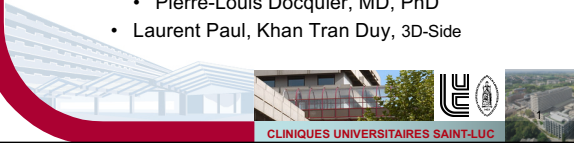


PEDIATRIC ORTHOPAEDICS

Computer assisted surgery in Paediatric Orthopaedics

- Solange de Wouters, MD
- Pierre-Louis Docquier, MD, PhD
- Laurent Paul, Khan Tran Duy, 3D-Side



CLINIQUES UNIVERSITAIRES SAINT-LUC

Definitions

- CAS = computer assisted surgery
- CAOS = computer assisted orthopaedic surgery :
 - pre-operative planning
 - intra-operative guidance (1995 for transpedicular screw)

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PSI: Patient Specific Instrument

- Single-use instrument specific to each patient
- Uses volumetric images (CT or MRI) of the patient to extract anatomical landmarks and create a customised surgical plan
- Created by 3D-printing
- Allows insertion of wires or guidance of a sawblade

3

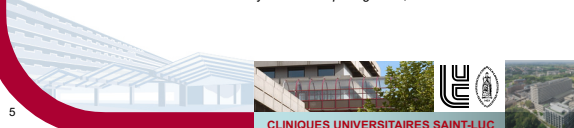
Indications in Paediatric Orthopaedics

- PSI developed for:
 - Complex osteotomies
 - Tarsal coalition resection
 - Tumour resection and allograft reconstruction

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COMPLEX OSTEOTOMIES: EXAMPLE OF SUPRACONDYLAR OSTEOTOMY OF HUMERUS FOR CUBITUS VARUS¹

¹ Tricot M, Duy KT, Docquier PL. 3D-Corrective Osteotomy Using Surgical Guides for Posttraumatic Distal Humeral Deformity. *Acta Orthop Belg* 2012;78:538-42.



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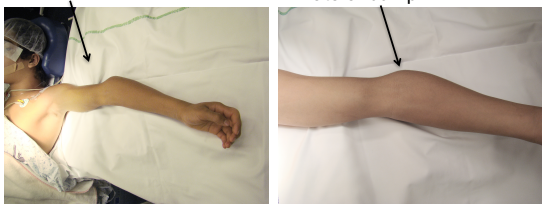
5

Introduction

CUBITUS VARUS

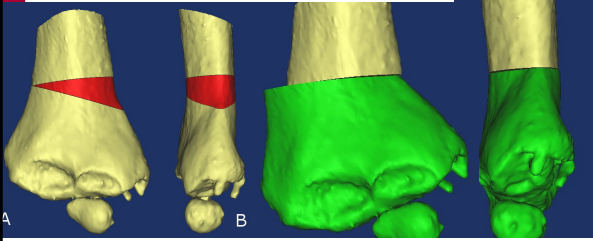
Varus

Lateral bump



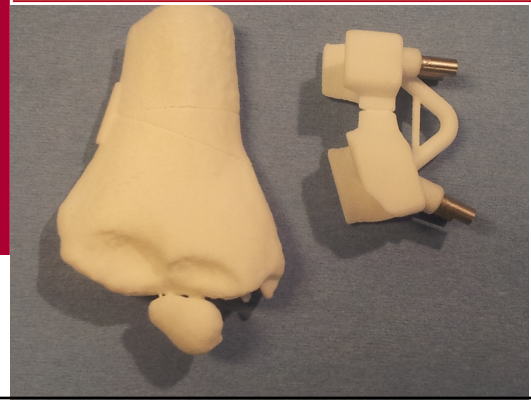
6

Planning

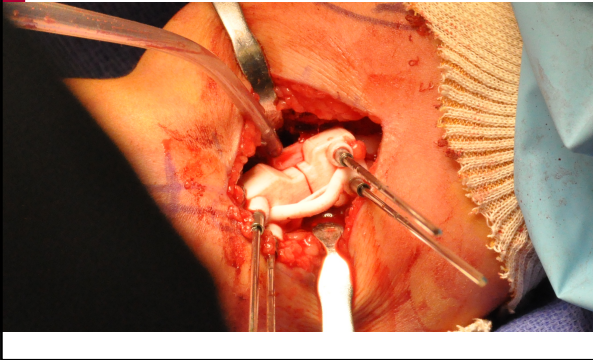


7

First PSI to insert wires



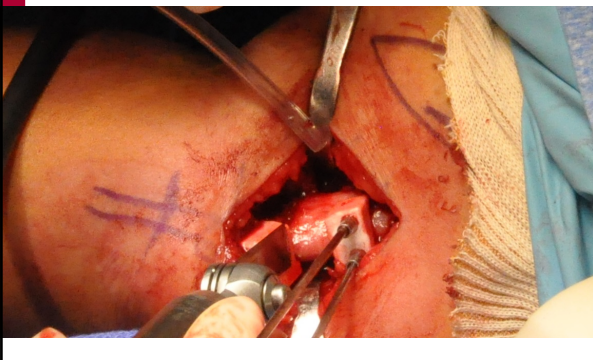
Surgery



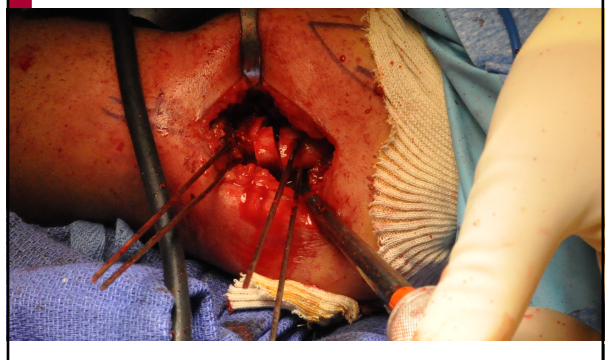
Surgery



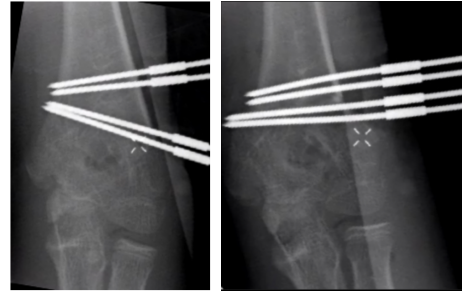
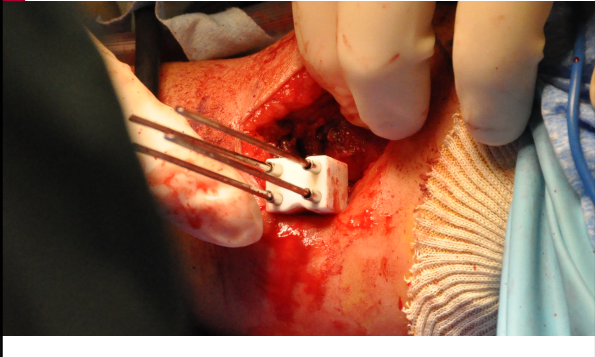
Surgery



Surgery



Surgery



TARSAL COALITION RESECTION²

² de Wouters S, Tran Duy K, Docquier PL. Patient-Specific Instruments for Surgical Resection of Painful Tarsal Coalition in Adolescents. *Orthop Traumatol Surg Res* 2014;100:423-7.

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Tarsal coalition

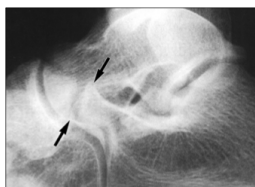
- Abnormal junction (bony, cartilaginous or fibrous), between 2 or more bones of hind-foot or mid-foot
- Very frequent: 1% population^{3,4}
- The most frequent forms:
 - Calcaneo-navicular
 - Talo-calcaneal

³ Harris RL, Beath T. Etiology of Peroneal Spastic Flat Foot. *J Bone Joint Surg Br* 1948;30:624-634.
⁴ Vamer KE, Michelson JD. Tarsal Coalition in Adults. *Foot Ankle Int* 2000;21:669-672.

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Diagnosis



Calcaneo-navicular



Talo-calcaneal

17

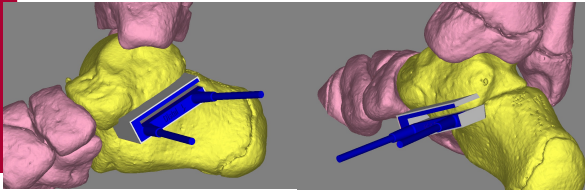
Surgery

- After failure of conservative treatment
- Preoperative imaging:
 - Foot CT-scan for planning

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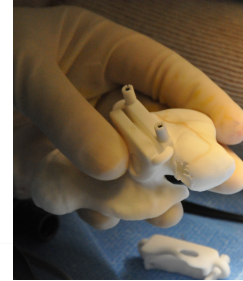
Technique



Virtual guide

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Technique



PSI in polyamide

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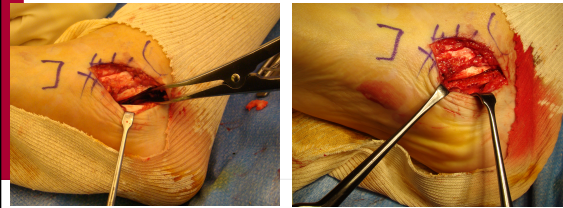
Technique



21

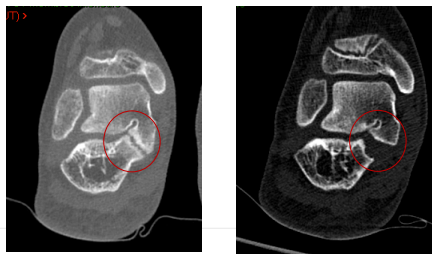
Technique

- Interposition of fascia lata



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Postoperative imaging : CT for TC

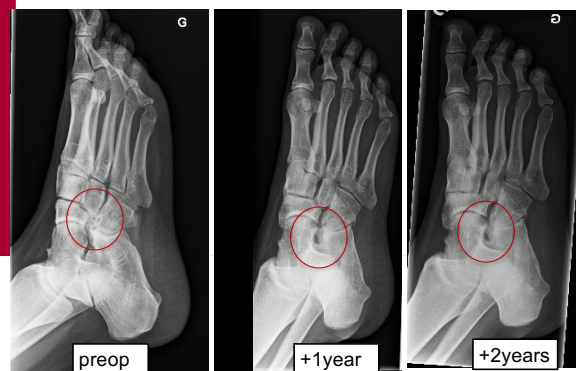


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preop

+1year

Postoperative imaging : X-ray for CN



preop

+1year

+2years

TUMOUR RESECTION AND RECONSTRUCTION WITH ALLOGRAFT FOR BONE SARCOMA⁵

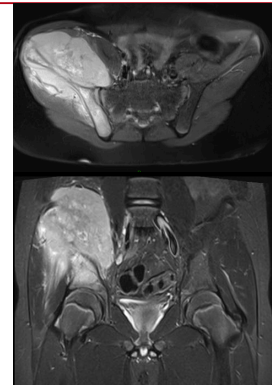
⁵ Bellanova L, Paul L, Docquier PL. Surgical Guides (Patient-Specific Instruments) for Pediatric Tibial Bone Sarcoma Resection and Allograft Reconstruction. *Sarcoma* 2013;2013:787653.

25



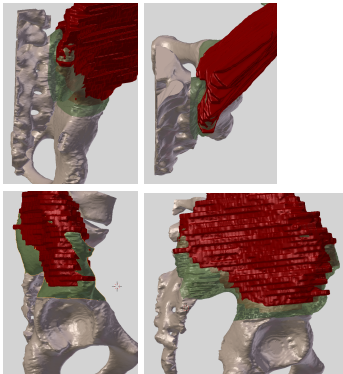
Example : pelvis

- 14-year-old boy
- Ewing sarcoma (zones 1, 2 and 4 of Enneking)



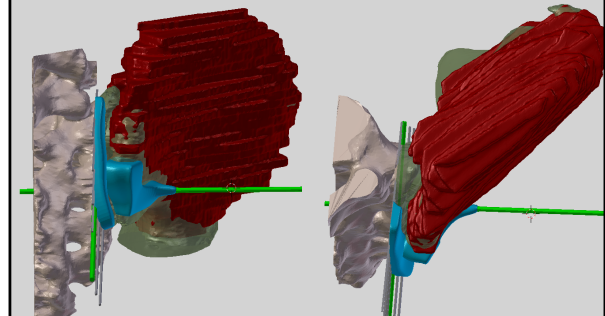
26

Choice of cutting planes



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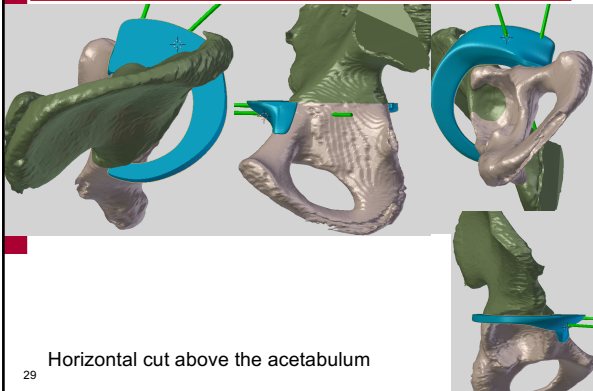
PSI for the sacral ala



Vertical cut in the sacral ala

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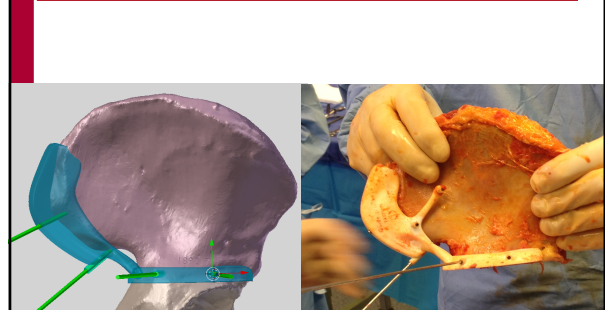
PSI for the acetabular cut



Horizontal cut above the acetabulum

29

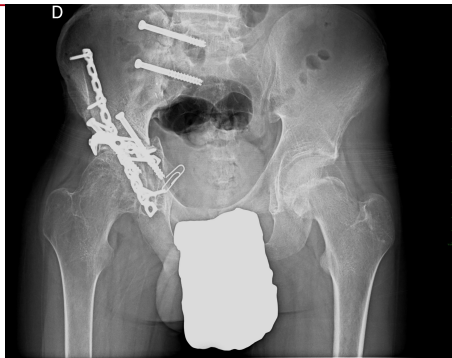
PSI for allograft



Cutting of allograft

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Reconstruction



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2 postoperative years

Conclusions

- Advantages of PSI :
 - Better accuracy
 - Time sparing (all the measures are made prior surgery, no measure has to be made the day of the surgery, no matching has to be made)
 - Decrease of X-rays dosis during the surgery
- Disadvantages:
 - Need of CT-scan (radioprotection in children)

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