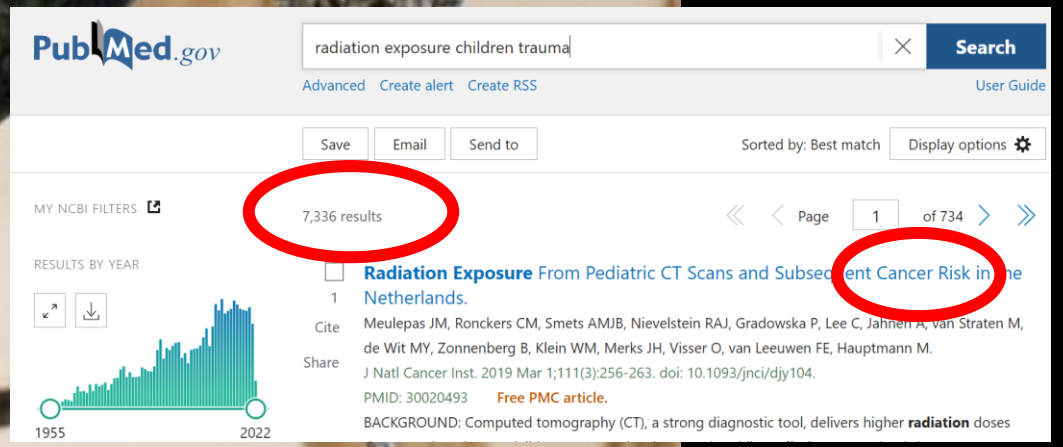
Journal of Pediatric Orthopaedics: July 2021 - Volume 41 - Issue - p S75-S79
doi: 10.1097/BPO.0000000000001822


# Radiation Safety in Pediatric Orthopaedics

Caird, Michelle S. MD

Author Information

Journal of Pediatric Orthopaedics: July/August 2015 - Volume 35 - Issue - p S34-S36
doi: 10.1097/BPO.0000000000000542




Pediatr Radiol. 1989;19(4):216-8. doi: 10.1007/BF02386835.

# Rational use of diagnostic imaging in paediatrics. The report of a World Health Organization Study Group

D F Merten [1], P E Palmer, E M Sweet, H Fendel, C Fauré, M Fujioka

Affiliations + expand

PMID: 2748226 DOI: 10.1007/BF02386835

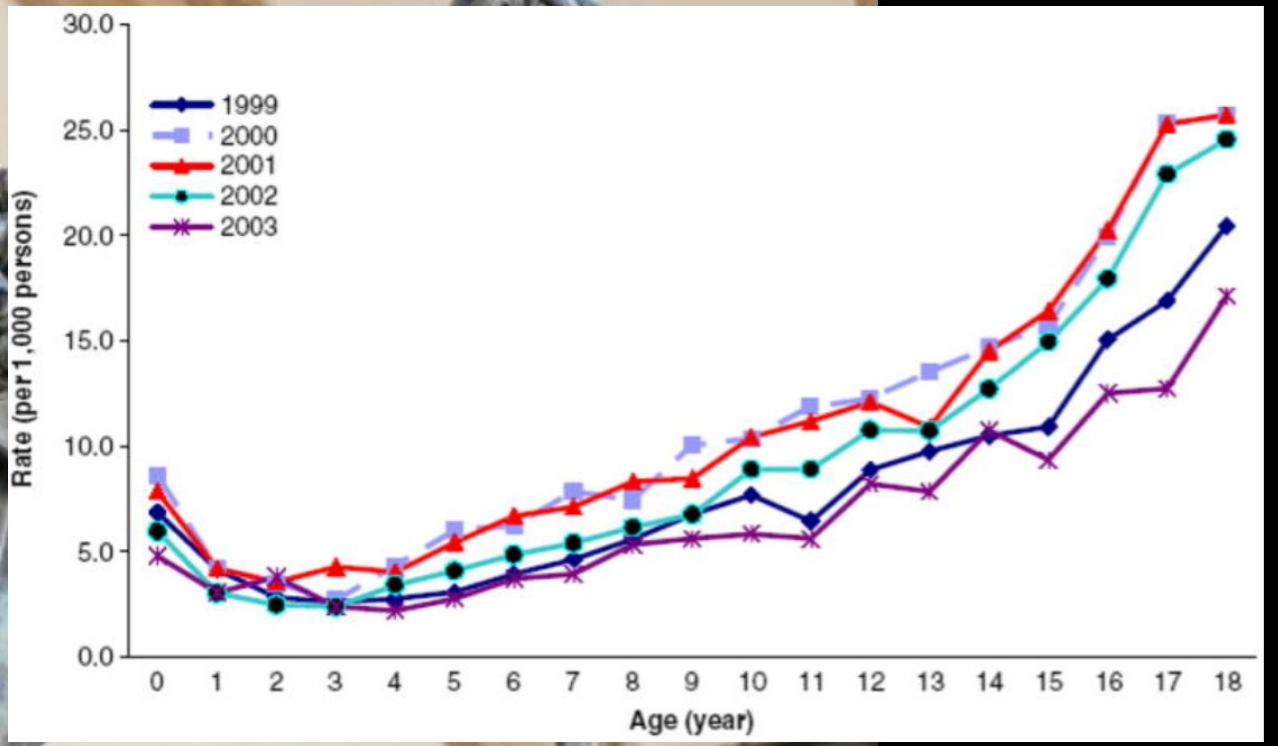
Archives de Pédiatrie
Volume 19, Issue 1, January 2012, Pages 64-73

Mise au point

# Expositions radiologiques à visée diagnostique pendant l'enfance et risque de cancer : bilan des connaissances et perspectives

# Diagnostic radiation exposure in children and cancer risk: Current knowledge and perspectives

H. Baysson [a], C. Etard [b], H.J. Brisse [c], M.-O. Bernier [a]




Review > Pediatr Radiol. 2009 Feb;39 Suppl 1(Suppl 1):S4-26. doi: 10.1007/s00247-008-1026-3. Epub 2008 Dec 16.

# Children's exposure to diagnostic medical radiation and cancer risk: epidemiologic and dosimetric considerations

Martha S Linet [1], Kwang Pyo Kim, Preetha Rajaraman

J Natl Cancer Inst. 2019 Mar 1;111(3):256-263. doi: 10.1093/jnci/djy104.

# Radiation Exposure From Pediatric CT Scans and Subsequent Cancer Risk in the Netherlands

Johanna M Meulepas [1], Cécile M Ronckers [2], Anne M J B Smets [3], Rutger A J Nievelstein [3], Patrycja Gradowska [1], Choonsik Lee [4], Andreas Jahnen [5], Marcel van Straten [6], Marie-Claire Y de Wit [7], Bernard Zonnenberg [8], Willemijn M Klein [9], Johannes H Merks [2 10], Otto Visser [11], Flora E van Leeuwen [1], Michael Hauptmann [1]

Affiliations + expand

PMID: 30020493 PMCID: PMC6657440 DOI: 10.1093/jnci/djy104

We found evidence that CT-related radiation exposure increases brain tumor risk. No association was observed for leukemia

...Based on only 11 events, the results are not statistically significant and have large uncertainties...

J Natl Cancer Inst. 2019 Sep; 111(9): 1000–1001. PMCID: PMC6748705
Published online 2019 Apr 12. doi: 10.1093/jnci/djz061 PMID: 30977809

# Re: "Radiation Exposure From Pediatric CT Scans and Subsequent Cancer Risk in the Netherlands"

Daniel Wollschläger, Maria Blettner, and Roman Pokora



CONTEMPORARY ISSUES IN RADIATION PROTECTION IN MEDICAL IMAGING SPECIAL FEATURE: REVIEW ARTICLE

# Epidemiological studies of CT scans and cancer risk: the state of the science

Amy Berrington de Gonzalez, Elisa Pasqual and Lene Veiga

Published Online: 21 Sep 2021 · Doi: https://doi.org/10.1259/bjr.20210471

In conclusion, there is growing evidence from epidemiological data that CT scans can cause cancer. The absolute risks to individual patients are, however, likely to be small.

Pediatric Radiology
https://doi.org/10.1007/s00247-020-04803-0

ORIGINAL ARTICLE

# Early life ionizing radiation exposure and cancer risks: systematic review and meta-analysis

Kossi D. Abalo[1] · Estelle Rage[1] · Klervi Leuraud[1] · David B. Richardson[2] · Hubert Ducou Le Pointe[3] · Dominique Laurier[4] · Marie-Odile Bernier[1]

Received: 23 January 2020 / Revised: 12 June 2020 / Accepted: 5 August 2020


**Correction to: Pediatric Radiology (2020)**
https://doi.org/10.1007/s00247-020-04803-0

The original version of Table 2 included two incorrect values. The third line of the last column of Table 2 should read: 3.6 (0.5–12.0)[a]. The fourth line of the last column of Table 2 should read: 2.3 (1.0–4.9)[b]. The corrected table is included below.

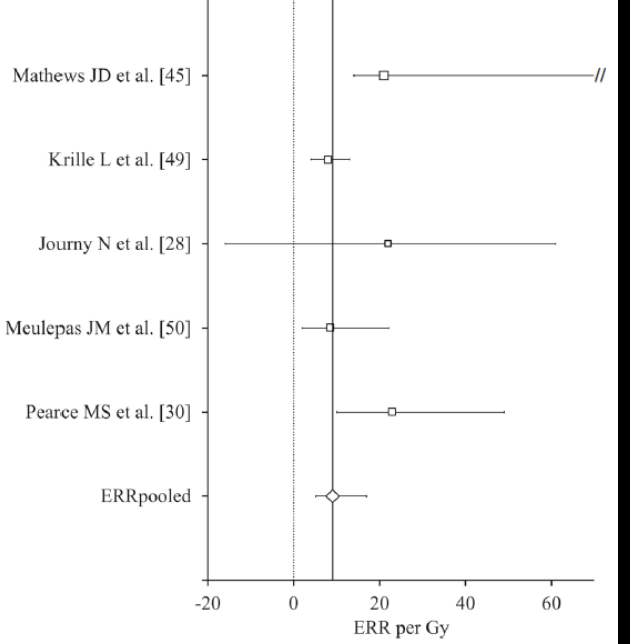



**Fig. 5.** Excess relative risk (ERR) of brain tumors following postnatal medical diagnostic exposure to CT

Although prenatal medical radiation during the last 50 years appeared unrelated to a subsequent later life risk of cancer, pooled results from studies on CT exposure during childhood showed greater risks for leukemia and brain tumors. Published studies present some methodological limitations. Although the benefits of prenatal and postnatal diagnostic radiation examinations outweigh the risks associated with the doses delivered by these procedures, the results of this analysis justify continued efforts to optimize doses to patients.

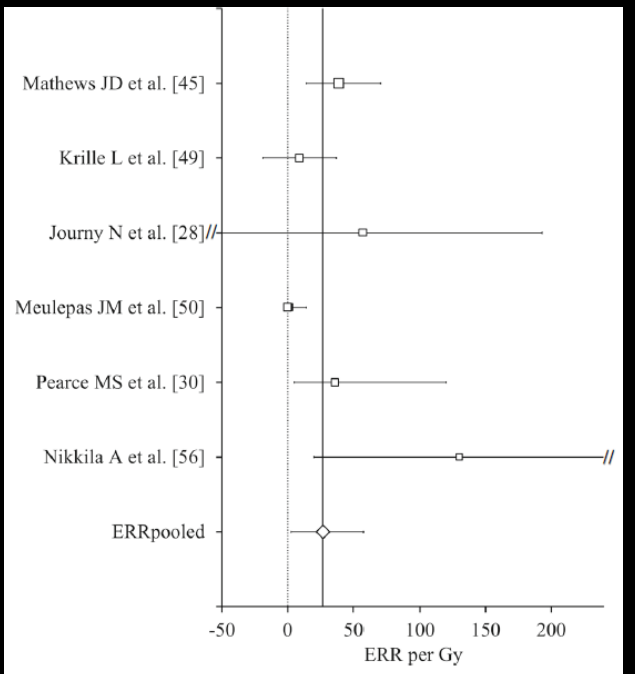



**Fig. 4** Excess relative risk (ERR) of leukemia following postnatal medical diagnostic exposure to CT

# 100% ALARA

Table of Contents

ICRP PUBLICATION 26: Recommendations of the International Commission on Radiological Protection

◂ Previous Issue | Volume 1 Issue 3, July 1977 | Next Issue ▸


rX
alternatives

# VISIT THE PATIENT

ORIGINAL ARTICLES

# Measures to Improve Diagnostic Safety in Clinical Practice

Singh, Hardeep MD, MPH*; Graber, Mark L. MD†,‡,§; Hofer, Timothy P. MD, MSc‖,¶

Author Information

Journal of Patient Safety: December 2019 - Volume 15 - Issue 4 - p 311-316
doi: 10.1097/PTS.0000000000000338

# GENERAL CLINICAL (ORTHOPAEDIC) EVALUATION

Most common (according to me, in our area):

- Flat foot
- Spine/scoliosis
- Knee Vs hip pain
- 2nd hip displasia in ICP
- Trauma (+/- recent)
    - w/out imaging
    - w/out clinical evaluation

# GENERAL CLINICAL (ORTHOPAEDIC) EVALUATION

Most common (according to me, in our area):

- Flat foot
- Spine/scoliosis
- Knee Vs hip pain
- 2nd hip displasia in ICP
- Trauma (+/- recent)
  - w/out imaging
  - w/out clinical evaluation

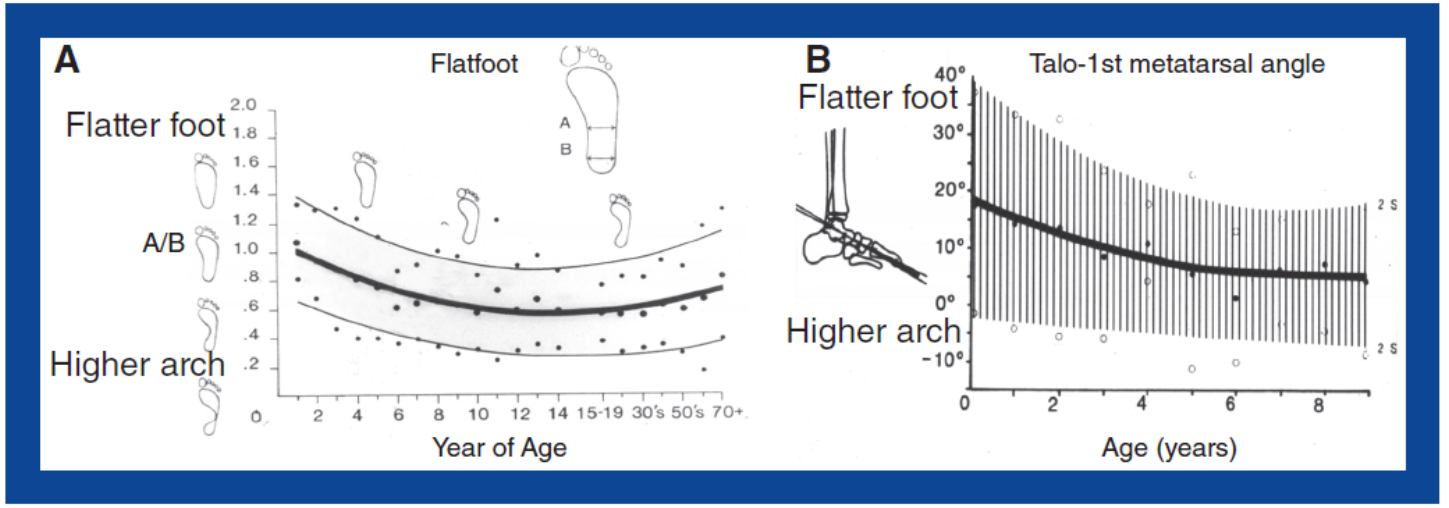
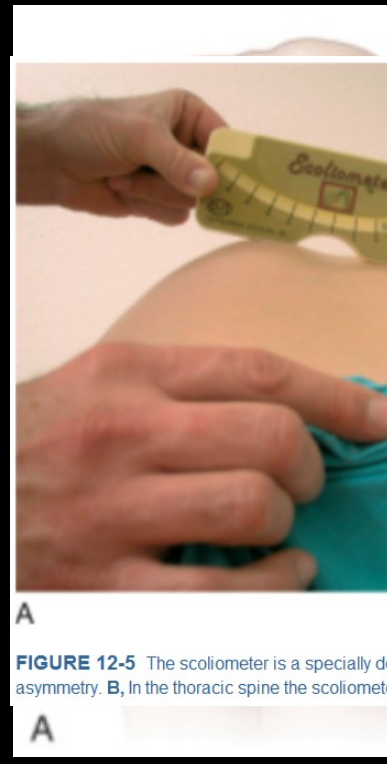


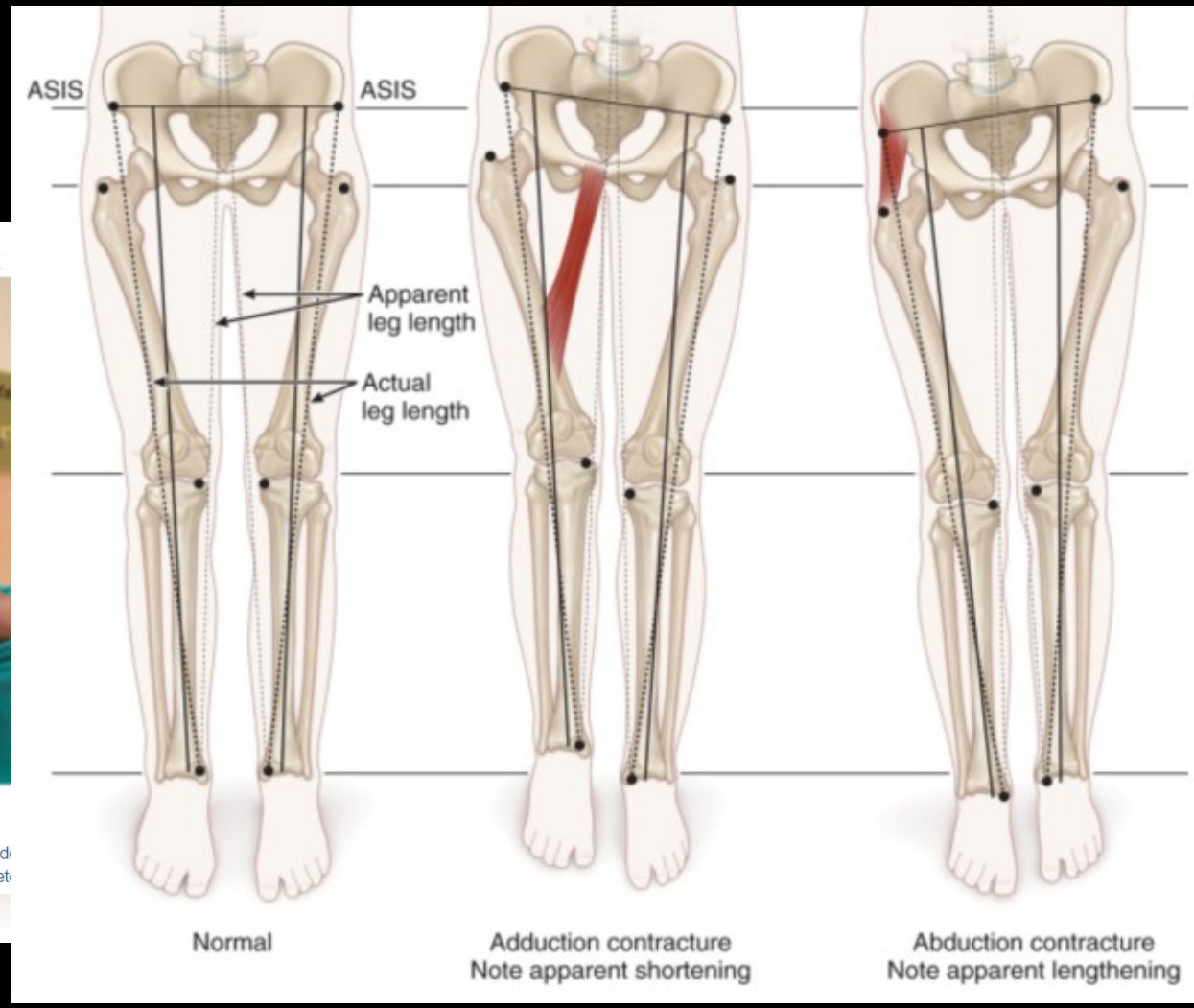

**Figure 2-1.** **A.** Footprints from individuals of all ages show that children are more flatfooted than adults, there is a wide range of normal arch heights, and the arch generally elevates spontaneously during the first decade of life. (From Staheli LT, Chew DE, Corbett M. The longitudinal arch. A survey of eight hundred and eighty two feet in normal children and adults. J Bone Joint Surg Am. 1987;69:426–428, with permission.) **B.** Radiographs from children of all ages confirm the footprint data. The drawing and graph represent the lateral talus–1st metatarsal (so-called Meary's) angle. (From Vanderwilde R, Staheli LT, Chew DE, et al. Measurements on radiographs of the foot in normal infants and children. J Bone Joint Surg Am. 1988;70:407–415, with permission.)

# GENERAL CLINICAL (ORTHOPAEDIC) EVALUATION

Most common (according to me, in our area):

- Flat foot
- Spine/scoliosis
- Knee Vs hip pain
- 2nd hip displasia in ICP
- Trauma (+/- recent)
  - w/out imaging
  - w/out clinical evaluation



# GENERAL CLINICAL (ORTHOPAEDIC) EVALUATION

Most common (according to me, in our area):

- Flat foot
- Spine/scoliosis
- Knee Vs hip pain
- 2nd hip displasia in ICP
- Trauma (+/- recent)
  - w/out imaging
  - w/out clinical evaluation

# GENERAL CLINICAL (ORTHOPAEDIC) EVALUATION

Most common (according to me, in our area):

- Flat foot
- Spine/scoliosis
- Knee Vs hip pain
- 2nd hip displasia in ICP
- Trauma (+/- recent)
  - w/out imaging
  - w/out clinical evaluation

DEVELOPMENTAL MEDICINE & CHILD NEUROLOGY SYSTEMATIC REVIEW

## Prevention of hip displacement in children with cerebral palsy: a systematic review

STACEY D MILLER[1] | MARIA JURICIC[1] | KIM HESKETH[2] | LYNORE MCLEAN[3] | SONJA MAGNUSON[1] | SHERYLIN GASIOR[3] | EMILY SCHAEFFER[1,4] | MAUREEN O'DONNELL[3,5] | KISHORE MULPURI[1,4]

**1** BC Children's Hospital, Vancouver, BC; **2** Closing the Gap Health Care Group, Barrie, ON; **3** Sunny Hill Health Centre for Children, Vancouver, BC; **4** Department of Orthopaedics, University of British Columbia, Vancouver, BC; **5** Department of Pediatrics, University of British Columbia, Vancouver, BC, Canada.

Correspondence to Stacey D Miller at BC Children's Hospital, Orthopaedics, 1D62, 4480 Oak Street, Vancouver, BC, V6H 3V4, Canada. E-mail: smiller4@cw.bc.ca

THE BONE & JOINT JOURNAL

■ CHILDREN'S ORTHOPAEDICS

## Prevention of dislocation of the hip in children with cerebral palsy

20-YEAR RESULTS OF A POPULATION-BASED PREVENTION PROGRAMME

## Australian Hip Surveillance Guidelines for Children with Cerebral Palsy 2014

Wynter M, Gibson N, Kentish M, Love SC, Thomason P, Willoughby K, Graham HK

# GENERAL CLINICAL (ORTHOPAEDIC) EVALUATION

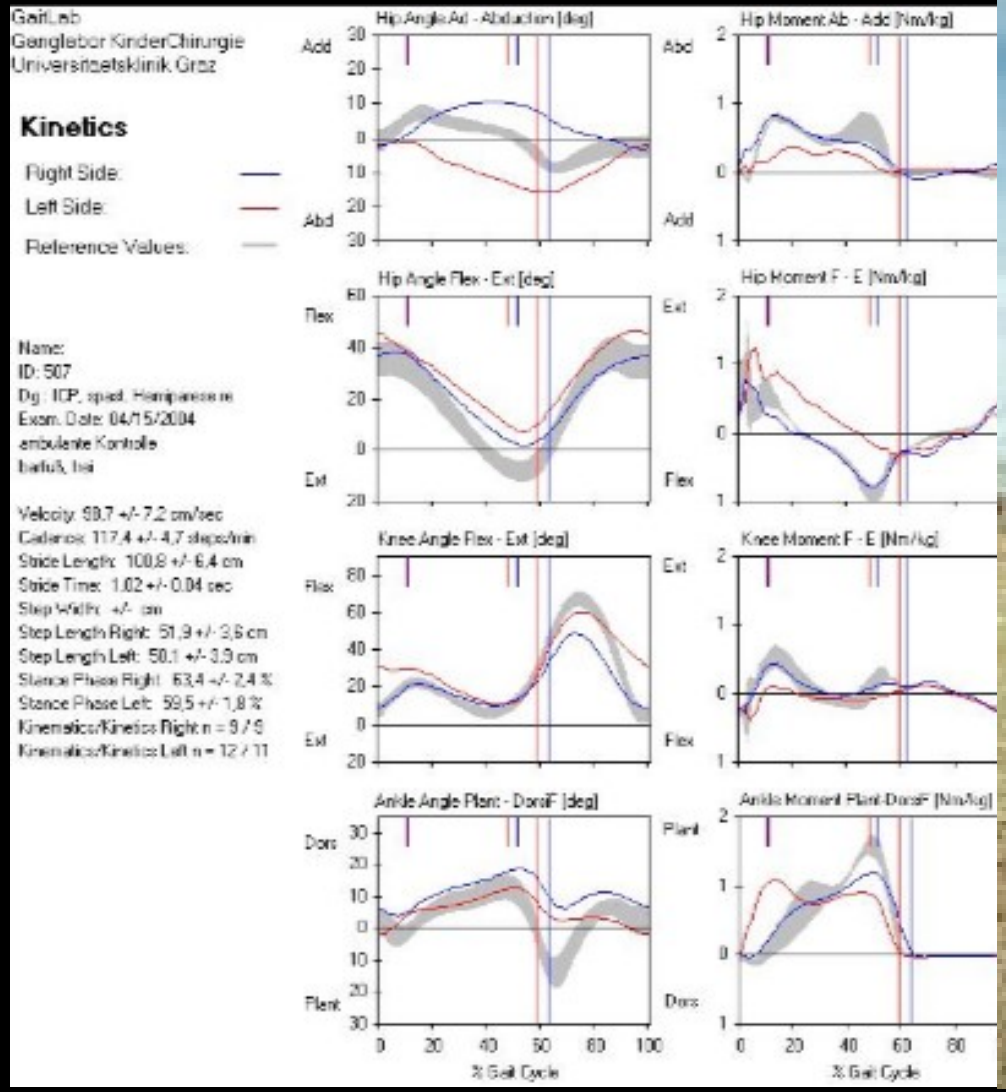
Most common (according to me, in our area):

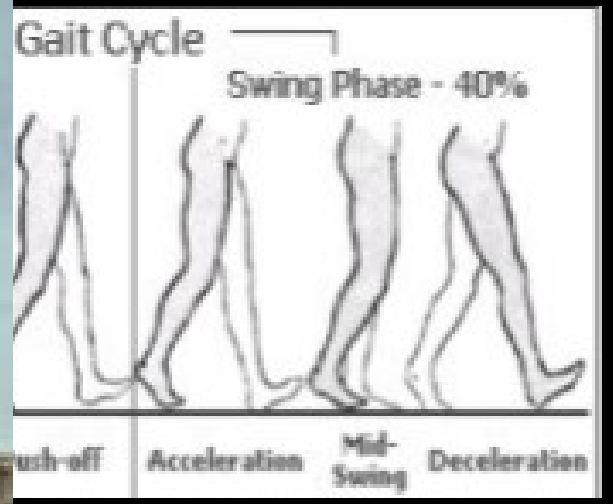
- Flat foot
- Spine/scoliosis
- Knee Vs hip pain
- 2nd hip displasia in ICP
- Trauma (+/- recent)
  - w/out imaging
  - w/out clinical evaluation

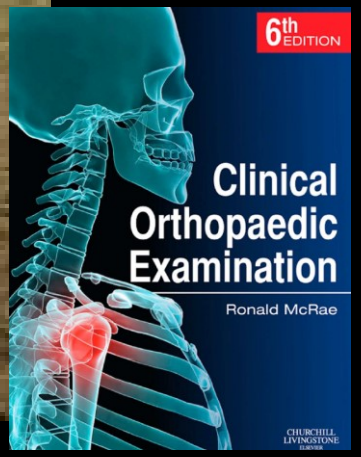
**TRAUMA =**

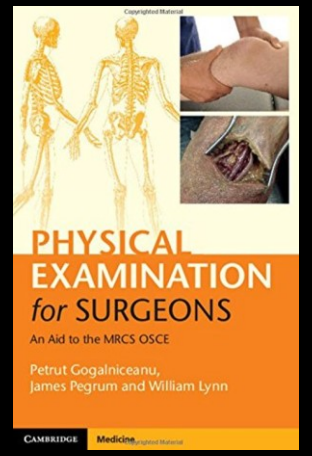
# ORTHOPAEDIC EVALUATION

- WALK (and RUN / JUMP) ANALYSIS

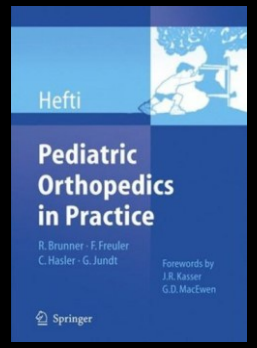


# FLEXIBLE FLATFOOT (FFF)




***"Before deciding on a treatment…carefully consider whether any treatment is even necessary"***


Rx solo se necessario trattamento!!

# ORTHOPAEDIC EVALUATION

ARTHRITIS & RHEUMATISM
Vol. 52, No. 6, June 2005, pp 1730–1735
DOI 10.1002/art.21100


## A Comparative Assessment of Alignment Angle of the Knee by Radiographic and Physical Examination Methods

Virginia B. Kraus, T. Parker Vail, Ted Worrell, and Gary McDaniel

Navali *et al. Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology* 2012, **4**:40
http://www.smarttjournal.com/content/4/1/40

SMARTT
SPORTS MEDICINE ARTHROSCOPY REHABILITATION THERAPY TECHNOLOGY

RESEARCH Open Access

## A comparative assessment of alternatives to the full-leg radiograph for determining knee joint alignment

Amir M Navali, Leila Azhar Shekoufeh Bahari* and Behrouz Nazari

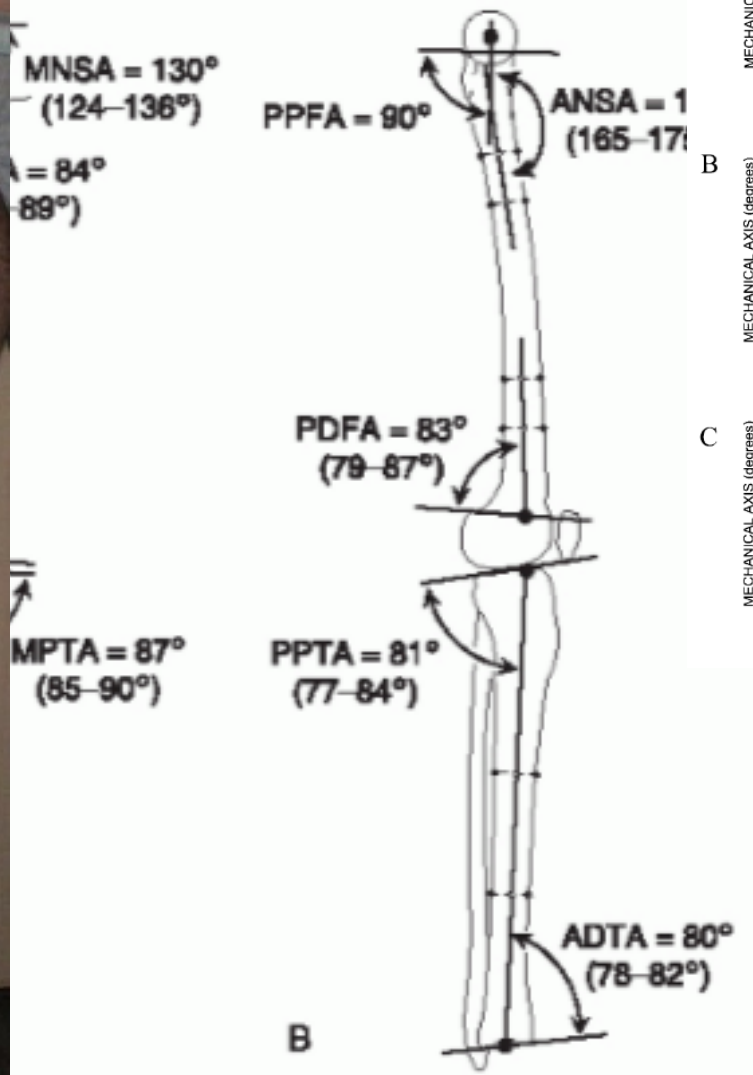
› Arthrosc Sports Med Rehabil. 2020 Dec 15;2(6):e753-e759. doi: 10.1016/j.asmr.2020.06.010. eCollection 2020 Dec.

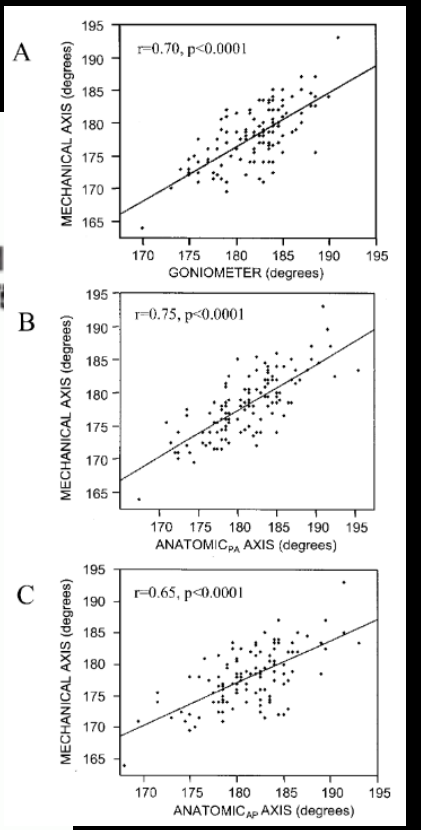
## True Mechanical Alignment is Found Only on Full-Limb and not on Standard Anteroposterior Radiographs

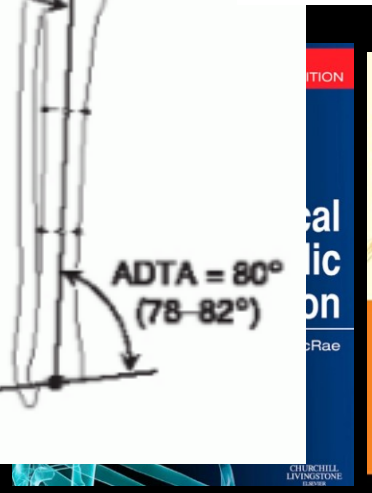
Nathan R Graden [1 2], Robert S Dean [1], David H Kahat [1 2], Nicholas N DePhillipo [1 3], Robert F LaPrade [1 2]

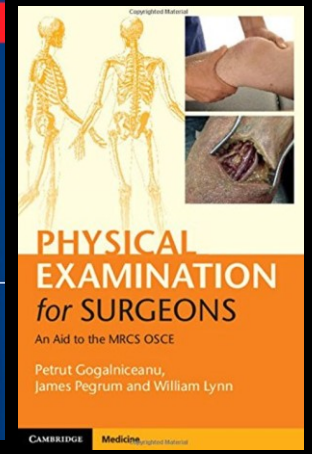
Affiliations + expand

PMID: 33364613 PMCID: PMC7754530 DOI: 10.1016/j.asmr.2020.06.010

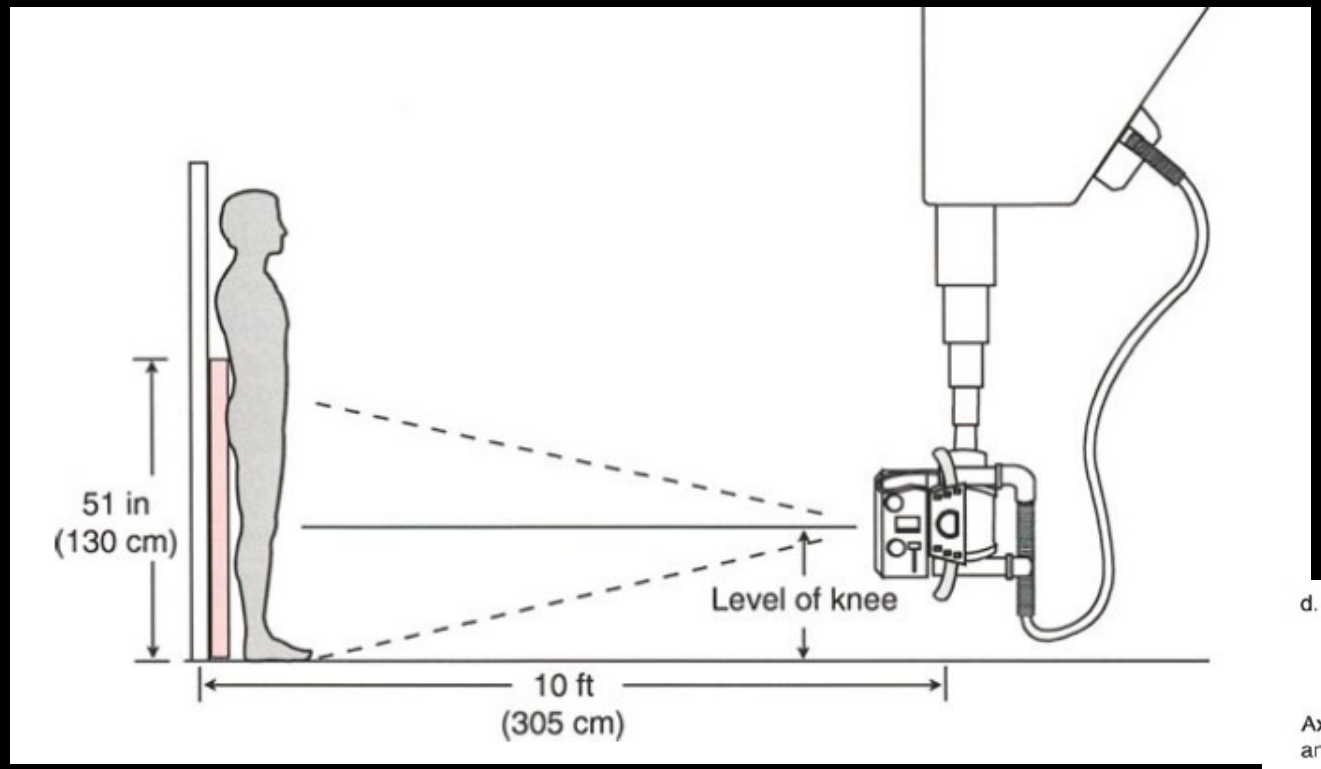


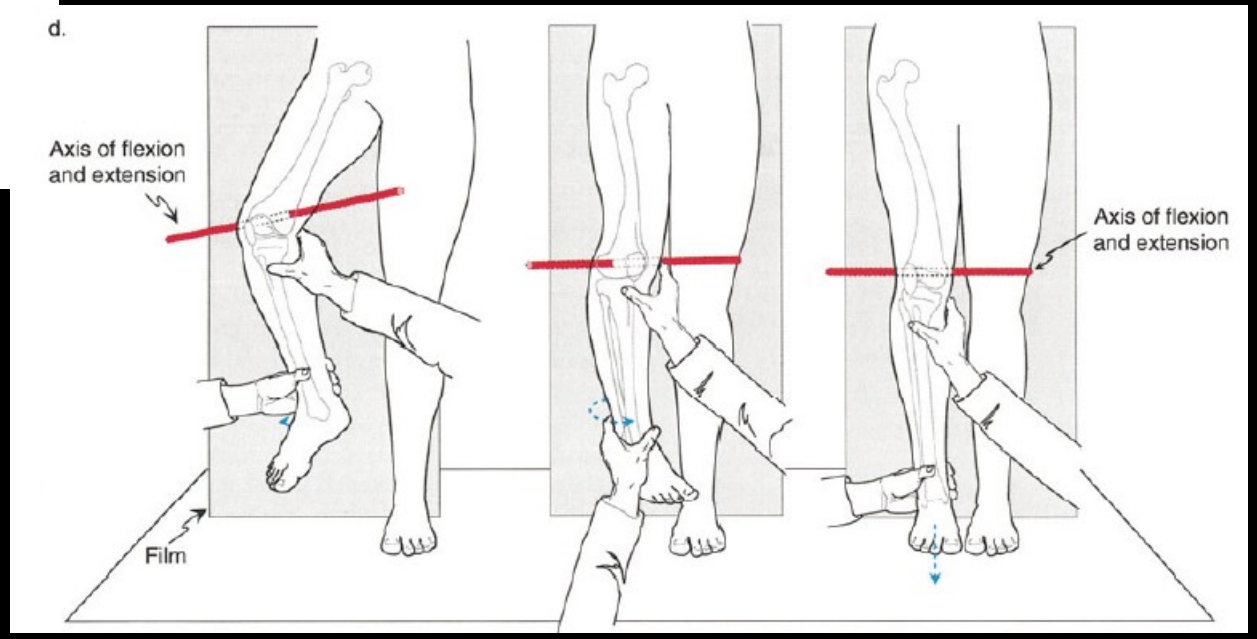



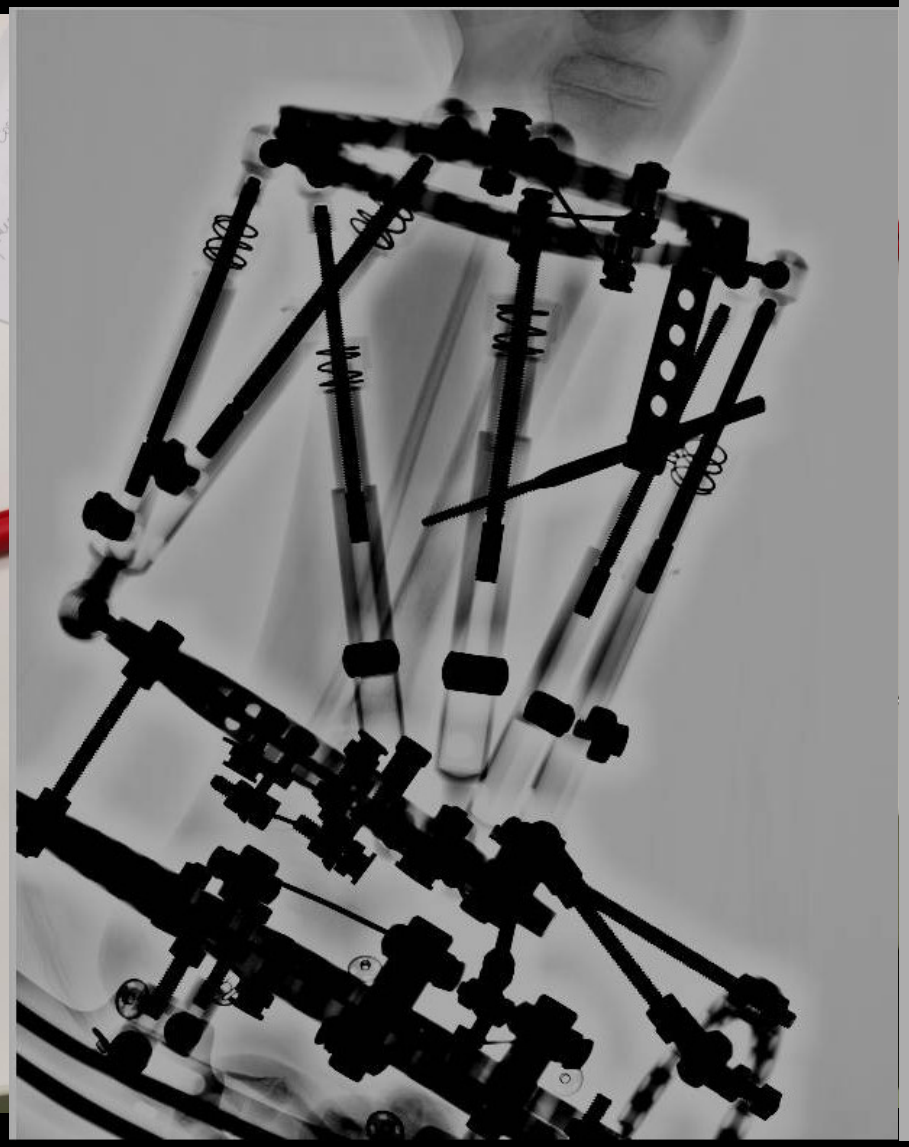



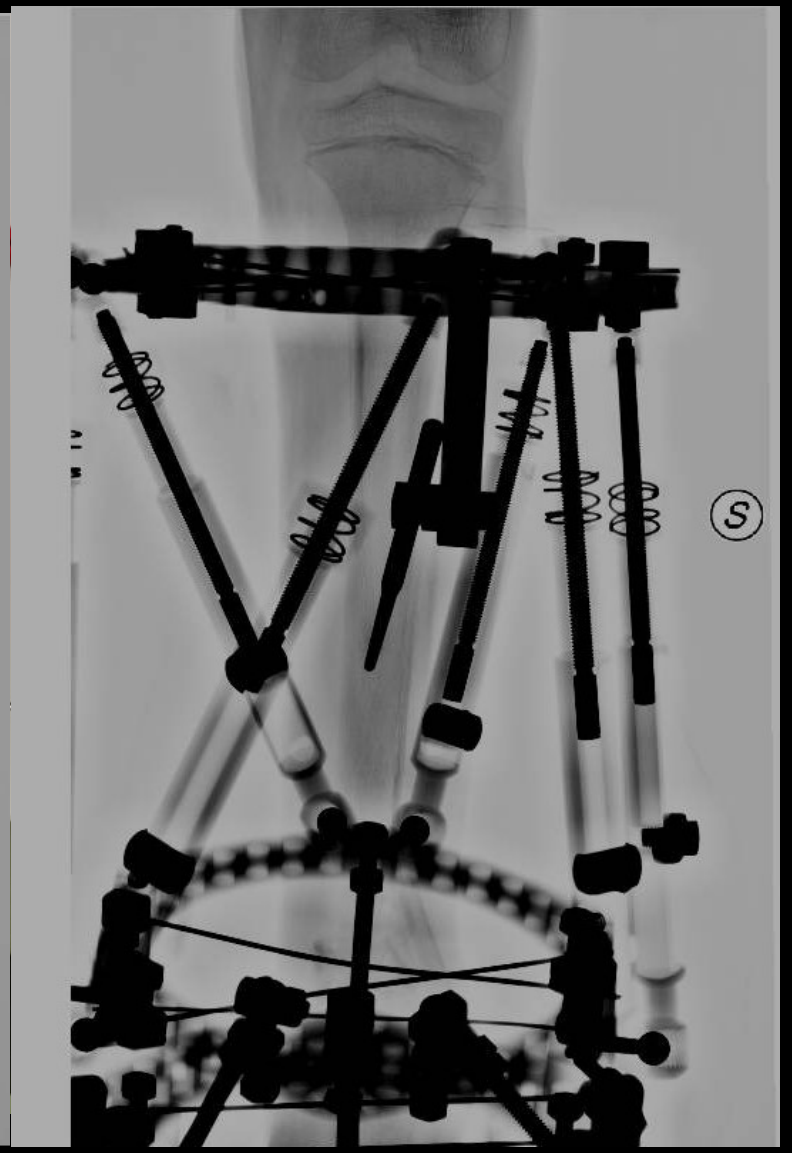


# ORTHOPAEDIC EVALUATION



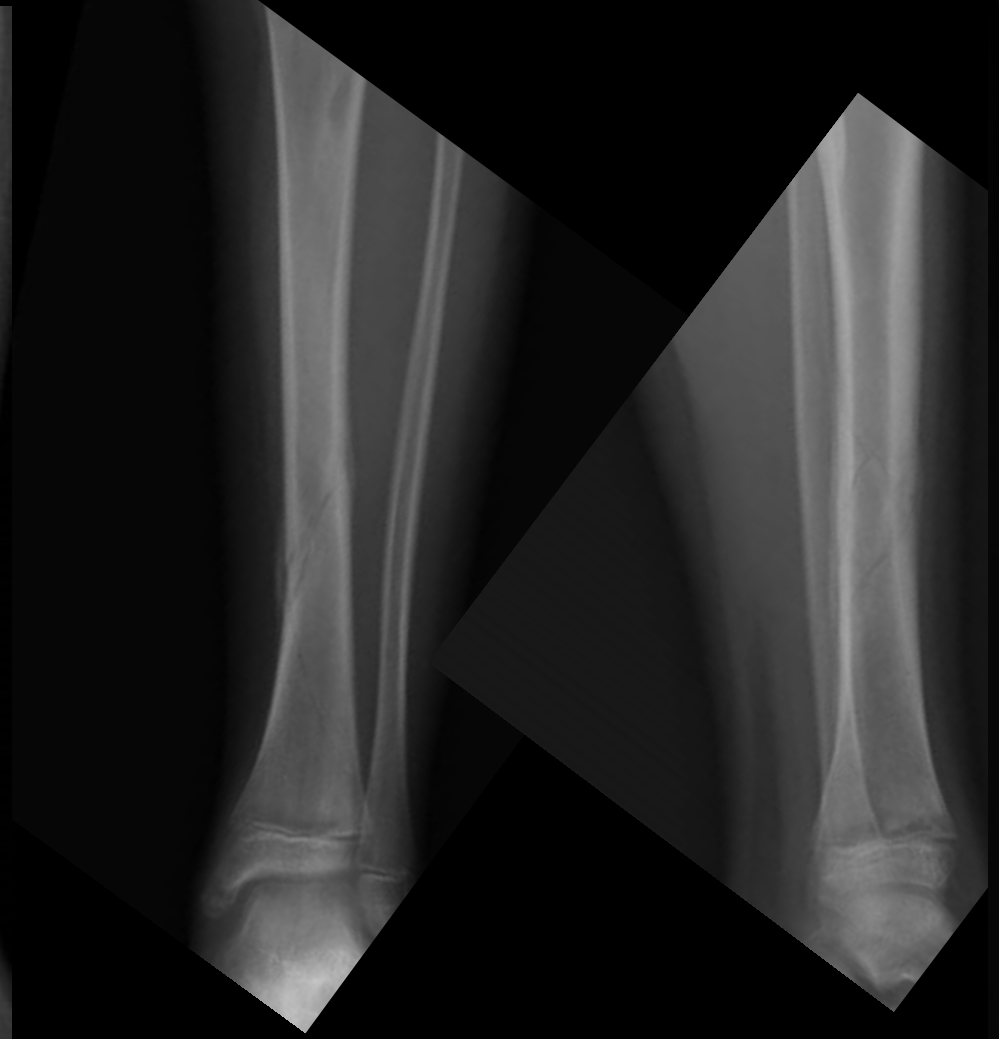







# NON ALTERNATIVE: CORRETTA INDICAZIONE

10y _ $T_0$

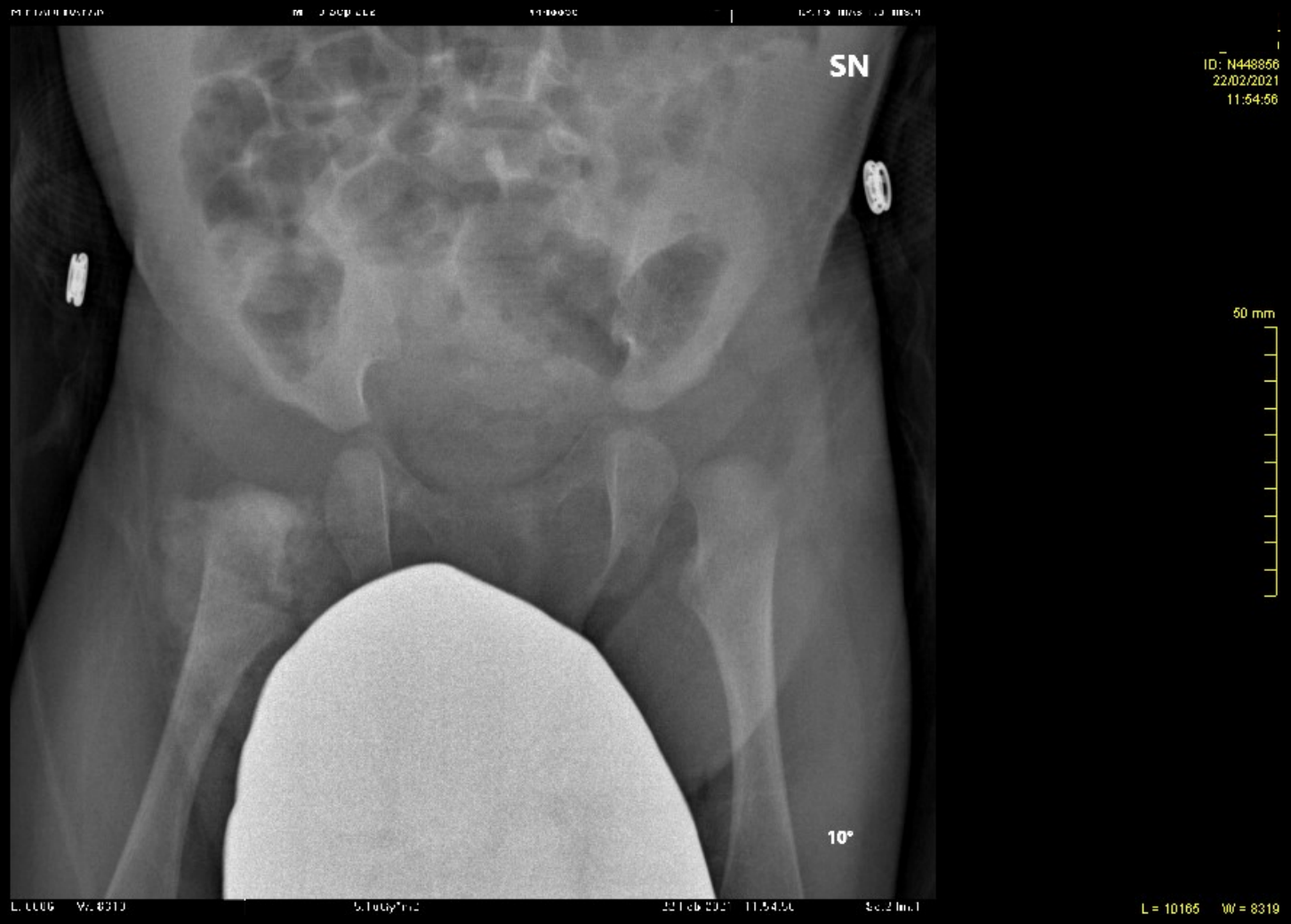


10y _ 1,5M / FWB

10y _ 3M / ?

# NON ALTERNATIVE: ESEGUIRE CORRETTAMENTE rX

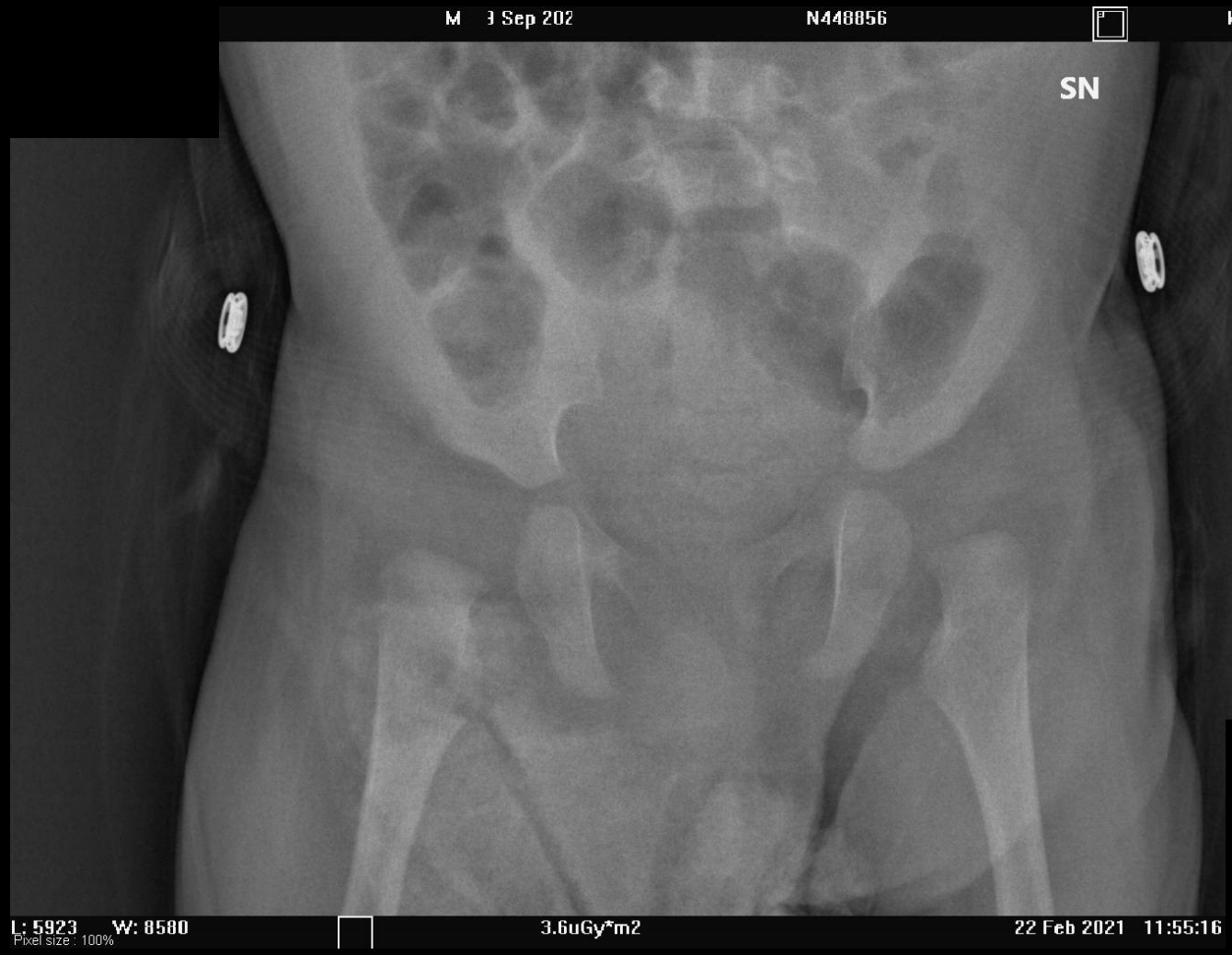
1

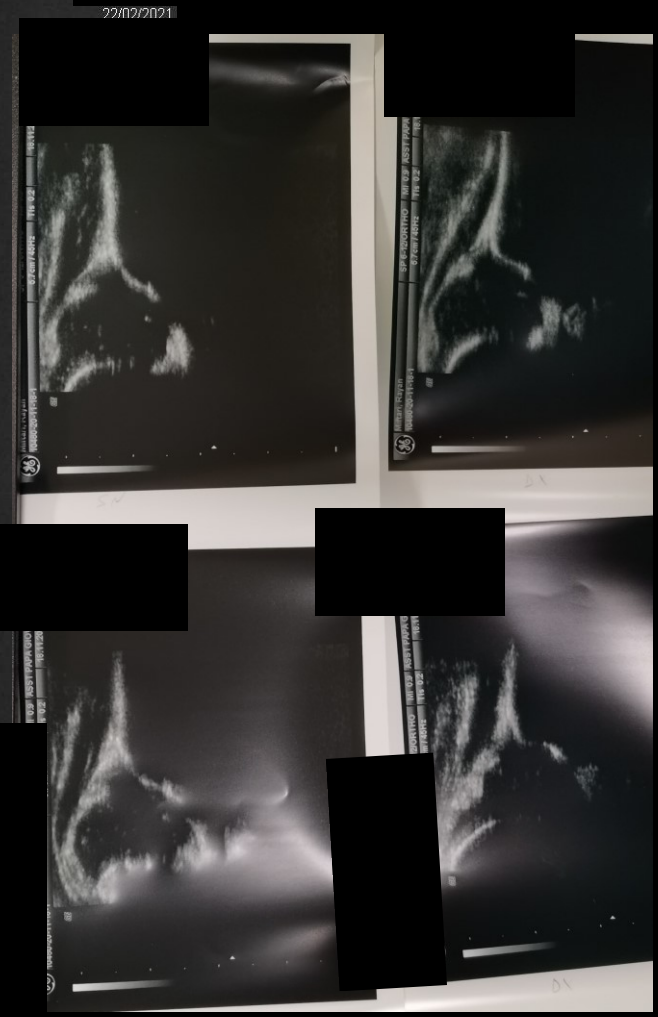



- 6 Mo - DDH init D _ Prematuro agenesia corpo calloso – facies – plagiocefalia [...]

# NON ALTERNATIVE: ESEGUIRE CORRETTAMENTE rX

2



"alterazione strutturale del femore prossimale soprattutto in sede pertrocanterica con grossolane calcificazioni andiacenti.. ptosica la porzione superiore del femore destro...si consiglia consulto ortopedico in tempi brevi"

# NON ALTERNATIVE: ESEGUIRE CORRETTAMENTE rX

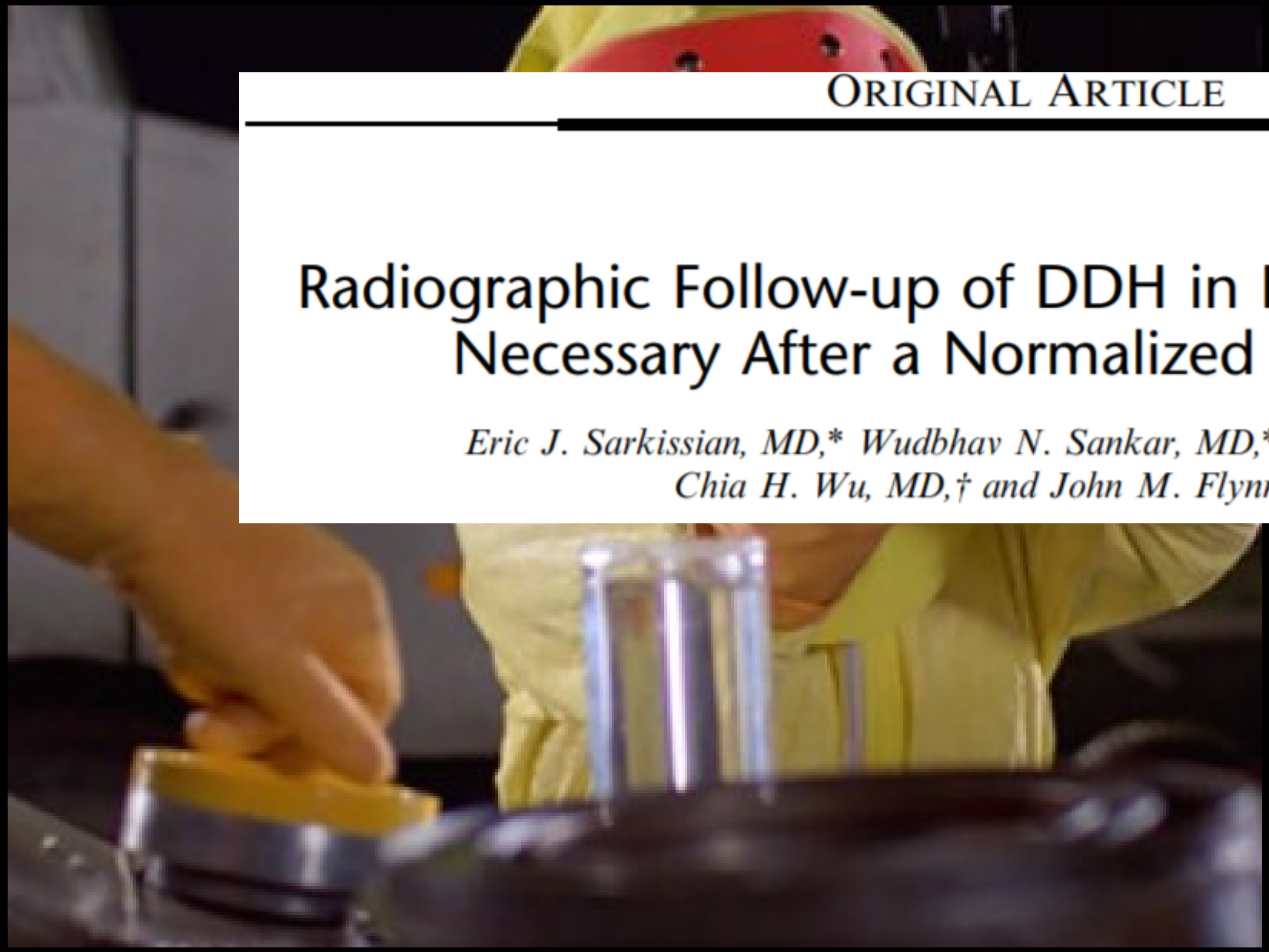
3

# NON ALTERNATIVE: ESEGUIRE CORRETTAMENTE rX

## RAW MATERIAL CHARACTERISTICS

| | |
|---|---|
| **Topsheet:** | Polypropylene (PP); permanently hydrophilic non-woven. |
| **3 Layer Design made of:** | |
| 1) Acquisition Layer: | Polyethylene (PET) and polypropylene (PP); white. |
| 2) Absorbent Core: | |
| a) SAP: | Super absorbent polymer and permeable polyacrylate. |
| b) Fluff: | 100% FSC-certified cellulose fluff; ECF-bleached with chlorine dioxide. |
| 3) Dusting Layer: | 100% FSC-certified cellulose fluff; ECF-bleached with chlorine dioxide. |
| **Standing Leg Cuffs:** | Polypropylene (PP); hydrophobic. |
| **Leg Elastics:** | Spandex and polypropylene (PP). |
| **Backsheet:** | Breathable textile backsheet (BTBS). |
| **Construction Adhesive:** | Hot melt adhesive (HMA) sprayed between layers; consists of resin and wax. |
| **Closure System:** | Polypropylene (PP) hook tabs for repositioning. |
| **Frontal Tape:** | Polyethylene (PET) and polypropylene (PP). |
| **Lot Number:** | Machine number and production date printed with ink on front ear of the diaper, bag and case. |
| **Wetness Indicator:** | Hot melt adhesive (HMA) that changes color when wet. |
| **Shelf Life:** | 5 years |
| **Package:** | LDPE 4 LDPE |

# NON ALTERNATIVE: ESEGUIRE CORRETTAMENTE rX



ORIGINAL ARTICLE

## Radiographic Follow-up of DDH in Infants: Are X-rays Necessary After a Normalized Ultrasound?

*Eric J. Sarkissian, MD,* Wudbhav N. Sankar, MD,* Xiaowei Zhu, MS,*
Chia H. Wu, MD,† and John M. Flynn, MD**

Y

# NON ALTERNATIVE: ESEGUIRE CORRETTAMENTE rX

*The British Journal of Radiology, 82* (2009), 363–370

## The use of gonad shielding in paediatric hip and pelvis radiographs

S L FAWCETT, BA, BM BCh, MRCS and S J BARTER, MBBS, MRCP, FRCR

*Addenbrooke's Hospital, University of Cambridge Teaching Hospitals NHS Foundation Trust, Hills Road, Cambridge CB2 2QQ, UK*

Jeukens *et al. Insights into Imaging* (2020) 11:15
https://doi.org/10.1186/s13244-019-0828-1

Insights into Imaging

ORIGINAL ARTICLE Open Access

## Gonad shielding in pelvic radiography: modern optimised X-ray systems might allow its discontinuation

Cécile R. L. P. N. Jeukens*, Gerhard Kütterer, Pierre J. Kicken, Marij J. Frantzen, Jos M. A. van Engelshoven, Joachim E. Wildberger and Gerrit J. Kemerink

Original Clinical Article

JOURNAL OF CHILDREN'S ORTHOPAEDICS

## Gonadal shield: is it the Albatross hanging around the neck of developmental dysplasia of the hip research?

A. Kumar[1]
W. W. Chau[1]
A. L.-H. Hung[1]
J. K.-T. Wong[2]
B. K. W. Ng[1]
J. C. Y. Cheng[1]

in female patients than male patients (68.1% *versus* 11.1%, $p < 0.01$). GS was ineffective at gonadal protection in 73.2% (41) of the pelvises with worse protection in female patients (78.7% vs 44.4%; $p = 0.03$).

*Conclusions* Ironically, essential anatomy was obstructed in all the adequately protected female pelvises. Routine GS usage results in substantial attrition of radiographic data in DDH patients

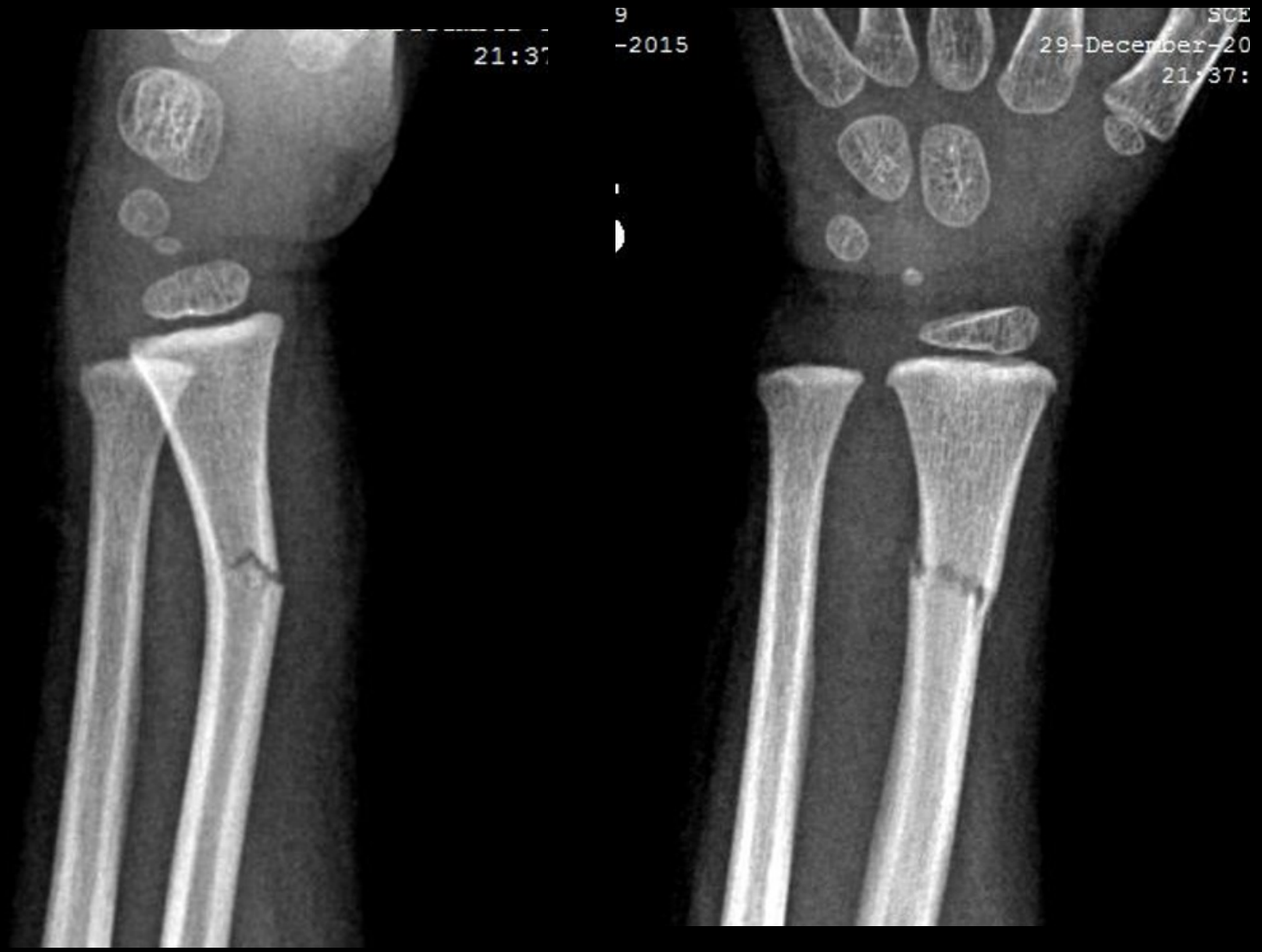
N

# NON ALTERNATIVE: rX in TRAUMA*

**TRAUMA =**

**2P DI TUTTO IL SEGMENTO INTERESSATO**
**INCL ARTICOLATIONE PROX + DISTALE**

# NON ALTERNATIVE: rX in TRAUMA*



# NON ALTERNATIVE: rX in TRAUMA*


# NON ALTERNATIVE: rX in TRAUMA*


visione d'insieme:
- bowing
- fratture associate
- [...]

# NON ALTERNATIVE: rX in TRAUMA*


# NON ALTERNATIVE: rX in TRAUMA*

**TRAUMA** =

**INTERO SEGMENTO IN 2P**

**FU** =

# NON ALTERNATIVE: rX in TRAUMA*

**TRAUMA =**

"Doubt can only be removed by action."

Johann Wolfgang von Goethe

**…THAN THERE'RE SOME EXCEPTIONS…**

- **Pronatio dolorosa**
- **Wrist (Cave! Overview?)**
- **Eversion ankle sprain screening in ED?**
- **Clavicle #**
- **Phalanx #**
- **[…]**

Pediatr Emerg Care. 2012 Sep;28(9):851-4. doi: 10.1097/PEC.0b013e318267a73d.

**Sonographic diagnosis of metaphyseal forearm fractures in children: a safe and applicable alternative to standard x-rays.**

Eckert K[1], Ackermann O, Schweiger B, Radeloff E, Liedgens P.

Emerg Med J. 2011 Oct;28(10):838-40. doi: 10.1136/emj.2009.088286. Epub 2010 Oct 13.

**The sonographic Ottawa Foot and Ankle Rules study (the SOFAR study).**

Canagasabey MD[1], Callaghan MJ, Carley S.

J Pediatr Orthop. 2015 Jul-Aug;35(5 Suppl 1):S34-6. doi: 10.1097/BPO.0000000000000542.

**Radiation Safety in Pediatric Orthopaedics.**

Caird MS[1].

# NON CI SONO ALTERNATIVE PER

1. ANAMNESI ED ESAME OBIETTIVO
2. CORRETTA INDICAZIONE
3. CORRETTA TECNICA ESECUTIVA (DELLA rX)

4. ESAME DI PRIMA LINEA PER TRAUMATOLOGIA PED*
5. ESAME DI PRIMA LINEA PER ORTOPEDIA PED*

6. rX „MEDICO-LEGALI“ NON SONO UN‘OPZIONE

* Con le dovute eccezioni.

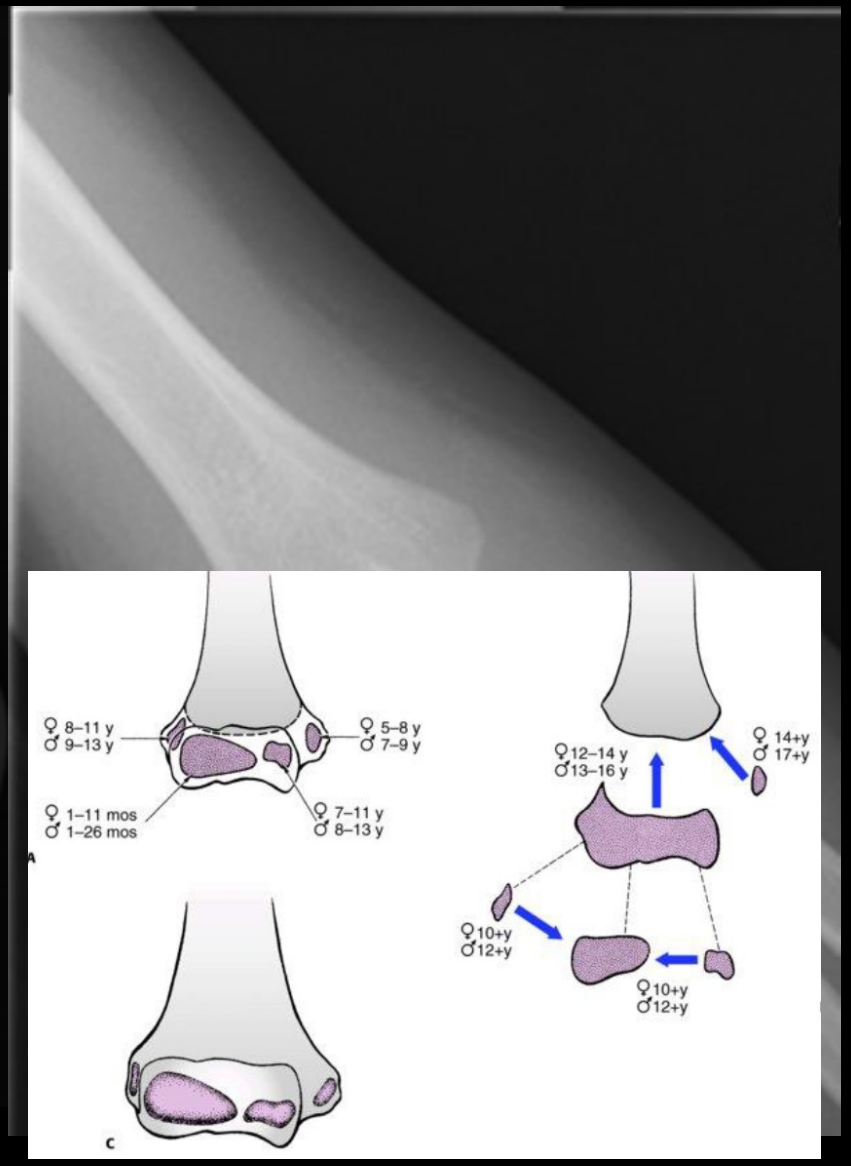
# FREQUENTI FONTI DI INUTILE ESPOSIZIONE (O&T)

1. „medico-legale“ passata
2. „medico-legale“ presente
3. „medico-legale“ futura

4. „la controlaterale“
5. Per proiezioni eseguite male
6. Rimozione MDS -> „per documentare“ (cosa?!)
7. „guardiamo come va…“
8. rX precenti non allegate

9. rX non presenti nel proprio PACS, PACS non abilitato ad archiviare fotografie

# FREQUENTI FONTI DI INUTILE ESPOSIZIONE (O&T)

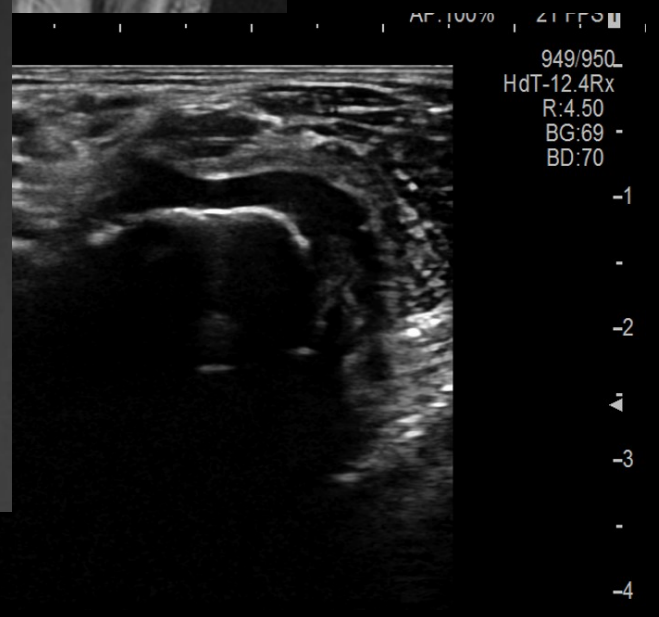



1. **Esposizione di torace e organi interni**
2. **Sequenza nuclei accrescimento**
3. **Anche con la controlaterale non possibile definire il danno articolare**

TABLE 12-1 Sequence and Timing of Ossification in the Elbow

| | *Girls (yr)* | *Boys (yr)* |
|---|---|---|
| Capitellum | 1.0 | 1.0 |
| Radial head | 5.0 | 6.0 |
| Medial epicondyle | 5.0 | 7.5 |
| Olecranon | 8.7 | 10.5 |
| Trochlea | 9.0 | 10.7 |
| Lateral epicondyle | 10.0 | 12.0 |

# FREQUENTI FONTI DI INUTILE ESPOSIZIONE (O&T)




e organi interni

scimento

terale non
nno articolare

# FREQUENTI FONTI DI INUTILE ESPOSIZIONE (O&T)

„la controlaterale“: NON PIÙ INDICATA!!!!!

- Atlanti radiografici
- Eco
- MR


alternatives

# ALTERNATIVE (?): EOS


Micro-grid Ionization-chamber (EOS)

Limite:
- disponibilità!
- 3D affidabile?

„Conclusions: The standard EOS imaging system moderately reduced the total radiation exposure to skeletally immature scoliosis patients. Over the entire treatment course, this represented 2.72 mSv mean reduction or 0.91 years of background radiation. Posteroanterior films significantly reduced breast and thyroid dose.“

Review > Health Technol Assess. 2012;16(14):1-188. doi: 10.3310/hta16140.

**EOS 2D/3D X-ray imaging system: a systematic review and economic evaluation**

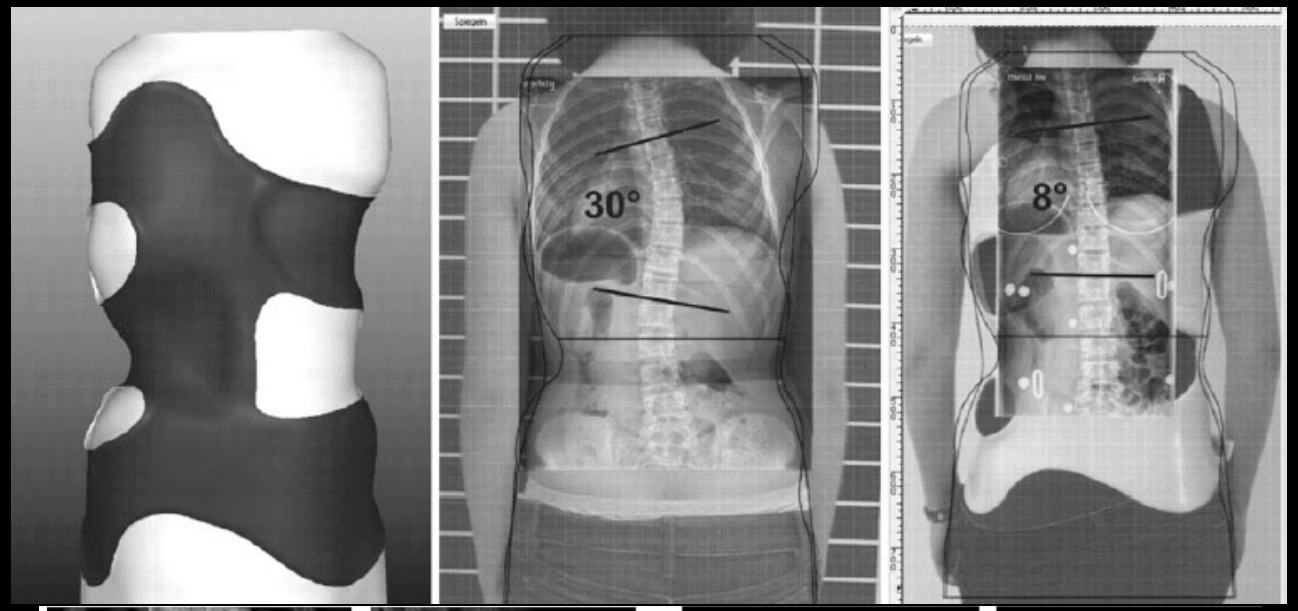
C McKenna [1], R Wade, R Faria, H Yang, L Stirk, N Gummerson, M Sculpher, N Woolacott

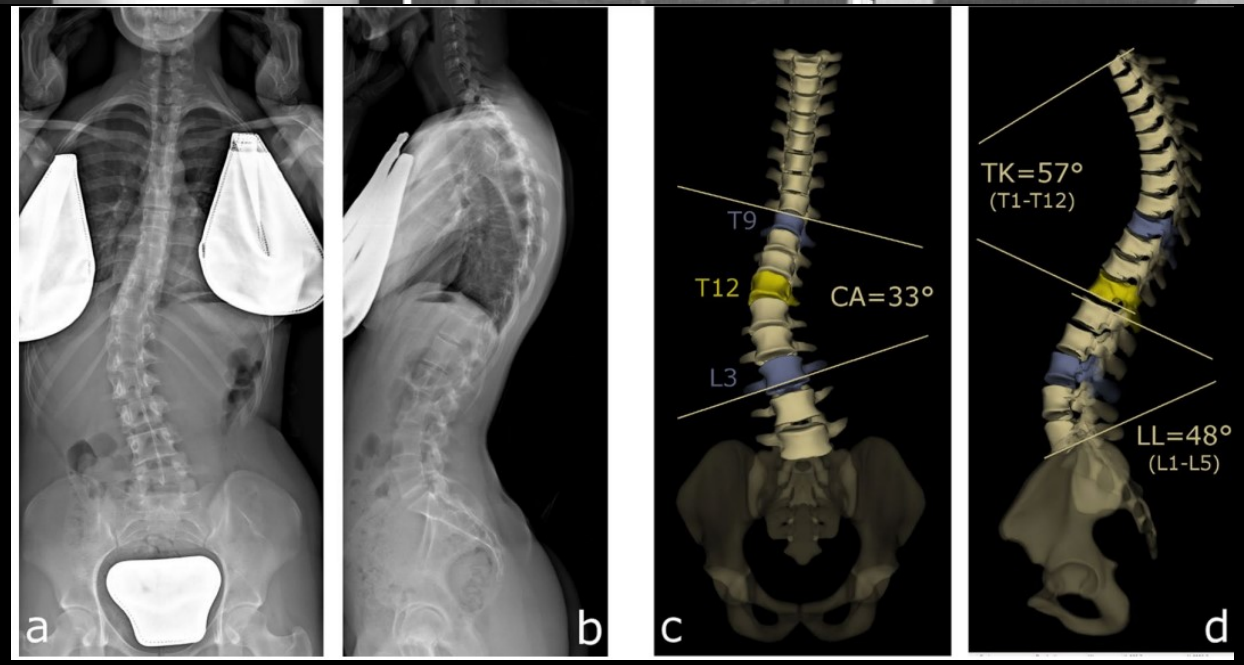
Comparative Study > Spine (Phila Pa 1976). 1996 Jul 1;21(13):1540-7; discussion 1548. doi: 10.1097/00007632-199607010-00011.

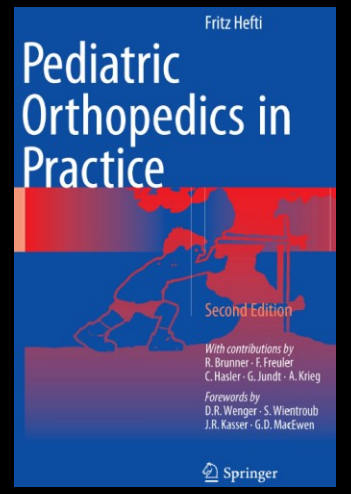
**Reducing the lifetime risk of cancer from spinal radiographs among people with adolescent idiopathic scoliosis**

A R Levy [1], M S Goldberg, N E Mayo, J A Hanley, B Poitras

# ALTERNATIVE (?): Scoliosi




PA e LL alla prima rx, quindi
Controllo clinico ogni 3M e
Controllo rX PA (6-12 mesi)

Controllo in bustino solo al collaudo

Rasterstereography è riconosciuta sicuramente per lo screening, la sua validità nel monitorare la progressione di una curva in trattamento è dibattuta.

Disponibile anche (ma meno diffusa) moirè photometry

› Eur Spine J. 2019 Mar;28(3):526-535. doi: 10.1007/s00586-018-05876-0. Epub 2019 Jan 7.

**Is rasterstereography a valid noninvasive method for the screening of juvenile and adolescent idiopathic scoliosis?**

Tito Bassani [1], Elena Stucovitz [2], Fabio Galbusera [2], Marco Brayda-Bruno [3]

# ALTERNATIVE (?): low dose standing CT


Low dose 3D scan

Limite:
- disponibilità!
- indicazioni


# ALTERNATIVE: MR

Vantaggi

- Non rX
- Visualizzare cartilagine, tessuti molli, versamento
- contrasto
- Patologia reumatica, traumatologica, infettiva e neoplastica
- (meno rispetto a eco) operatore dipendente

Limiti:

- Sedazione
- Non in carico
- Costi/disponibilità

ALTERNATIVE: MR

# Alternativa o 2nd livello ?

# ALTERNATIVE: MR Vs rX

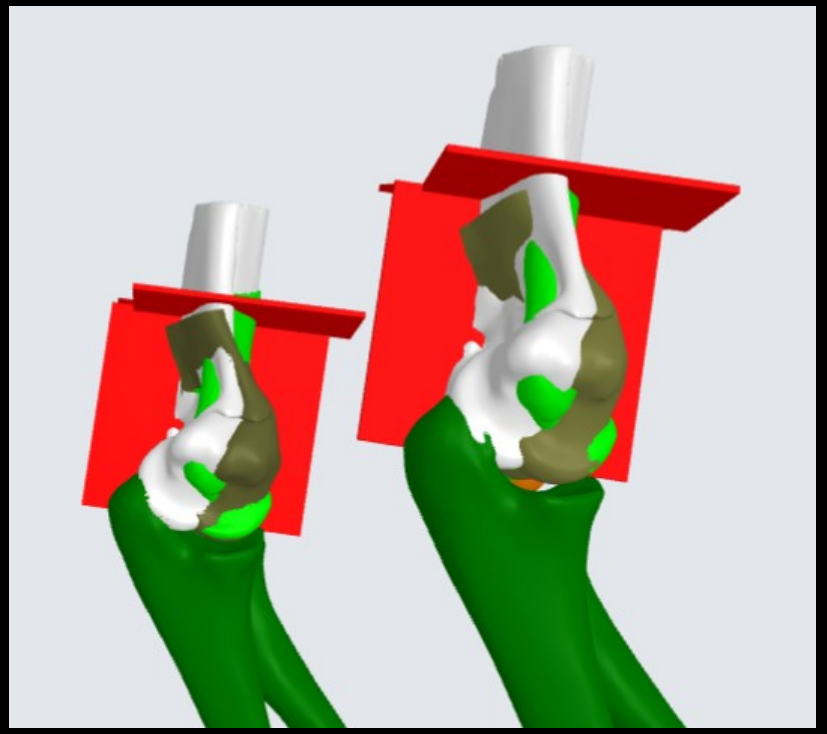
Lesioni articolari/periarticolari ( 1° livello?!)

OAI (diagnosi, FU)

(controllo in gesso DDH)

Studio della torsione
planning 3D

# ALTERNATIVE: MR Vs CT



Patologia traumatica

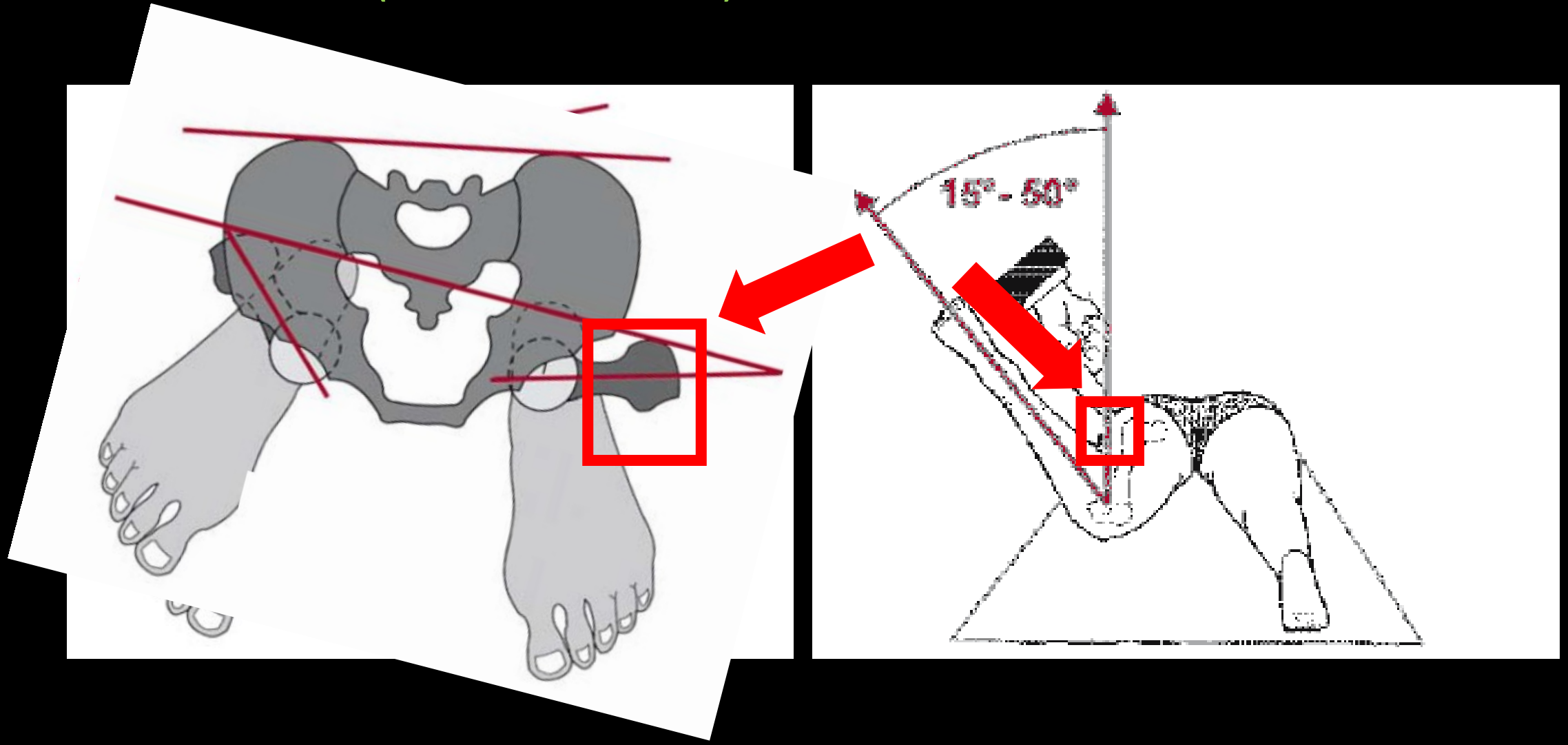
Studio della torsione/deformità
planning 3D

In alcune condizioni sostituisce scintigrafia ossea (CRMO…)

NB sono solo le „alternative“! In sostanza, a parte la patologia neoplastica e politrauma, la TC può essere sempre sostituita da MR. Unico problema è la sua disponibilità ed evtl sedazione.

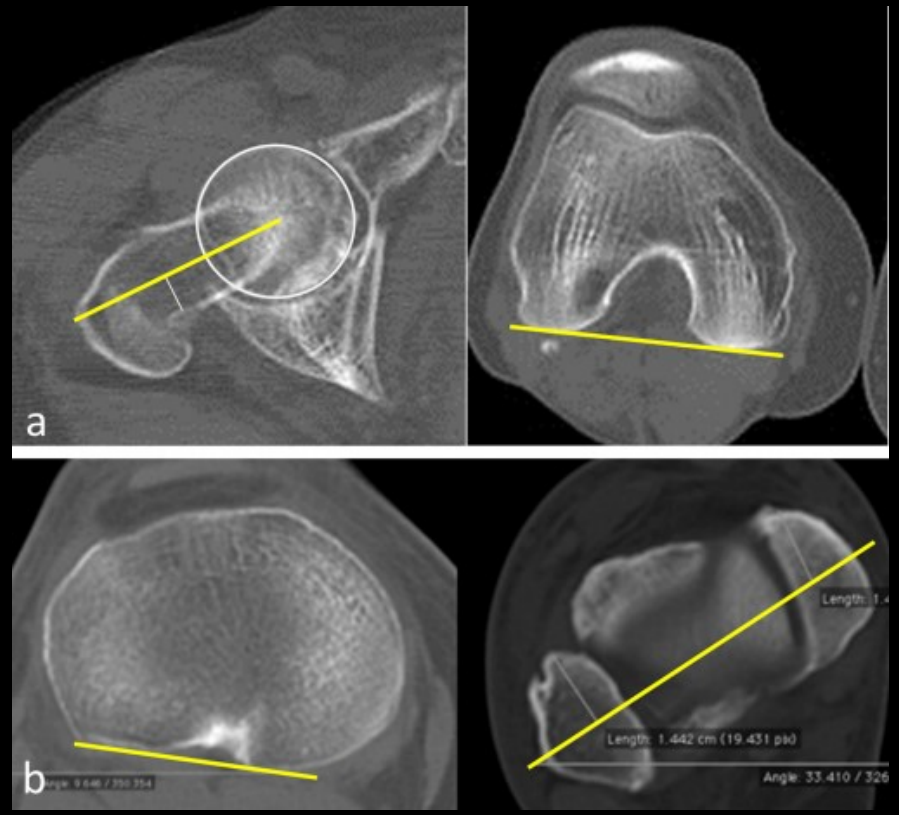
# ALTERNATIVE: MR Vs CT

Femoral torsion (-> anteversion…): how can it be mearsured?



# ALTERNATIVE: MR Vs CT

Femoral torsion (-> anteversion…): how can it be mearsured?




Orthopaedics & Traumatology: Surgery & Research (2013) 99, 509–516

Available online at SciVerse ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com/en

ORIGINAL ARTICLE

**Measuring femoral and rotational alignment: EOS system versus computed tomography**

D. Folinais[a,*], P. Thelen[a], C. Delin[a], C. Radier[a], Y. Catonne[b], J.Y. Lazennec[b]

# ALTERNATIVE: MR Vs CT

Femoral torsion (-> anteversion…): how can it be mearsured?

J Bone Joint Surg Am. 2006 Jan;88(1):138-43.

**Ultrasound measurements of torsions in the tibia and femur.**

Hudson D[1], Royer T, Richards J.

Accuracy and Reliability of Computed Tomography and Magnetic Resonance Imaging Compared With True Anatomic Femoral Version

*Michael J. Beebe, MD,*† James D. Wylie, MD, MHS,* Bill G. Bodine, BS,* Ashley L. Kapron, PhD,* Travis G. Maak, MD,* Omer Mei-Dan, MD,‡ and Stephen K. Aoki, MD**

Gait Posture. 2008 Nov;28(4):708-10. doi: 10.1016/j.gaitpost.2008.04.017. Epub 2008 Jun 13.

**A comparison of ultrasound to goniometric and inclinometer measurements of torsion in the tibia and femur.**

Hudson D[1].


Eco

# ALTERNATIVE: Ecografia

REVIEWS: REVIEW ARTICLE

## Ultrasound Evaluation of Pediatric Orthopaedic Patients

Litrenta, Jody MD; Masrouha, Karim MD; Wasterlain, Amy MD; Castaneda, Pablo MD

Author Information

Journal of the American Academy of Orthopaedic Surgeons: August 15, 2020 - Volume 28 - Issue 16 - p e696-e705
doi: 10.5435/JAAOS-D-17-00895

Disponibilità
Non rX
Visualizzare cartilagine, tessuti molli, versamento
Patologia reumatica

Limite:
- operatore dipendente
- solo superficie ossea
- standard mancanti per molte condizioni

ORIGINAL ARTICLE

## Sonographic Diagnosis of Metaphyseal Forearm Fractures in Children

*A Safe and Applicable Alternative to Standard X-Rays*

*Kolja Eckert, MD,* Ole Ackermann, MD,† Bernd Schweiger, MD,‡ Elke Radeloff, MD,* and Peter Liedgens, MD**

Zum Thema: **Sonographie**

W. Grechenig[1] · G. Pelcha[1] · H. Clement[1] · M. Fellinger[1] · J. Mayr[2]
[1] Universitätsklinik für Unfallchirurgie, Graz
[2] Universitätsklinik für Kinderchirurgie, Graz

## Sonographie beim Trauma

# ALTERNATIVE: Ecografia

RMD Open. 2021 Apr;7(2):e001581. doi: 10.1136/rmdopen-2021-001581.

**Development and reliability of a novel ultrasonographic joint-specific scoring system for synovitis with reference atlas for patients with juvenile idiopathic arthritis**

Nina Krafft Sande [1], Pernille Bøyesen [2], Anna-Birgitte Aga [2], Hilde Berner Hammer [3 4], Berit Flatø [2 4], Johannes Roth [5], Vibke Lilleby [2]

Settings and artefacts relevant in colour/power Doppler ultrasound in rheumatology

S T Torp-Pedersen, L Terslev

Disponibilità
Non rX
Visualizzare cartilagine, tessuti molli, versamento
Patologia reumatica

Limite:
- operatore dipendente
- solo superficie ossea
- standard mancanti per molte condizioni

# ALTERNATIVE: Ecografia

Orthopäde
2002 · 31:143-153 © Springer-Verlag 2002

Zum Thema: **Sonographie**

W. Grechenig[1] · G. Pelcha[1] · H. Clement[1] · M. Fellinger[1] · J. Mayr[2]
[1] Universitätsklinik für Unfallchirurgie, Graz
[2] Universitätsklinik für Kinderchirurgie, Graz

**Sonographie**

Orthopäde
2002 · 31:135-142 © Springer-Verlag 2002

Zum Thema: **Sonographie**

J. Mayr[1] · W. Grechenig[2] · G. Pelcha[2]
[1] Universitätsklinik für Kinderchirurgie,
[2] Universitätsklinik für Unfallchirurgie,
[3] Anatomisches Institut, Karl-Franzens-

**Sonoanato**
**der kindlic**

Arthritis Care & Research
Vol. 68, No. 3, March 2016, pp 348–356
DOI 10.1002/acr.22670


ORIGINAL ARTICLE

## Toward Standardized Musculoskeletal Ultrasound in Pediatric Rheumatology: Normal Age-Related Ultrasound Findings

PAZ COLLADO,[1] JELENA VOJINOVIC,[2] JUAN CARLOS NIETO,[3] DANIEL WINDSCHALL,[4] SILVIA MAGNI-MANZONI,[5] GEORGE A. W. BRUYN,[6] ANNAMARIA IAGNOCCO,[7] MARIA ANTONIETTA D'AGOSTINO,[8] AND ESPERANZA NAREDO,[3] ON BEHALF OF THE OMERACT ULTRASOUND PEDIATRIC GROUP

Sonda lineare 7.5 -> 20 MHz (di solito 7.5 -> 12 MHz sono sufficienti)

Mini_Convex per DDH neonatale è unica eccezione

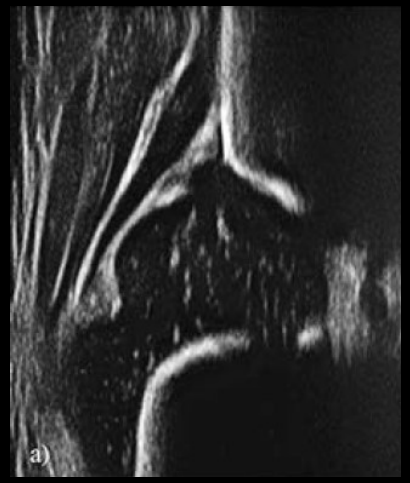
Color Doppler/Power Doppler

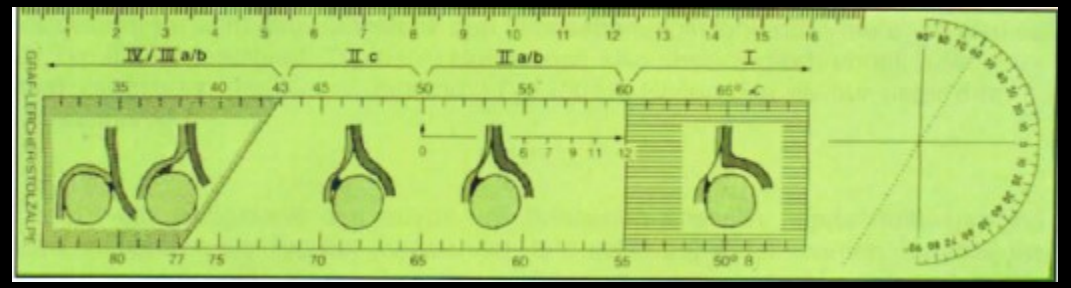
Lettino e braccio guida per sonda per DDH

## Settings and artefacts relevant in colour/power Doppler ultrasound in rheumatology

S T Torp-Pedersen, L Terslev

# ALTERNATIVE: Ecografia / Displasia anca_Graf




Screening universale < 6 settimane

Trattamento conservativo

Possibile fino a che la maturazione del nucleo di ossificazione della testa del femore rende NON visibile il fondo dell'acetabolo. Ciò accade in media tra 8 e 12 mesi di vita ma, in sostanza, va valutato caso per caso.

Nel trattamento uso combinato rX + ecografia (+ evtl MR)

*Review*

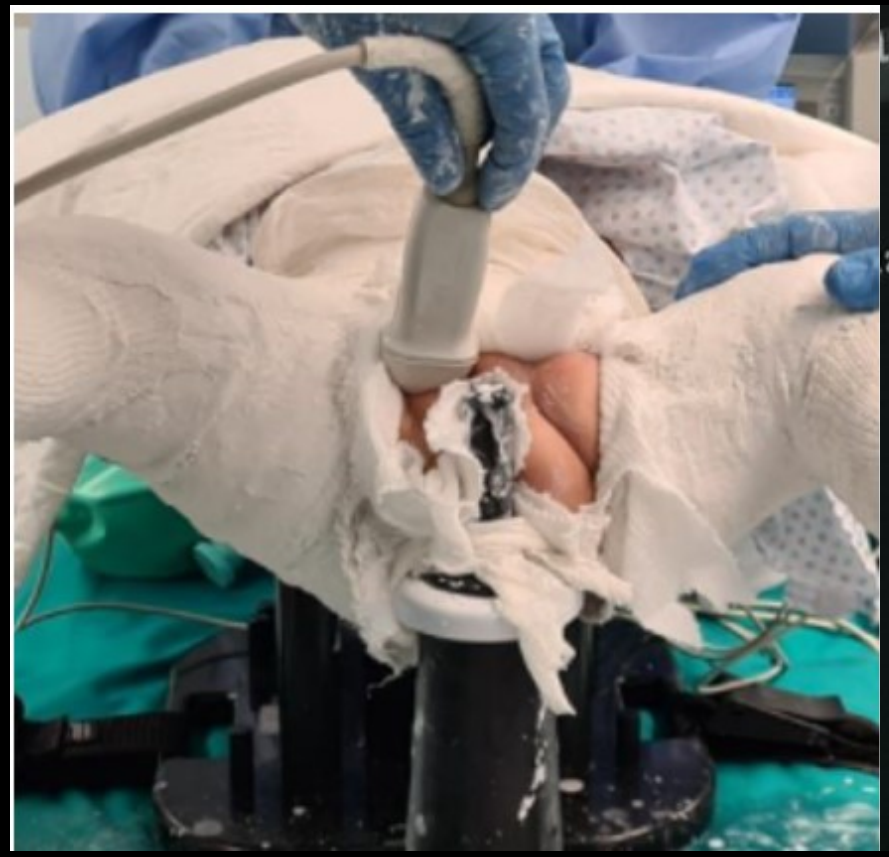
*Med Ultrason 2013, Vol. 15, no. 4, 299-303*
DOI:

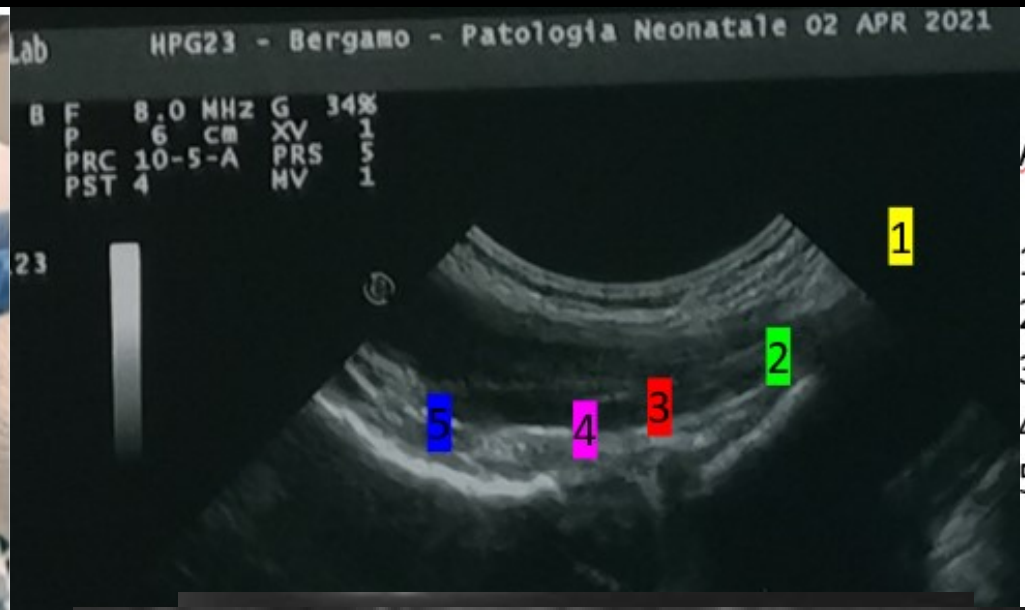
**Hip sonography update. Quality-management, catastrophes – tips and tricks**

**Reinhard Graf, Mohammad Mohajer, Florian Plattner**

Orthopädie LKH-Stolzalpe, Austria

# ALTERNATIVE: Ecografia / Displasia anca_van Douveren






Anatomic landmarks:

1. Bladder / Simphysis
2. Ramus superior Os Pubis
3. Labrum
4. Femural head
5. Femur neck

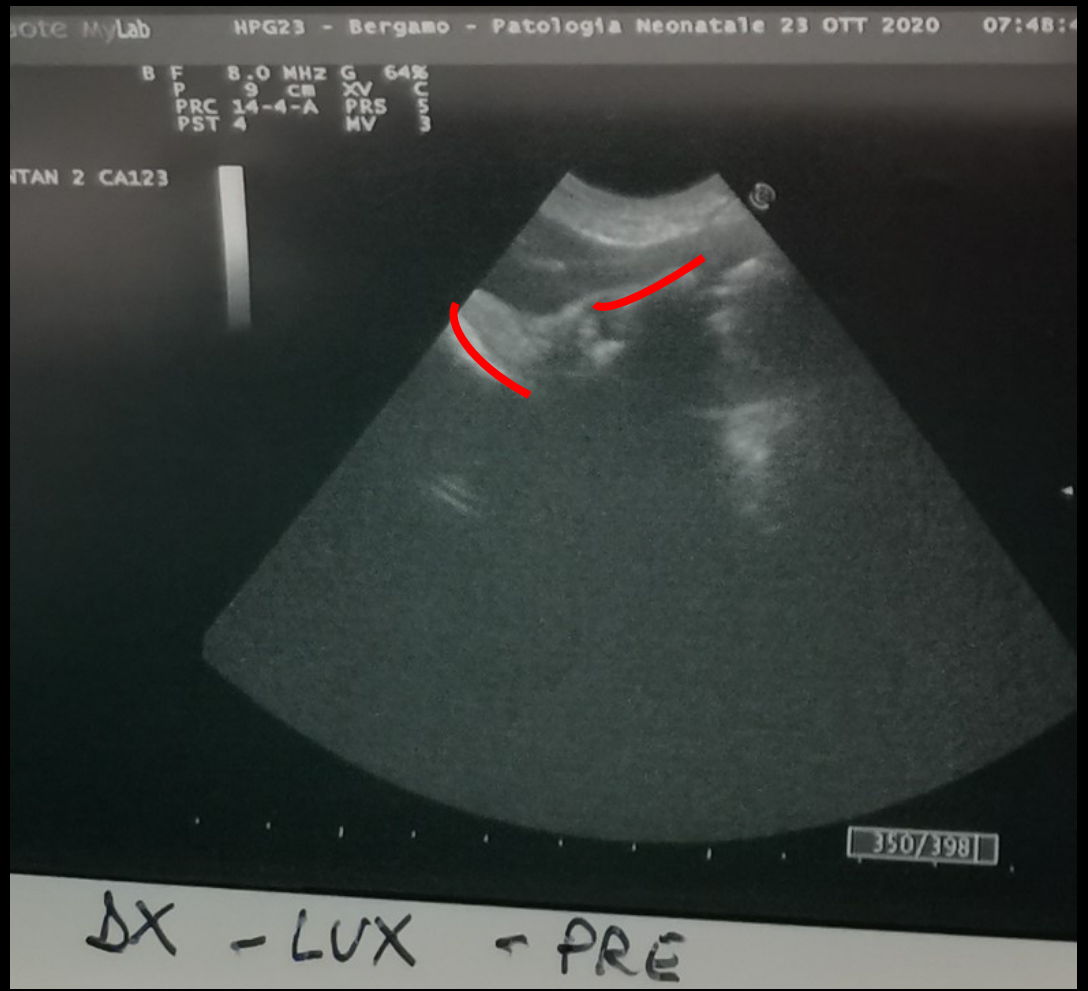
THE JOURNAL OF BONE & JOINT SURGERY (Br)

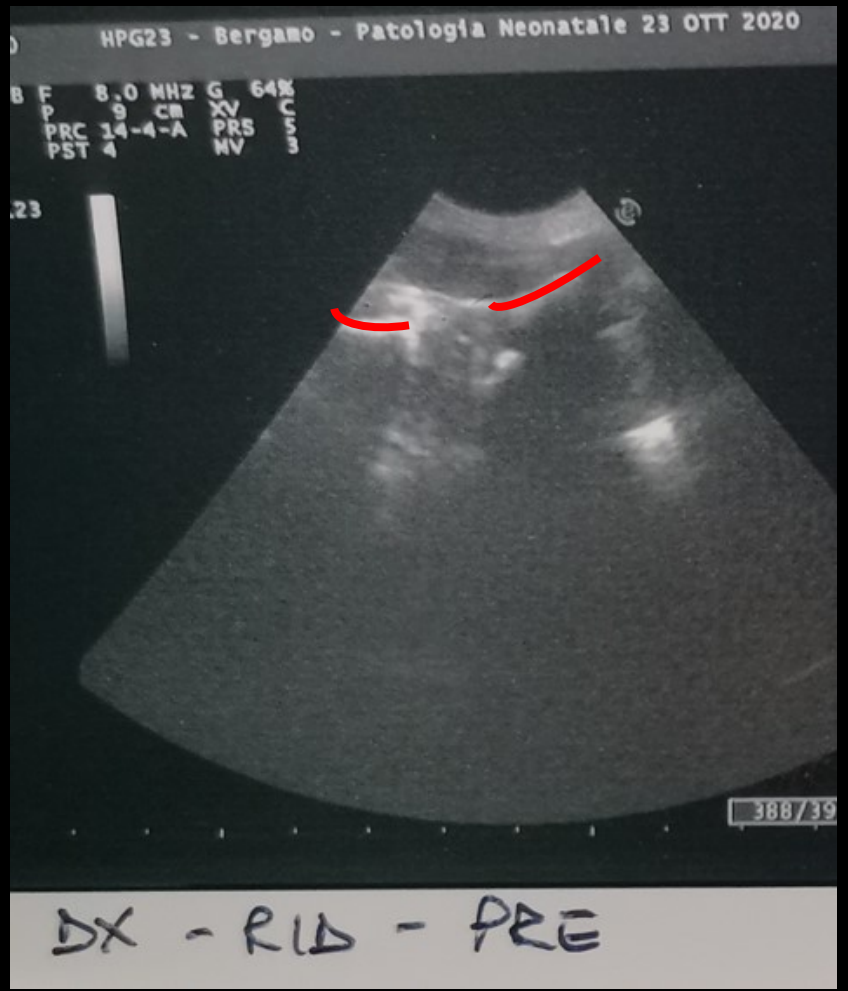
**Ultrasound in the management of the position of femoral head during treatment in a spica cast af reduction of hip dislocation in developmental dysplasia of the hip**

Florens Q. M. P. van Douveren, Hans E. H. Pruijs, Ralph J. B. Sakkers, Rutger A. J. Nievelstein, Frederik J. A. Beek

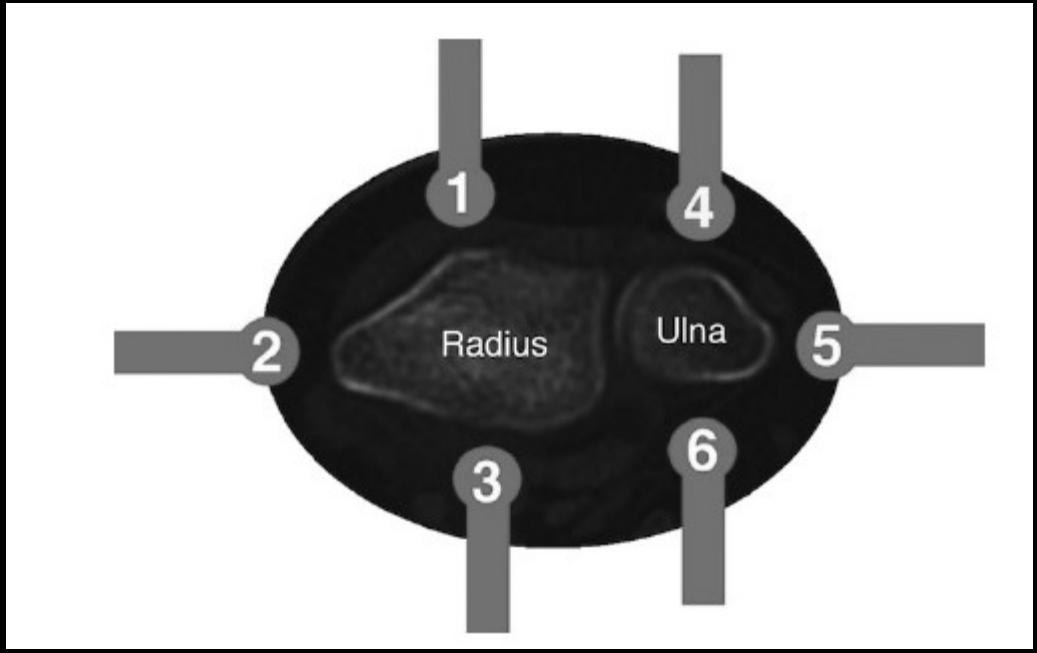
*From the Wilhelmina Children's Hospital, Utrecht, The Netherlands*

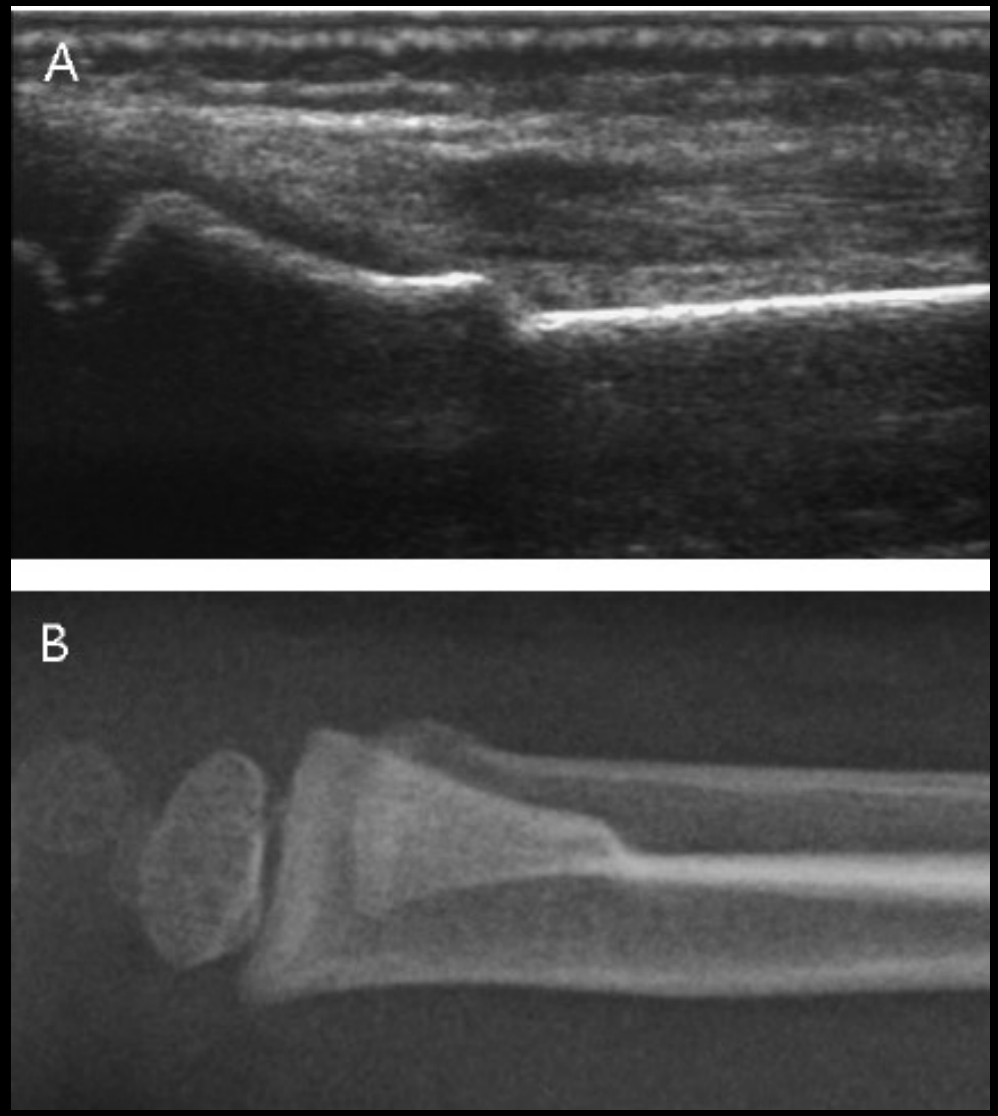
# ALTERNATIVE: Ecografia / Displasia anca_van Douveren



# ALTERNATIVE: Ecografia / Polso



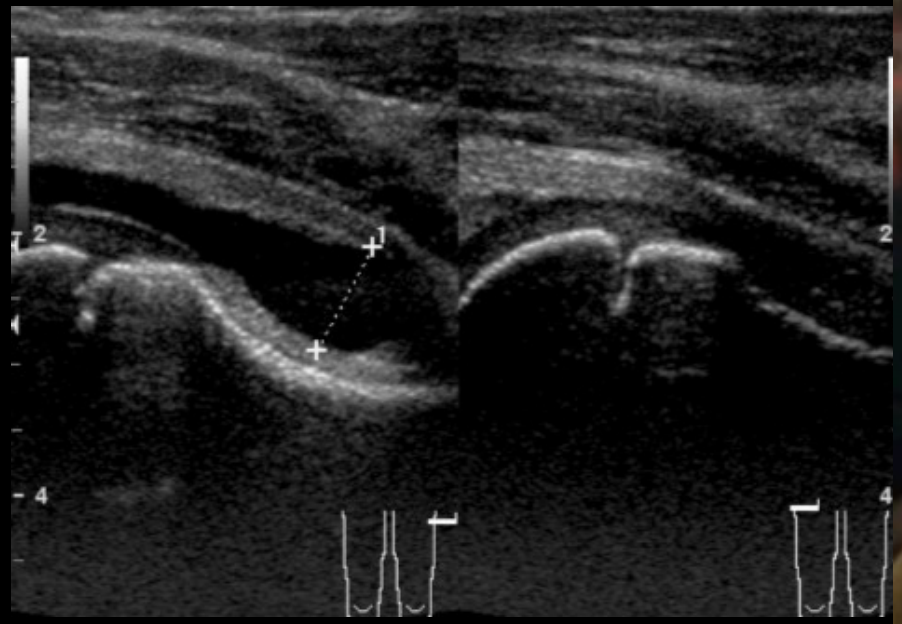

ORIGINAL ARTICLE

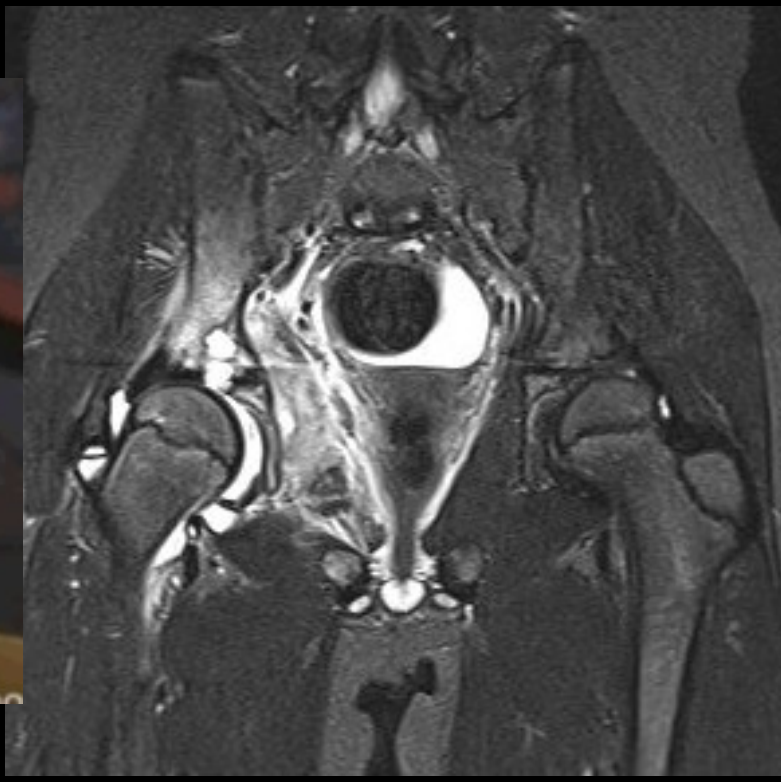
## Sonographic Diagnosis of Metaphyseal Forearm Fractures in Children

*A Safe and Applicable Alternative to Standard X-Rays*

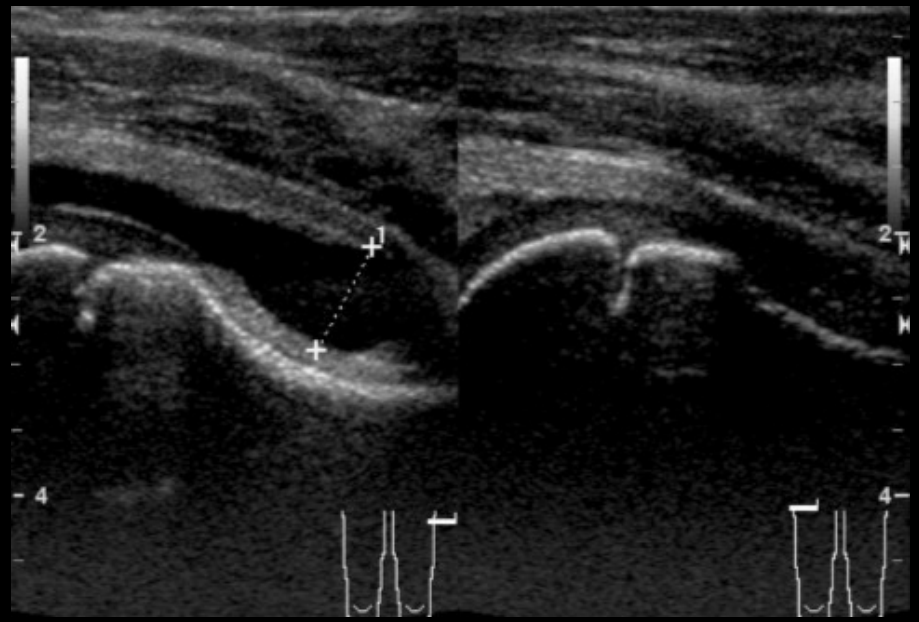
*Kolja Eckert, MD,* Ole Ackermann, MD,† Bernd Schweiger, MD,‡ Elke Radeloff, MD,* and Peter Liedgens, MD**

# ALTERNATIVE: Ecografia / Coxitis fugax



# ALTERNATIVE: Ecografia / Coxitis fugax

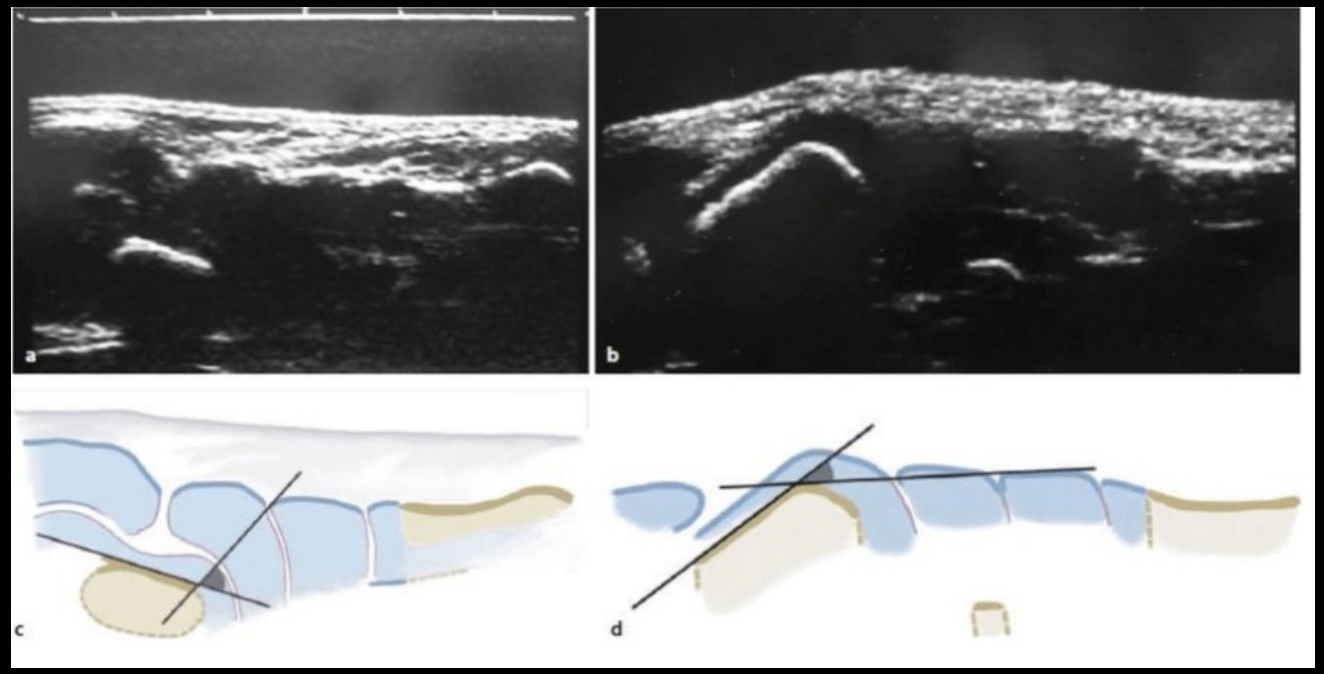


1. Clinica
2. PCR
3. Eco
4. Check risoluzione (clinica + eco)

A queste condizioni, possibile gestire senza rx

DD artrite settica LCPD, ECF, K, reuma, …

# ALTERNATIVE: Ecografia / Piede torto





Hamel *et al. BMC Musculoskeletal Disorders* (2021) 22:332
https://doi.org/10.1186/s12891-021-04193-w

BMC Musculoskeletal Disorders

RESEARCH ARTICLE Open Access

## Radiological tarsal bone morphology in adolescent age of congenital clubfeet treated with the Ponseti method

Johannes Hamel[1], Hubert Hörterer[1,2] and Norbert Harrasser[3*]

# ALTERNATIVE: Ecografia / Displasia anca_secondaria / LCPD

J Pediatr Orthop. Jul-Aug 1993;13(4):437-43. doi: 10.1097/01241398-199307000-00004.

## Ultrasonography in the primary evaluation of patients with Perthes disease

T Terjesen [1]

Affiliations + expand

PMID: 8370776 DOI: 10.1097/01241398-199307000-00004

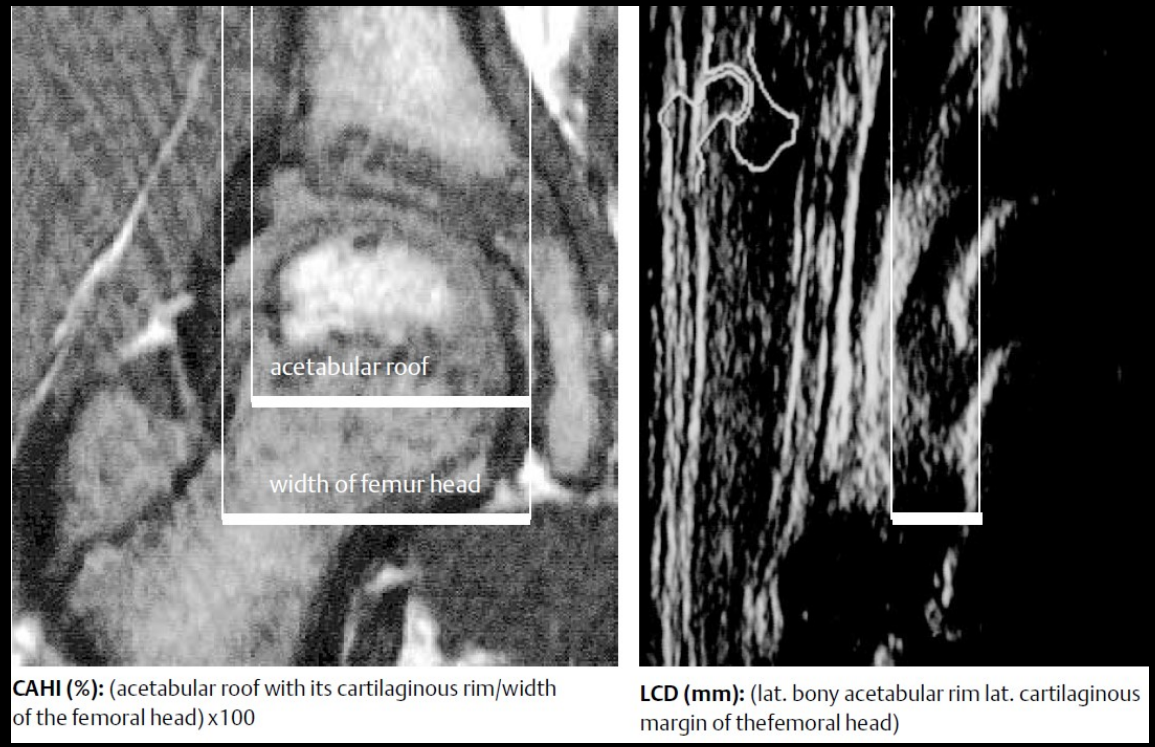
Int Orthop. 1993 Nov;17(5):300-4. doi: 10.1007/BF00181704.

## Ultrasonography in Perthes' disease. Clinical relevance and influence on treatment

T Wirth [1], G W LeQuesne, D C Paterson

Affiliations + expand

PMID: 8125667 DOI: 10.1007/BF00181704




**CAHI (%):** (acetabular roof with its cartilaginous rim/width of the femoral head) x100

**LCD (mm):** (lat. bony acetabular rim lat. cartilaginous margin of thefemoral head)

## Evaluation of Hip Containment in Legg-Calvé-Perthes Disease: A Comparison of Ultrasound and Magnetic Resonance Imaging

*Die Containmentdiagnostik beim M. Perthes – Ein Vergleich von Ultraschall und Magnetresonanztomographie*

M. H. F. Stücker[1, 2]
J. Buthmann[1]
A. L. Meiss[1]

Original Clinical Article

JOURNAL OF CHILDREN'S ORTHOPAEDICS

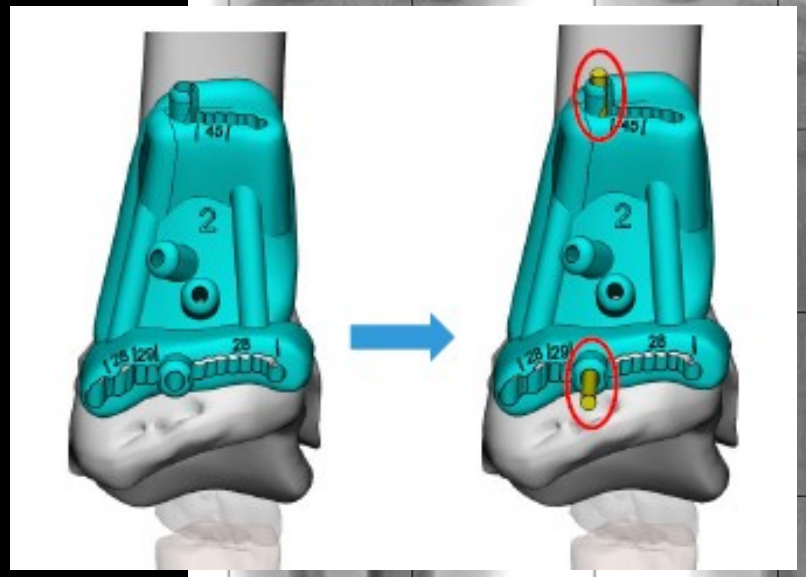
## MRI and sonography in Legg-Calvé-Perthes disease: clinical relevance of containment and influence on treatment

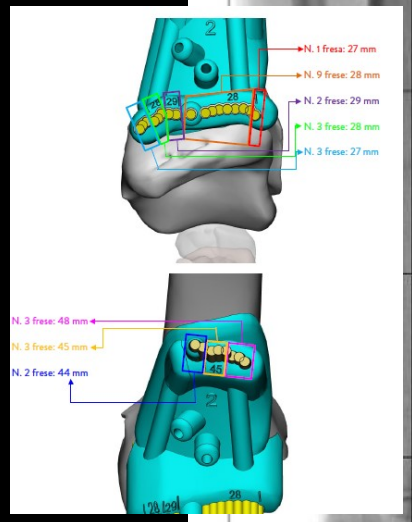
N. M. Jandl[1,2]
T. Schmidt[1,2]
M. Schulz[3]
W. Rüther[1,2]
M. H. F. Stuecker[1,4]

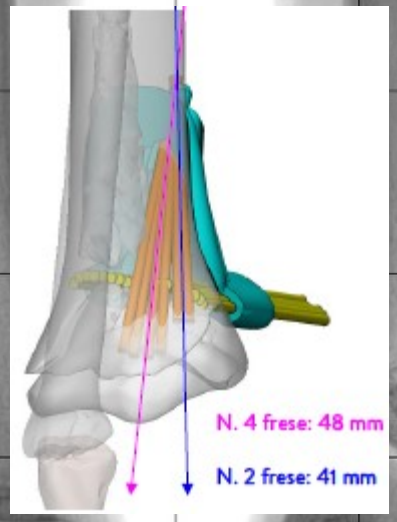
the CAHI, HA measurement in ultrasound is easier than the assessment of various parameters to calculate an index. Frequent sonographical follow-up assessment in critical joints is an alternative if MRI is not available, helping to detect an impending loss of containment early enough.

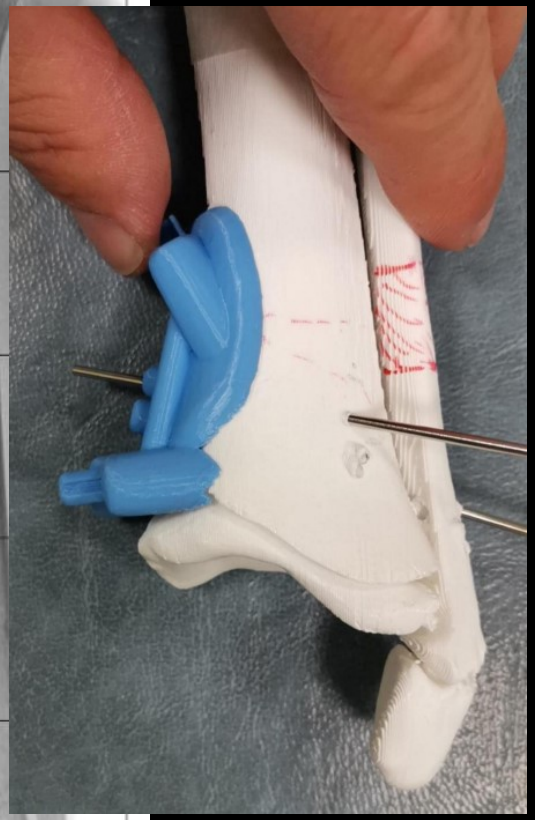
*Level of Evidence* Level II

# ALTERNATIVE: 3D planning and printing





# Conclusioni

- rX in ortopedia e traumatologia pediatrica costituiscono l'indagine di prima linea nella maggior parte delle condizioni;
- Corretta metodica e indicazione ed esecuzione delle rX costituisce il caposaldo della radioprotezione.
- Alternative:
  - strumenti a basso dosaggio
  - Ecografia
  - MR

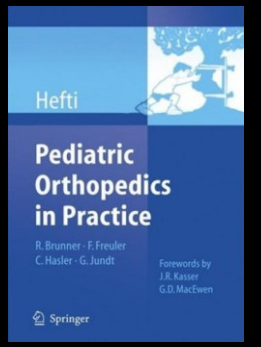
# Q?

**Guindani Nicola – ASST PG23 Dip Emergenze Urgenze (Dir. Prof Castelli)**
**aguindani@asst-pg23.it**

**Guindani Nicola – ASST PG23 Dip Emergenze Urgenze (Dir. Prof Castelli)**
**aguindani@asst-pg23.it**

# FLATFOOT

## SPECIAL EVALUATION




**AT FIRST PERFORM A GENERAL EVALUATION!**

- WALK – RUN – JUMP ON ONE LEG - ON TOES and HEELS
- ROM – ROM OF THE COLUMN!
- MUSCOLO-SKELETAL PROBLEM?
  - DEFORMITY? TORSION? MALALIGNEMENT? ASIMMETRY? LLD?
  - CONTRACTURES? MECHANICAL LIMITATIONS? GENERAL LAXITY?
- MUSCULAR DISEASE?
- NEURO?
  - SPASTICITY?
  - DEVELOPMENTAL/NEURO DISORDERS?

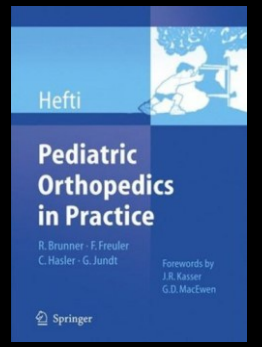
Clin Podiatr Med Surg. 2010 Jan;27(1):1-23. doi: 10.1016/j.cpm.2009.09.002.

**The natural history and pathophysiology of flexible flatfoot.**

Harris EJ[1].

# FLATFOOT

## SPECIAL EVALUATION




WITH STANDING PATIENT

- OVERUSE SKIN CHANGES
- WALK – RUN – JUMP ON ONE LEG - ON TOES AND HEELS
- WALKING ON THE LATERAL AND MEDIAL MARGIN OF THE FOOT (FUNCTION OF THE PL, PB, TA, TP)
- M. TRICEPS SURAE SHORTENING?
- LONGITUDINAL FOOT ARCH
  - ✓ ON TIP TOE?
  - ✓ RAISING THE GREAT TOE? („JACK'S TEST)
- VARUS POSITION OF THE CALCANEUS ON TIP TOE?

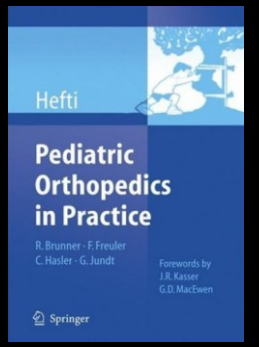
Clin Podiatr Med Surg. 2010 Jan;27(1):1-23. doi: 10.1016/j.cpm.2009.09.002.

**The natural history and pathophysiology of flexible flatfoot.**

Harris EJ[1].

# FLATFOOT

## SPECIAL EVALUATION




WITH LYING PATIENT

- SHORTER/CONTRACTED M. TRICEPS SURAE?
- LONGITUDINAL ARCH AT REST? Jeck‘s test?
- SKIN OVERUSE SIGNS? TENDER POINTS?
- ROM: TIBIO-ASTRAG AND SUB ASTRAG.? DORSIFLEX!!
- TORSION OF EXTREMITIES?
- GROSS NEUROLOGICAL PATHOLOGY? TARDIEU TEST? SILFERSKIOLD TEST?

REVIEW ARTICLE

**Neuro-orthopaedic evaluation of children and adolescents: A simplified algorithm**

J. Cottalorda[a,*], P. Violas[b], R. Seringe[c], the French Society of Pediatric Orthopaedics[1]

[a] Department of Pediatric Orthopaedics Surgery, University Hospital of Montpellier, Lapeyronie Hospital, 371, avenue du Doyen-Gaston-Giraud, 34295 Montpellier cedex 05, France
[b] Department of Pediatric Orthopaedics Surgery, University Hospital of Rennes, Rennes, France
[c] Paris-Descartes University, Cochin Hospital, Paris Hospital Group, Paris, France

Accepted: 24 April 2012

Clin Podiatr Med Surg. 2010 Jan;27(1):1-23. doi: 10.1016/j.cpm.2009.09.002.

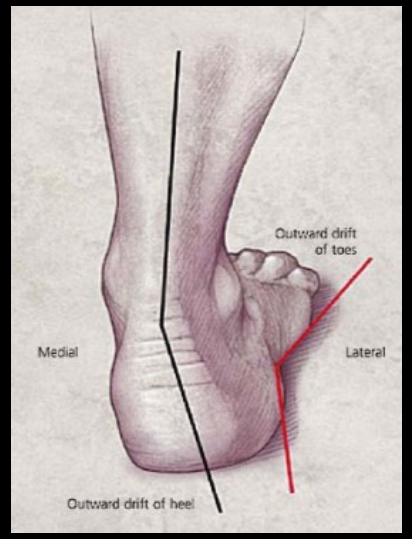
**The natural history and pathophysiology of flexible flatfoot.**

Harris EJ[1].

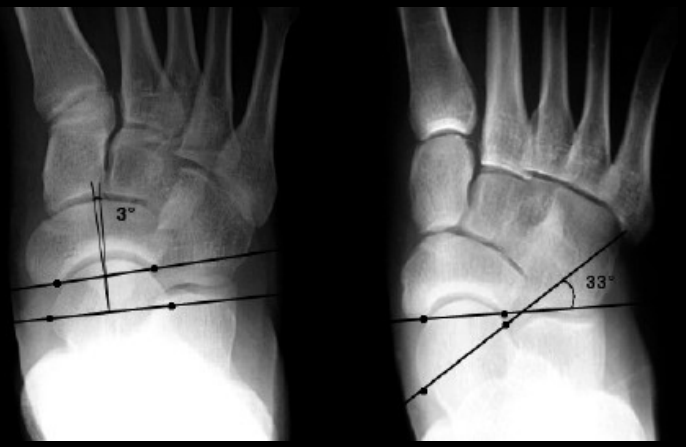
# FLATFOOT

## PLANAL PREDOMINANCE

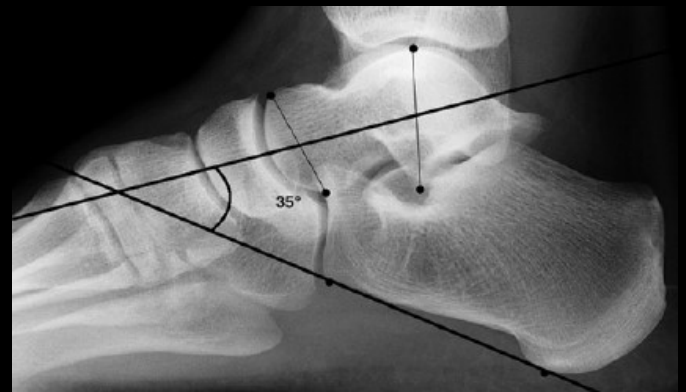
a. CORONAL (CALC VALGUS/EVERSION)




b. TRANSVERSE (TALO-NAV SUBLUX)




c. SAGITTAL (FAILURE OF MEDIAL COLUMN)



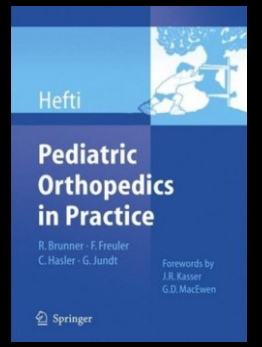

Clin Podiatr Med Surg. 2010 Jan;27(1):1-23. doi: 10.1016/j.cpm.2009.09.002.

The natural history and pathophysiology of flexible flatfoot.

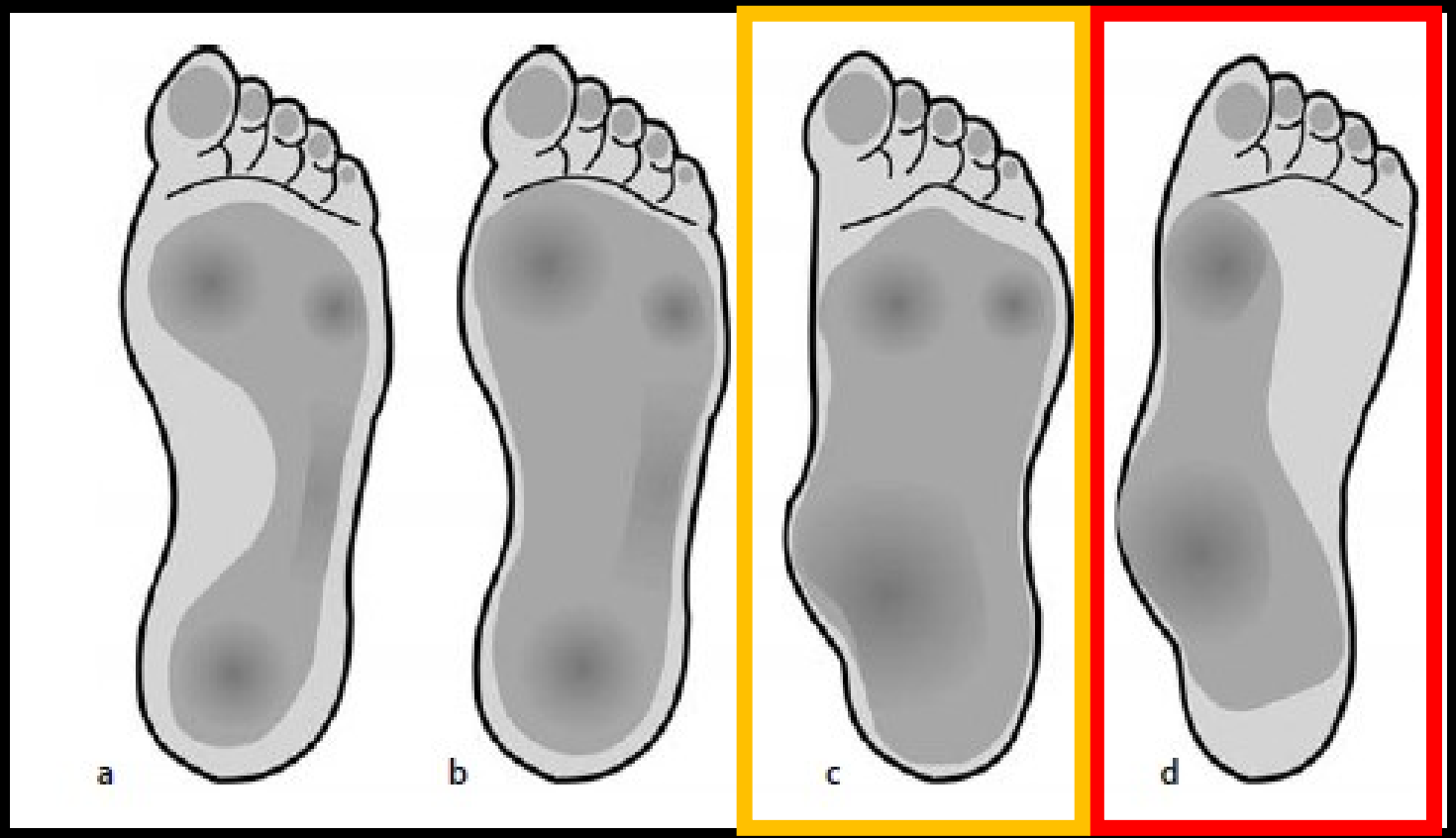
Harris EJ[1].

# FLATFOOT

## SPECIAL EVALUATION

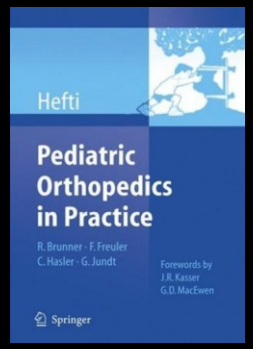



PODOSCOPE



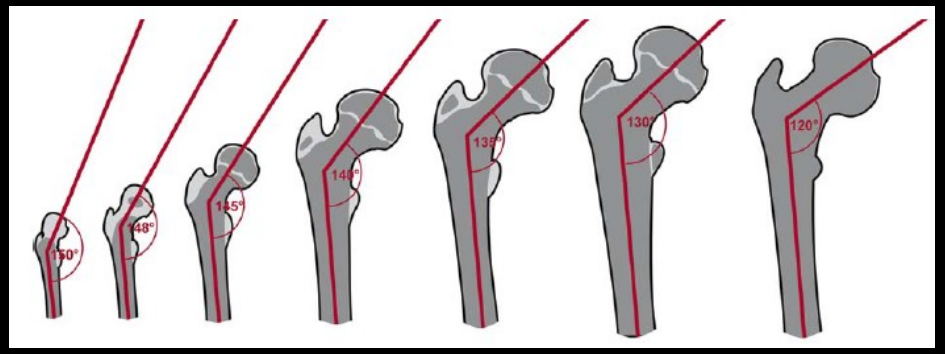
# FLATFOOT

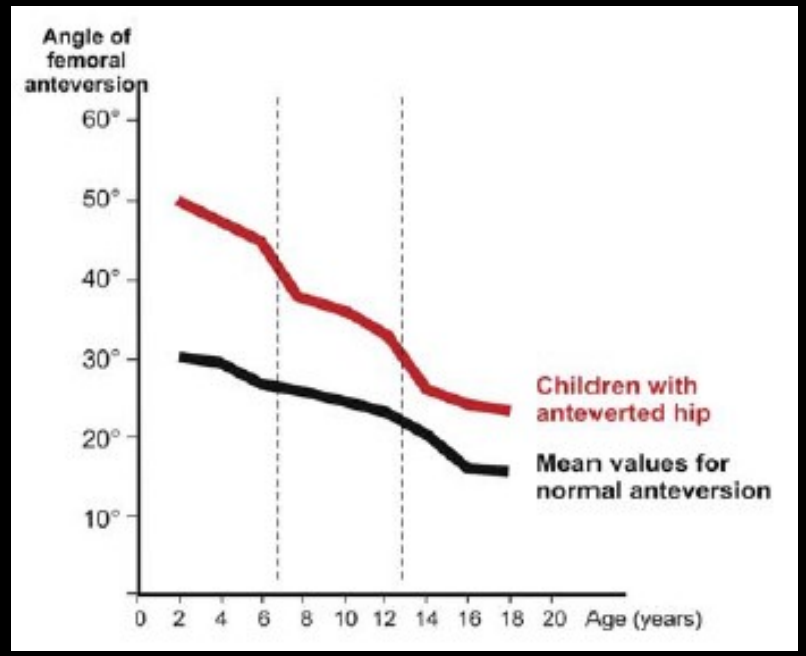
## PHYSIOLOGICAL FLAT VALGUS FOOT




"INCREASED VALGUS POSITION OF THE HEEL AND FLATTENING OF THE LONGITUDINAL ARCH IN CHILDREN, COMPARED TO ADULTS, AS A RESULT OF INCREASED ANTEVERSION OF THE FEMORAL NECK"

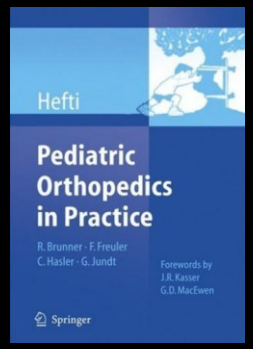
- **FAT UNDERNEATH THE FOOT ALWAYS BEVOR 3 Y**
- **„NORMALISATION" FROM 3 TO 6 Y**



# FLATFOOT

## PHYSIOLOGICAL FLAT VALGUS FOOT




"INCREASED VALGUS POSITION OF THE HEEL AND FLATTENING OF THE LONGITUDINAL ARCH IN CHILDREN, COMPARED TO ADULTS, AS A RESULT OF INCREASED ANTEVERSION OF THE FEMORAL NECK"
*It's a normal foot*

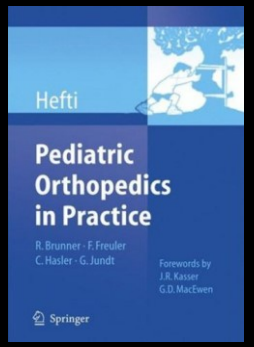
- **NO TREATMENT NECESSARY**

- **PLANTARS WORSEN THE CONDITION**
- **NO INFLUENCE ON KNEE AXIS W/ OR /OUT TREATMENT**

- **IT'S PHYSIOLOGICAL ! … WALK BAREFOOT …**

# FLATFOOT

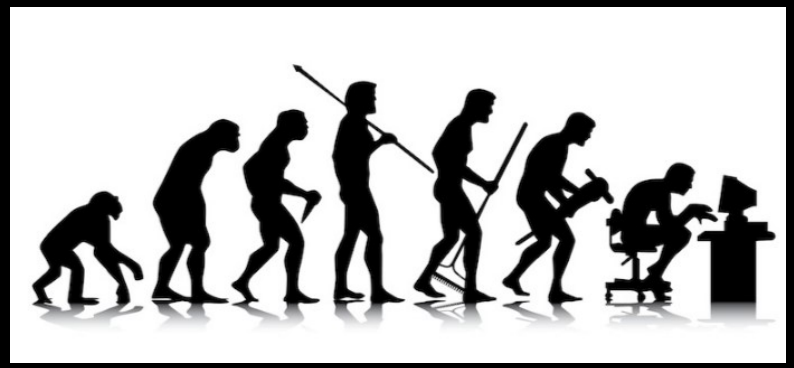
## NATURAL HISTORY


- BEFORE 3 Y: NO FLEXIBLE FLATFOOT (BUT OTHER PATHOLOGIACAL FORMS!)
- 3 Y: 54% -> 6Y : 24%

  1% FFF Vs 10% orthesis (90% orthesis unnecessary!)

Pfeiffer at al, 2006



- FF is a natural phase in the developing foot

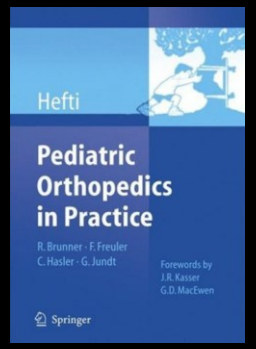
Farriol and Pascual, 1990

- Treatment of FF in children does not spares pain in adult life

Hogan & Staheli, 2002

# FLATFOOT

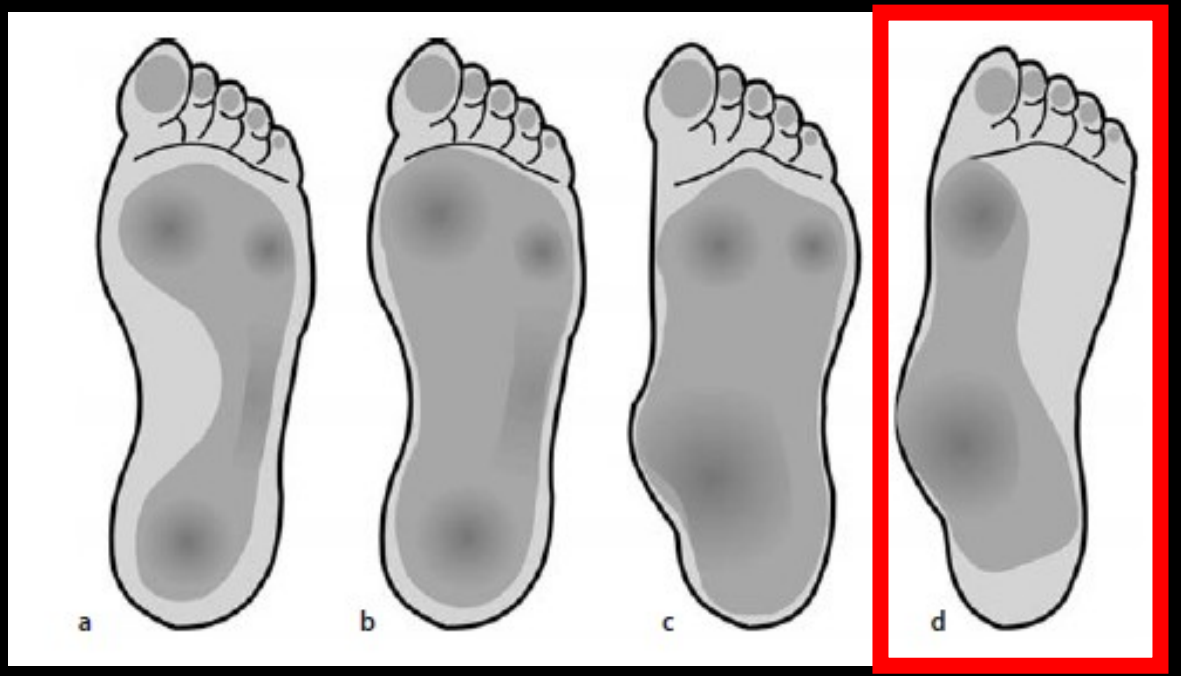
## FLEXIBLE FLATFOOT (FFF)




*"MISSING MEDIAL ARCH OVER THE WEIGHT-BEARING SURFACE, RESTRICTED DORSAL EXTENSION, A SHORTENED ACHILLES TENDON, AN INCREASED VALGUS POSITION OF THE REARFOOT AND HYPERPRONATION OF THE FOREFOOT. HOWEVER, THE FOOT REMAINS FLEXIBLE, AND THE MEDIAL ARCH CAN BE RESTORED BY VARIZATION OF THE HEEL. AN INCREASED TALOCALCANEAL ANGLE (>60°) IS MEASURED ON THE LATERAL X-RAY".*

*Synonim: Talipes Calcaneo-valgus*

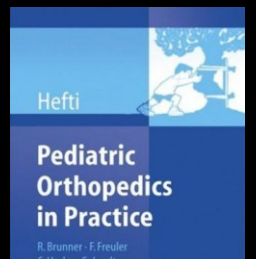
- **BEFORE 3 Y DIFFICULT DIAGNOSIS!**
- **DD (Talus Vert? Synosthosis?...)**
- **CAVO-VALGUS?**



# FLATFOOT

## FLEXIBLE FLATFOOT (FFF)

### THERAPY




*"Before deciding on a treatment…carefully consider whether any treatment is even necessary"*

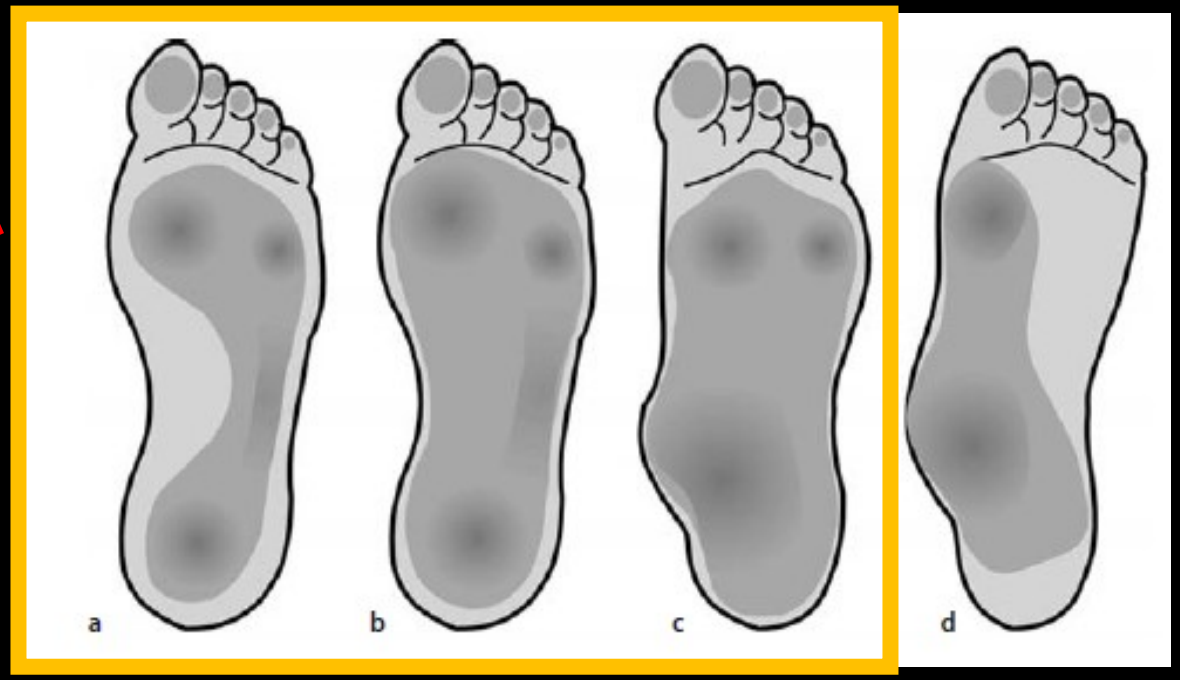
Clin Podiatr Med Surg. 2010 Jan;27(1):1-23. doi: 10.1016/j.cpm.2009.09.002.

**The natural history and pathophysiology of flexible flatfoot.**

Harris EJ[1].

**TRIPLANE DEFORMITY**

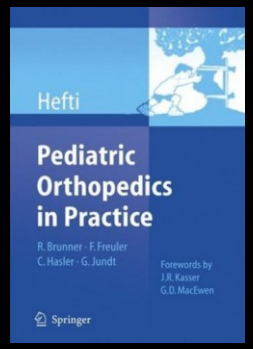
- FOOT EXERCISES
- WALKING BAREFOOT
- STRETCHING OF THE CALF MUSCLES



# FLATFOOT

## FLEXIBLE FLATFOOT (FFF)

### THERAPY




***"Before deciding on a treatment…carefully consider whether any treatment is even necessary"***

- FOR EXTREME GRADES CONSIDER FURTHER TREATMENT
- > 8 Y / > 10 Y CONSIDER SURGERY:
  - Talus reposition
  - Arthrorisis
  - Navicular susopension
  - Dwyer/Koutsogiannis
  - Evans