

## ENABLING TECHNOLOGIES ECOSYSTEM

- Surgical planning software
- Intraoperative three-dimensional (3D) imaging
- Computer-assisted surgery (CAS) image-guided navigation
- CAS robotically-guided
- Augmented reality (AR)
- Virtual reality (VR) – predominantly for MedEd
- Artificial intelligence (AI) and predictive modeling

## ENABLING TECHNOLOGIES ADVANTAGES

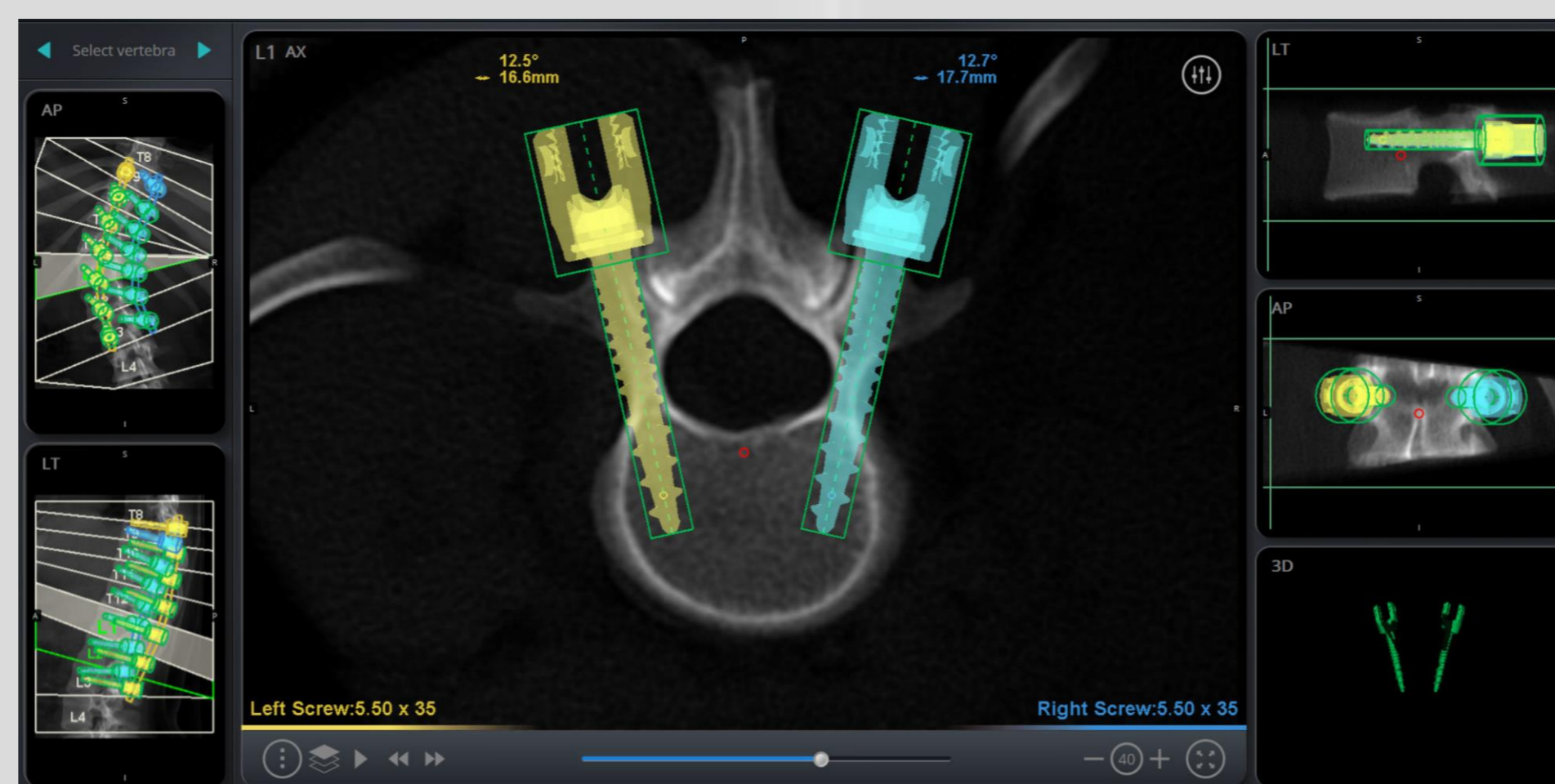
- Introduces automation and digitalization to surgery
- Surgeon maintains control to optimize clinical decisions
- Technology provides real-time feedback to surgical team
- Allows for real time visualization of patient anatomy
- Precision assistance by identifying patient anatomical nuances
- Standardizes and streamlines surgical workflows
- Increases systematic reproducibility of patient procedures
- Enables surgeons to customize patient approaches
- Reduces procedural variability



Image of the surgical robotic mount attached to a shanz pin on the patient's T12 pedicle on the convex side of a right thoracic curve

## PEDIATRIC PATIENT OUTCOMES

- Amplify the surgical experience for patients
  - Minimally invasive surgical techniques
  - Shorter skin-to-skin operative times
  - Reduced blood loss
  - Reduced anesthetic agent time
  - Less operative morbidity
  - Shorter hospital stays
  - Increased efficacy and safety



Screen shot of intraoperative planning software, setting the starting point, trajectory, and size of pedicle screws

## A GLIMPSE TO THE FUTURE...

- Dedicated enabling technology OR suites
- Intraoperative augmented reality overlays
- Data analytics and data science
- Machine learning
- Navigated bone cutting instruments
- Bespoke patient-specific implant sets
- Patient-specific 3D-printed rods and bending
- Smart implants



Pre-op standing X-ray of spine compared to post-op standing X-ray after robotically-guided pediatric spinal deformity correction

## PERIOPERATIVE NURSING IMPLICATIONS

- Staff assignments
  - Assignment of one additional nurse to facilitate room efficiency due to extra equipment
- Patient safety considerations
  - Consideration of robot mounting position onto operating table
  - Consideration of location of sterile field relative to operating room suite entrance
- Effective communication and intra-operative time planning with radiology technicians
- Enabling technologies in-servicing and training
  - Vendor training programs for key nursing staff who are then credentialed to train perioperative staff

### REFERENCE

Hedequist, D., Erickson, M., & Larson, A. (2020). Navigation and Robotics in Pediatric Spine Surgery. *JPOSNA*®, 2(1). Retrieved from: <https://www.jposna.org/ojs/index.php/jposna/article/view/81>

### ACKNOWLEDGEMENTS

Daniel Hedequist, MD, Mark Erikson, MD, A. Noelle Larson, MD, & Boston Children's Hospital Department of Orthopedic Surgery

