



Centre de
Recherche du
CHU Sainte-Justine

Towards the next-generation assistance technology for spinal surgery

A new approach combining intra-operative navigation and simulation

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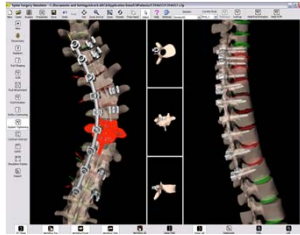
Introduction

Complex 3D deformities of the spine



Spine Surgery Simulator¹ (S3)

- ✓ Planning of an optimal instrumentation strategy & prediction of correction
- ✗ Complexity of the manual approach leads to adjustments during actual surgeries



Imaging and navigation systems²

- ✓ Planning & real time guidance
- ✗ Fail to determine an optimal strategy & predict the outcomes



Medtronic StealthStation S7

Next-generation assistance for spinal surgery ?

By developing a new intra-operative device that combines both functionalities of a navigation system and a surgical simulator

Objective

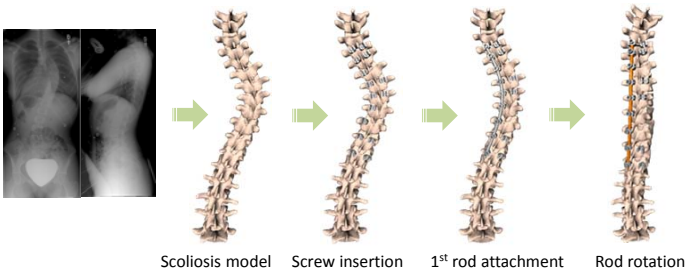
The short-term objective is to **demonstrate the feasibility** of combining the functionalities of the current StealthStation S7 navigation system (Medtronic, MN) with the functionalities of our pre-operative simulator S3. This **proof-of-concept** will build the long-term objectives for a new tool allowing:

- (1) to **compute pre-operatively** the best surgical strategy by predicting the results of the intervention, and
- (2) to **guide intra-operatively** the surgeon while allowing him to adapt in real-time the pre-operatively computed strategy.

Experimental setup for the proof-of-concept

Clinically-relevant simplification of an actual problem

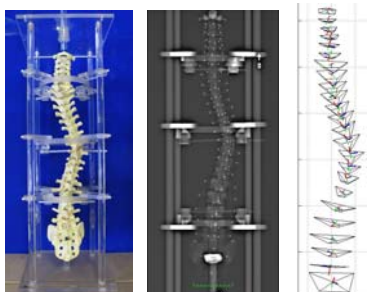
- Synthetic scoliosis model (based on 3D reconstruction from an actual Right-Thoracic case) with representative boundary conditions
- Pedicle screw insertion, rod attachment & simple correction maneuvers



Configurable and reproducible setup for the experimental testings

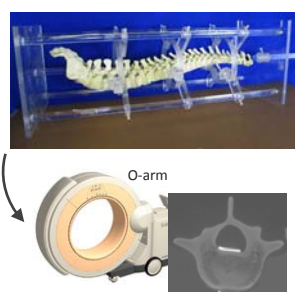
Pre-operative spinal shape

→ Geometrical model for simulation in S3

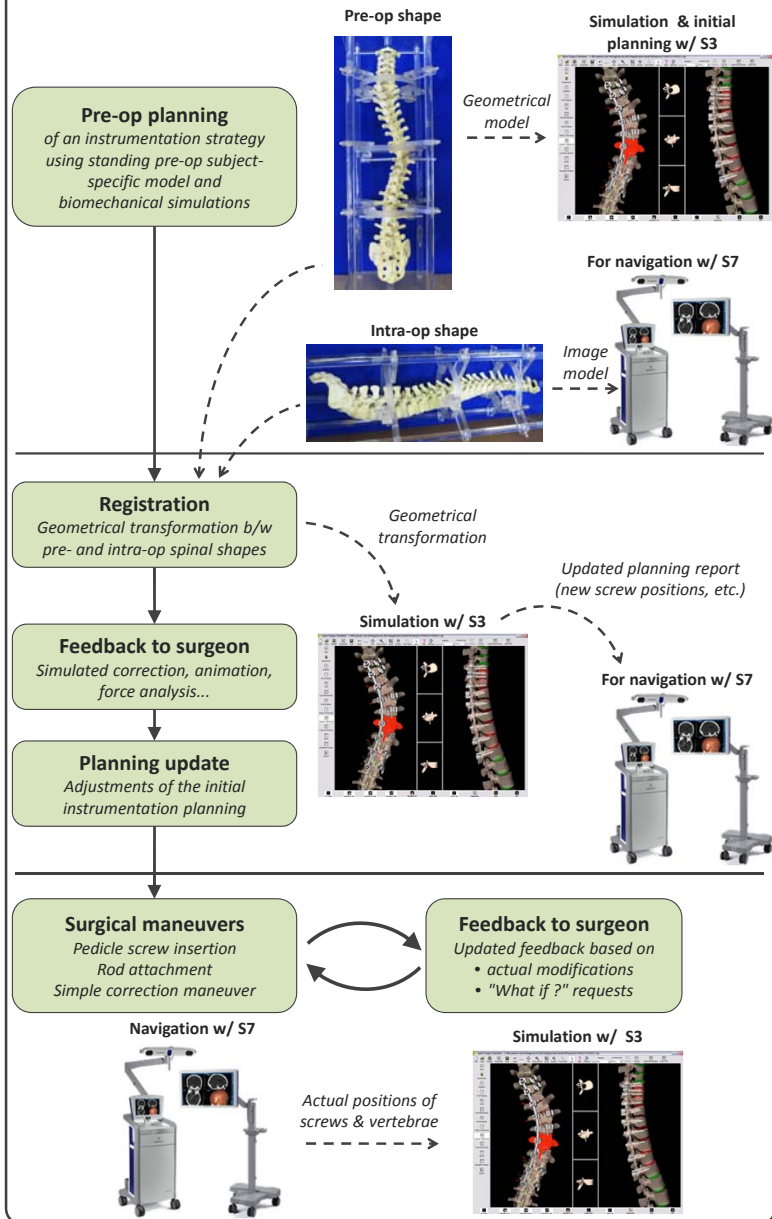


Intra-operative spinal shape

→ Image model (O-arm) for navigation with S7



New approach for spine surgery



Current works and conclusion

- New registration methods between pre-op and intra-op spinal shapes are currently under development by using innovative 3D reconstruction techniques, in order to allow the update of the initial planning (Intern collaborator: Laurence Deslauriers).
- New functions to dynamically interact with the geometrical model in S3 and the image model in S7 are also currently under development, to provide surgeons with updated feedbacks and enable them to make strategy adjustments (Collaborator: Jérémie Thériault M.Sc.A.).
- The project is dealing with major scientific and technological challenges. It will allow to develop relevant and innovative tools for a significant advancement in the development and validation of a next-generation surgical assistance system.

References

1. C-E Aubin, H Labelle, C Chevrefils, G Desroches, J Clin, and A Boivin. Preoperative planning simulator for spinal deformity surgeries. Spine, 33(20):2143–2152, September 2008.
2. Clinical Value of Image Guided Surgery for Spinal Procedures. Medtronic (Minneapolis, MN) www.medtronic.com

Acknowledgments

