Integrating interventional CBCT imaging into the treatment workflow of traumatic musculoskeletal injuries

Tess Reynolds, PhD.

Cancer Institute of NSW Early Career Fellow, ACRF Image X Institute, University of Sydney

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Email: <u>tess.reynolds@sydney.edu.au</u> Twitter: @drtessreynolds



Disclosures and Disclaimer

- The concept and information presented in this paper are based on research and is not commercially • available. Due to regulatory reasons its future available cannot be guaranteed.
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Introduction



Siemens ARTIS pheno

Siemens cios spin

Medtronic O-arm

Current Clinical Benefits



Verma et al. O-arm navigation versus C-arm: a review of screw placement over 3 years at a major trauma center. Br J Neurosurg. 2016. Summers et al. Odontoid screw placement using isocentric 3-dimensional C-arm fluoroscopy. J Spinal Disord Tch 2008. Beerekamp et al. Effects of intraoperative fluoroscopic 3D-imaging on peri-operative imaging strategy in calcaneal fracture surgery. Arch Orthop Trauma Surg. 2017 Houten et al. Clinical assessment of percutaneous lumbar pedicle screw placement using the O-arm multidimensional surgical imaging system. Neurosurgery 2012. Khanna et al. Effect of intraoperative navigation on operative time in 1-level lumbar fusion surgery. J Clin Neurosci 2016,



Current Clinical Challenges







- Compliments surgical experience
- lacksquare
- Reduce intraoperative imaging dose •



ACRF IMAGE \times INSTITUTE

Individualised to each vertebra







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Pre-operative CBCT scan

32 screws

Mean axial angle difference (planned v measured)

 $3.9^{\circ} \pm 1.9^{\circ}$



Post-operative CBCT scan

Mean sagittal angle difference (planned v measured)

$1.8^{\circ} \pm 0.8^{\circ}$

Post-operative CBCT scan



5 levels (10 cuts)

Average thickness of remaining laminar

1.6±0.2mm

(E) C7

Current Clinical Challenges

Metal Artifact Reduction

Metal Artifact Reduction

Current Clinical Challenges

Metal Artifacts

Optimized metal artifact reduction imaging trajectories

----- High-risk commonly performed procedures

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C-arm gantry rotation

Pre-operative imaging:

CT

Intraoperative imaging:

CBCT: Multi-turn reverse helical

Post-operative imaging:

CT

Mean axial angle difference (CT v multi-turn reverse helical)

 $3.3^{\circ} \pm 2.6^{\circ}$

Mean sagittal angle difference (CT v multi-turn reverse helical)

 $1.9^{\circ} \pm 1.5^{\circ}$

Bring CT like coverage into the operating room for surgical verification

Intraoperative imaging: CBCT: Multi-turn reverse helical

Future directions

- Extended FOV coverage (eliminate transfer CT)
- Weight bearing imaging

T. Reynolds et al. Continuous dual-isocenter imaging: simultaneously extending the longitudinal and lateral intraoperative 3D CBCT field-of-view for assessing musculoskeletal trauma. American Association of Physicists in Medicine Annual Meeting 2022 – Thursday 7/14/22 @ 1:10pm

- Extended FOV coverage (eliminate transfer CT)
- Metal artifact reduction imaging
- Weight bearing imaging

Research Team and Collaborators

University of Sydney:

Dr Tess Reynolds Dr Owen Dillon Professor Ricky O'Brien Zoe Williams (Hybrid Theatre)

Westmead Hospital:

Dr Andrew Kanawati, MD (Orthopaedic surgeon) Dr Alex Constantinidis, MD (Surgical trainee)

John Hopkins University:

A/Professor J. Webster Stayman A/Research Professor Grace Gang Quinn Ma - PhD Student Dr Clifford Weiss, MD (Radiologist) Dr Nicholas Theodore, MD (Neurosurgeon)

Siemens Healthineers:

Sigrun Klein (Germany) Michael Manhart (Germany) Tina Ehtiati (USA) Kevin Stevens (Australia)

3D-printed surgical guides

Metal artifact reduction

THE UNIVERSITY OF SYDNEY

JOHNS HOPKINS BIOMEDICAL ENGINEERING

SIEMENS Healthineers

Extended field of view imaging

80cm

Email: <u>tess.reynolds@sydney.edu.au</u> Twitter: @drtessreynolds