

Accuracy of screw placement in minimally invasive, robot-assisted iliosacral screw insertion in children with early onset neuromuscular scoliosis

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Disclosure

- Pr Gouron declares to be consultant for Implanet France
- Pr Lefranc declares to be consultant for Zimmer Biomet producing the Rosa[®] robot

Introduction

- Iliosacral screw (ISS) is an optimal implant for :
 - Stability even in porotic bone
 - Correction of pelvic obliquity in neuro-muscular scoliosis

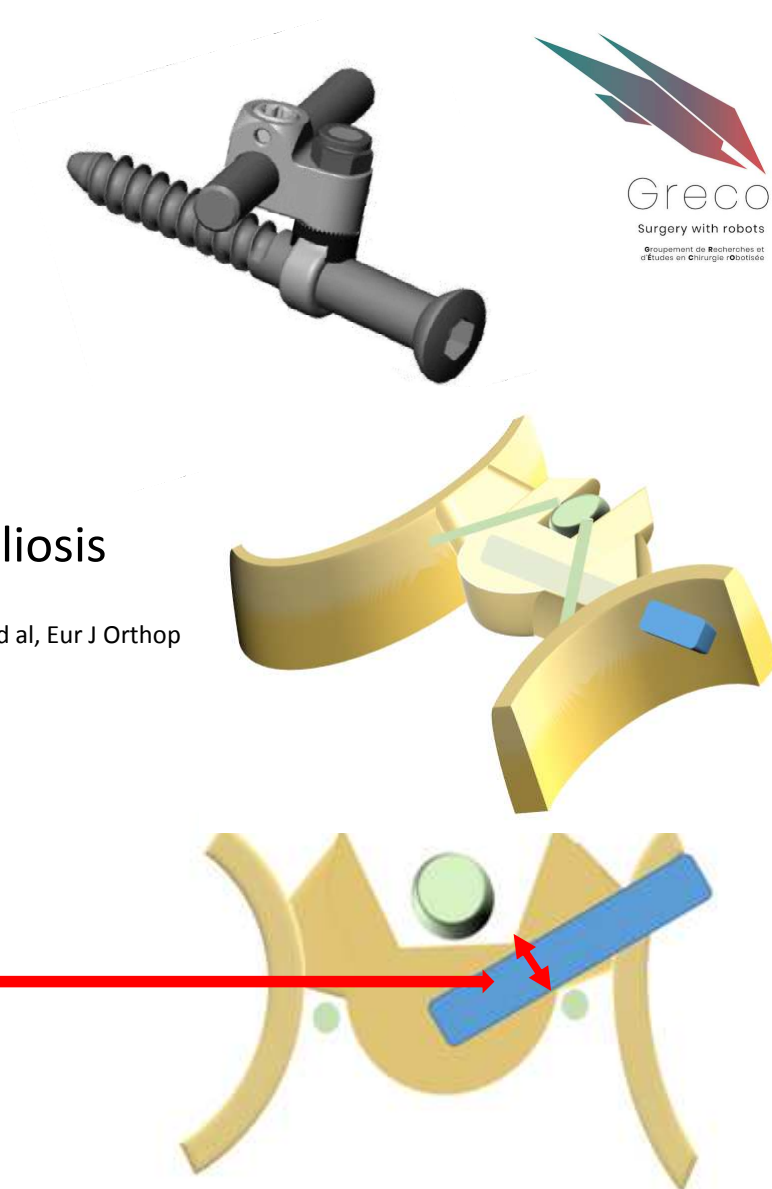
(Miladi L and al. Spine 1997 ; Peelle MW, and al. Spine 2006 ; Zahi R and al. Childs Nerv Syst 2010 ; Awwad W and al, Eur J Orthop Surg Traumatol 2015)

- Proximity of ISS to neurovascular structures.

Safety corridor 21mm, Trigno = 4°.

(Templeman D, Clin Orthop Relat Res 1996)

- Very young patients or with severe deformities



Surgical Technique

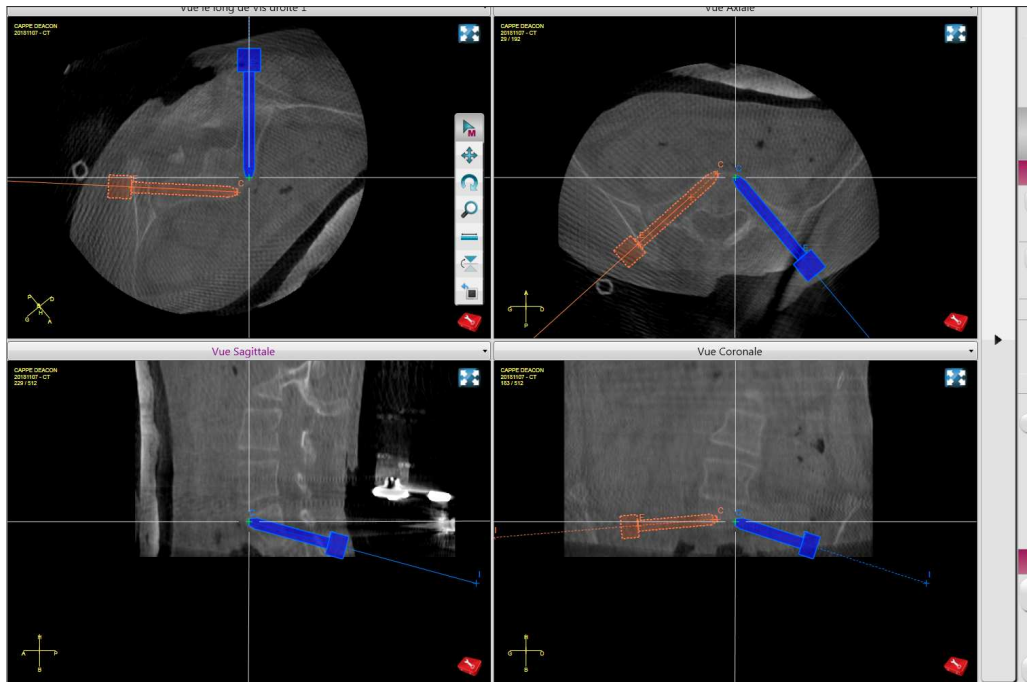
Development of an operative technique in a simulation center for the insertion of ISS planned + guided using robotic assistance



3D printed reproduction of our first case

Surgical Technique

- Planning the position of the ISS

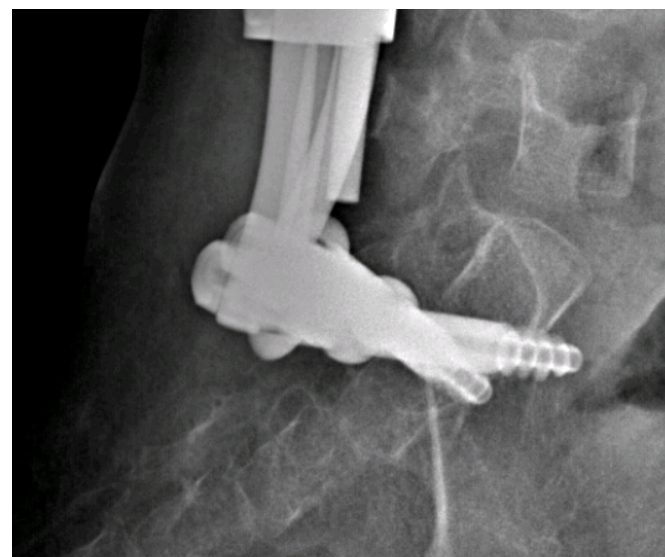
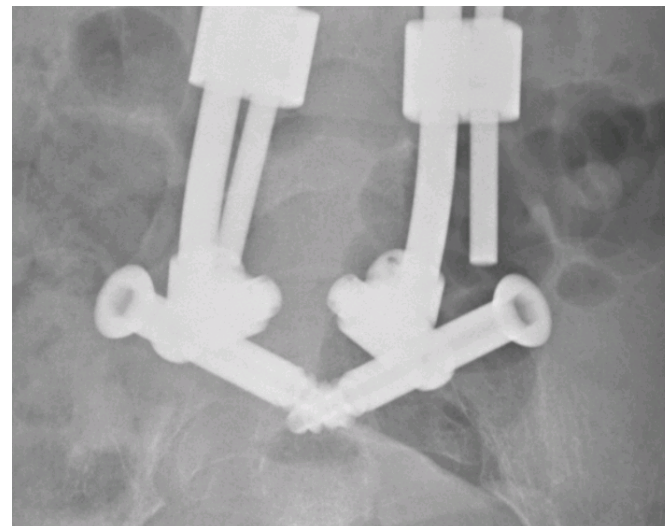
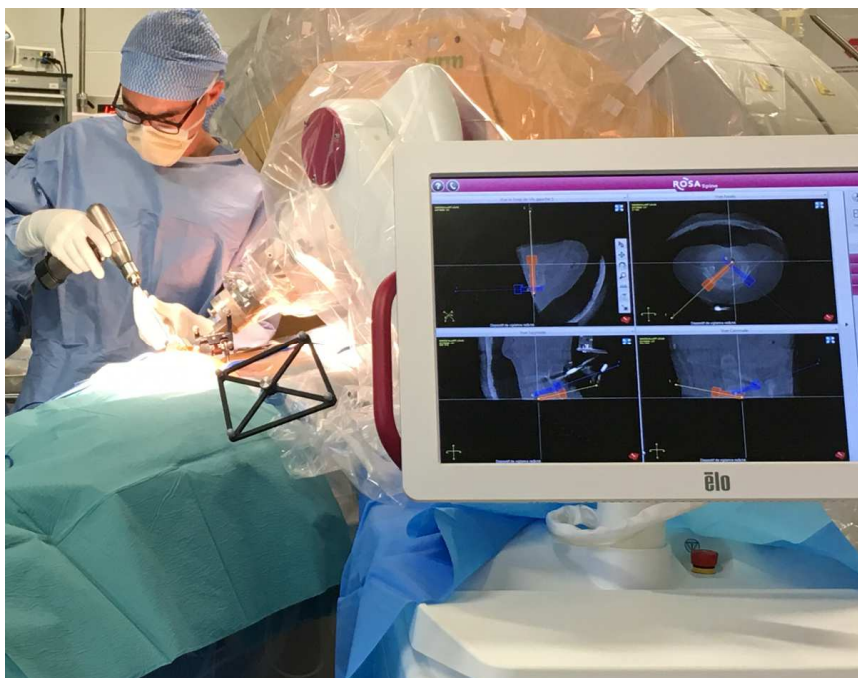


- Bipolar instrumentation in double team



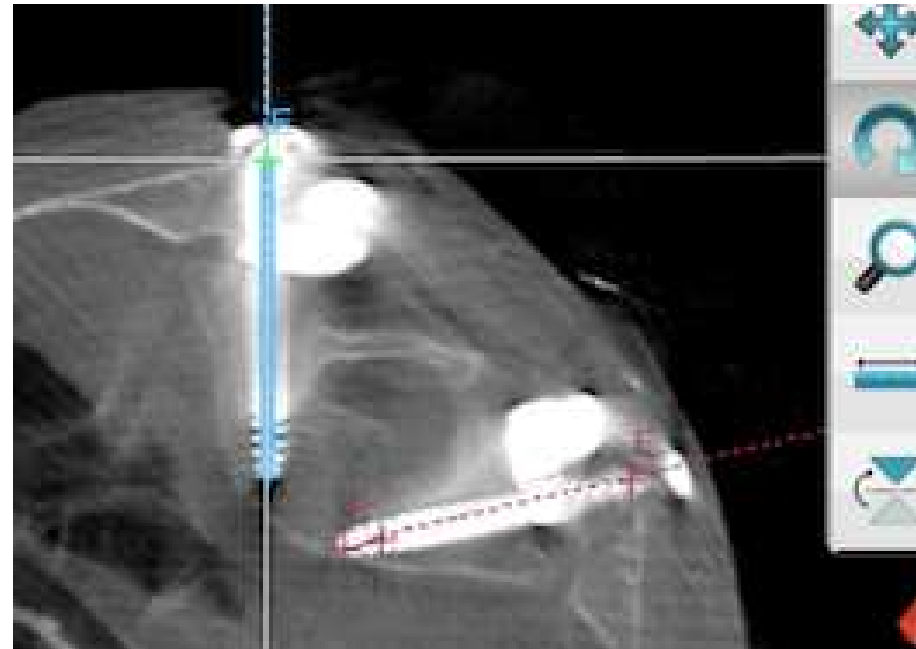
Objective

To evaluate the accuracy of iliosacral implant inserted with robotic assistance



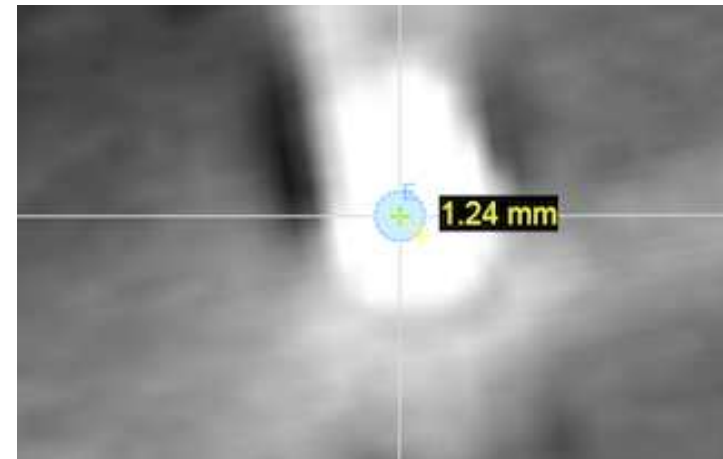
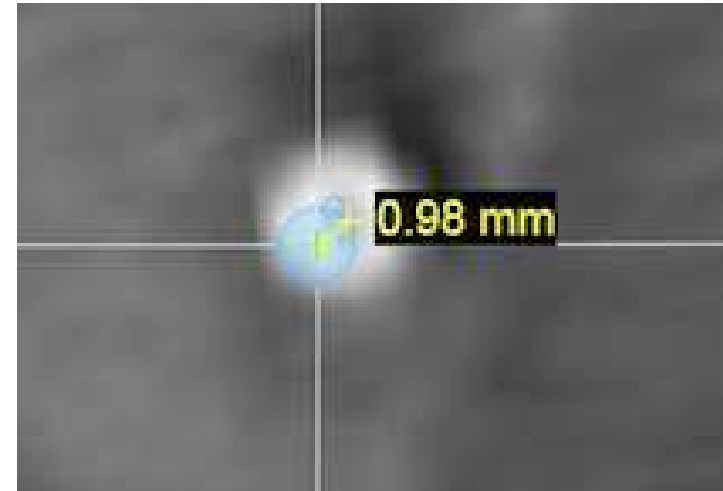
Material and Methods

- ▶ Retrospective study of all patients operated on since October 2017
 - ▶ Cortical breach (Ravi *et al.*)
 - ▶ Comparison of the surgical planning performed on the robot's software and the actual position of the screws.
- ▶ The pre- and post-surgery flat-panel CT images were merged
- ▶ The distance was measured at two points on the trajectory:
 - ▶ **Iliac entry point**
 - ▶ **Screw tip's target point in the sacrum**

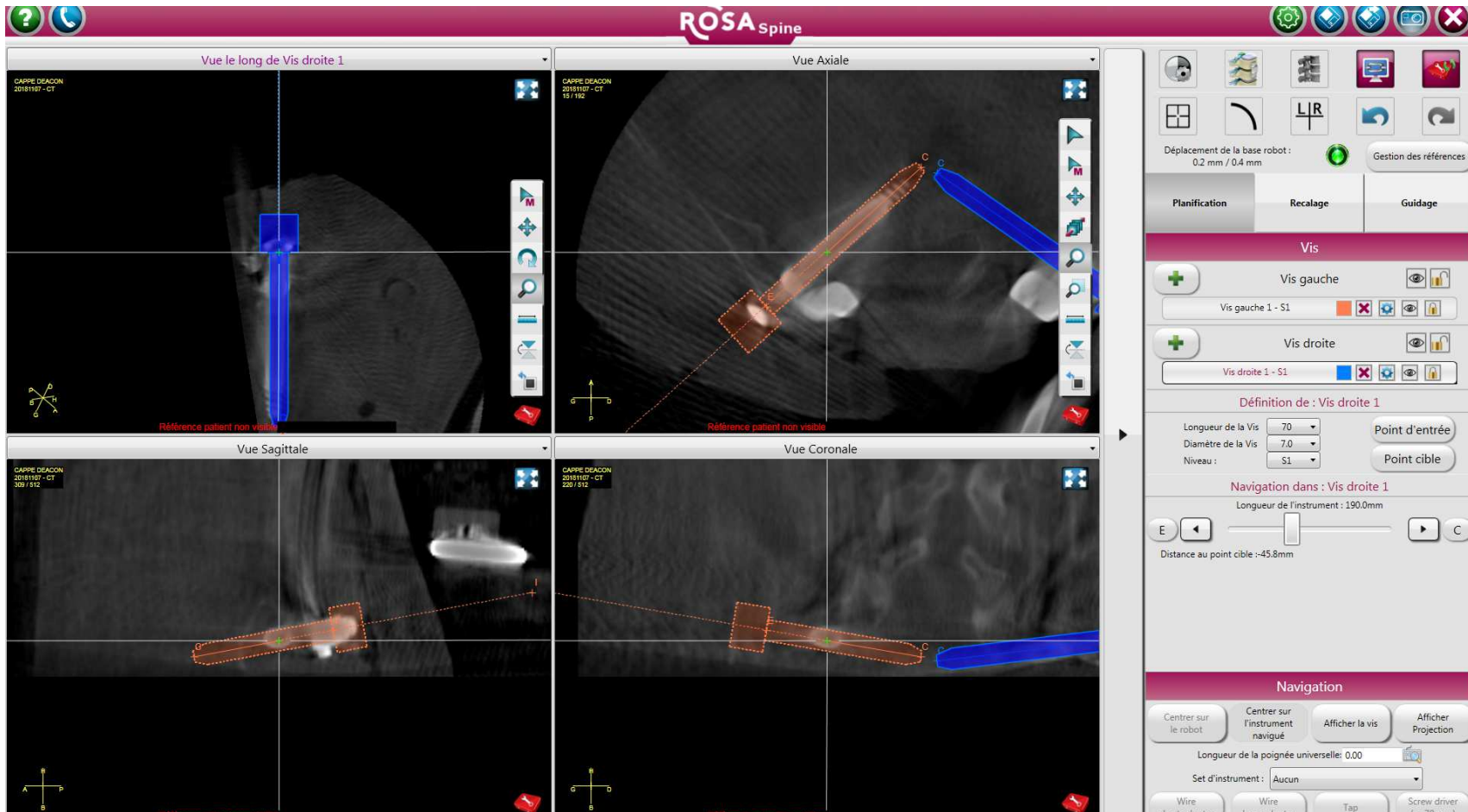


Results

- 15 patients (8 boys, 7 girls)
- Mean age: 11.8 years (7.3 to 18.2)
- 30 Ilio-Sacral Screws
- Absence of cortical breaches
 - 100% Ravi grade A
- Mean error =
 - 1,66 mm at the entry point
(min 0,13 ; max 3,12 ; SD : 0,73)
 - 1,29 mm at the target point
(min 0,4 ; max 2,4 ; SD : 0,44)



Results



The screenshot displays the ROSA spine software interface, which is used for robotic-assisted spine surgery. The interface is divided into four main view windows and a right-hand control panel.

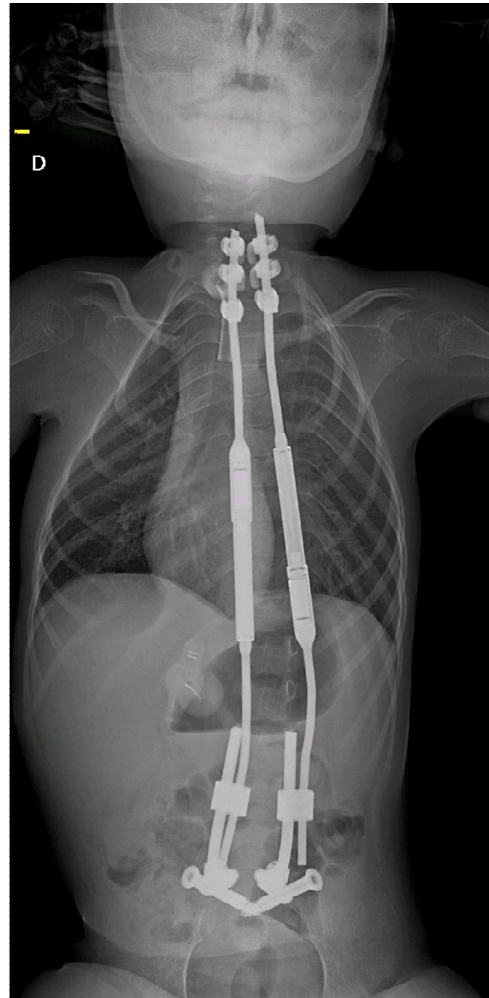
- Top Left View:** "Vue le long de Vis droite 1" (View along the right rod 1). It shows a sagittal CT scan with a blue vertical rod and a red dashed line indicating the patient's reference. A red warning message "Référence patient non visible" (Patient reference not visible) is present at the bottom.
- Top Right View:** "Vue Axiale" (Axial view). It shows an axial CT scan with a blue rod and a red dashed line. A red warning message "Référence patient non visible" is present at the bottom.
- Bottom Left View:** "Vue Sagittale" (Sagittal view). It shows a sagittal CT scan with a blue rod and a red dashed line.
- Bottom Right View:** "Vue Coronale" (Coronal view). It shows a coronal CT scan with a blue rod and a red dashed line.

The right-hand control panel contains several sections:

- Planification (Planning):** Includes a "Déplacement de la base robot" (Robot base displacement) section with a value of "0.2 mm / 0.4 mm" and a "Gestion des références" (Reference management) button.
- Recalage (Registration):** Includes buttons for "Planification", "Recalage", and "Guidage".
- Vis (View):** A section for managing views, including "Vis gauche" (Left view) and "Vis droite" (Right view), each with a "Vis gauche 1 - S1" and "Vis droite 1 - S1" option.
- Définition de : Vis droite 1 (Definition of: Right rod 1):** Includes input fields for "Longueur de la Vis" (Rod length) set to 70, "Diamètre de la Vis" (Rod diameter) set to 7.0, and "Niveau" (Level) set to S1. It also has "Point d'entrée" (Entry point) and "Point cible" (Target point) buttons.
- Navigation dans : Vis droite 1 (Navigation in: Right rod 1):** Includes a "Longueur de l'instrument" (Instrument length) set to 190.0mm and a "Distance au point cible" (Distance to target point) set to 45.8mm.
- Navigation:** Includes buttons for "Centrer sur le robot" (Center on robot), "Centrer sur l'instrument navigué" (Center on navigated instrument), "Afficher la vis" (Show rod), and "Afficher Projection" (Show projection). It also has a "Longueur de la poignée universelle" (Universal handle length) set to 0.00 and a "Set d'instrument" (Instrument set) dropdown menu currently set to "Aucun" (None).

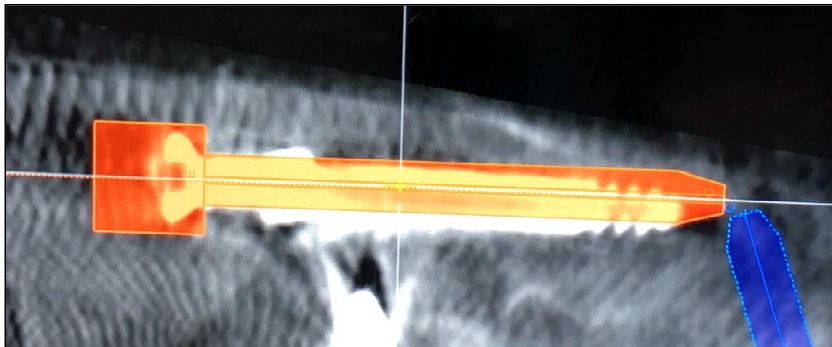
Discussion

- Iliosacral screws (CT planning coupled with navigation)
 - In traumatology (Takao M, Injury 2014)
 - For adult spinal deformity with a minimally invasive fusionless bipolar construct (Wolff, Orthop Traumatol Surg Res 2019)
- Respect in 100% cases of the **Safety corridor**
 - even in our youngest patient. (8mm)

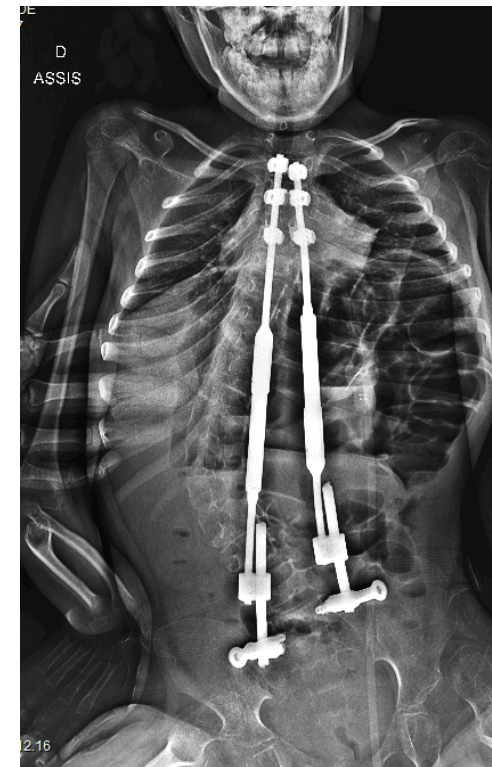


Conclusion

- Optimal positioning despite deformity and small size
- Concordance between planning and positioning
- Precision of implantation of ilio-sacral screws
 - Bio-mechanical efficiency
 - Limited Morbidity for young or very fragile patients



Our worst screw





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