Project Title

Spinal Navigation for Cervical Pedicle Screws

Project Lead and Members

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Organisation(s) Involved

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2. Lee Kong Chian School of Medicine, Nanyang Technological University
3. Department of Neurosurgery, National Neuroscience Institute

Project Period

Start date: Dec-2017

Completed date: Jan-2020

Aims

To evaluate the accuracy & safety of intraoperative O-arm-based three dimensional (3D) navigation in the insertion of the cervical pedicle screw (CPS) in spine surgery.

Background

In the cervical spine, CPS fixation has been shown to be biomechanically superior to the lateral mass screw (LMS) fixation. However, the insertion of the CPS is technically challenging, with the risk of pedicle breach into nearby neurovascular structures. Fortunately, the early adoption of 3D navigation has shown promising results in overcoming the challenges associated with CPS insertion.

Methods

This is a retrospective study of patients who underwent CPS insertion under intraoperative O-arm-based 3D navigation during the years 2009 - 2018. The radiological accuracy of CPS placement was evaluated using their intraoperative scans.

Results

A total of 297 CPSs were inserted under navigation. According to Gertzbein classification, 229 screws (77.1%) were placed without any pedicle breach (Grade 0). Of the screws that did breach the pedicle, 51 screws (17.2%) had a minor breach of less than 2mm (Grade 1), 13 screws (4.4%) had a breach of between 2mm and 4mm (Grade 2), and 4 screws (1.3%) had a complete breach of 4mm or more (Grade 3). 6 screws were revised intraoperatively. There was no incidence of neurovascular injury in this series of patients. 59 of the 68 breaches (86.8%) were found to perforate laterally, and the remaining 9 (13.2%) medially. It was noted that the C5 cervical level had the highest breach rate of 33.3%.

Lessons Learnt

Data collection in research can be challenging. With the vast amount of data on the electronic patient database available to us, mining it can be overwhelming. What I find to help in overcoming this arduous task is to first perform a literature review on the topic of interest. Subsequently, I would create an excel sheet of the specific data points relevant to achieving the aims of the study, and making small refinements along the way.

Conclusion

O-arm-based 3D navigation can improve the accuracy and safety of CPS insertion. The overall breach rate in this study was 22.9%. Despite these breaches, there was no incidence of neurovascular injury or need for revision surgery for screw malposition.

Project Category

Clinical Improvement, Safe Care, Research

Keywords

Clinical Improvement, Safe Care, Research,Computer-Assisted Surgery, Orthopaedic Surgery, Neurosurgery, Tan Tock Seng Hospital, Nanyang Technological University, National Neuroscience Institute, Neuronavigation, Spine Surgery, Intraoperative Complications, Cervical Pedicle Screw, O-Arm-Based 3D Navigation

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Project Attachment

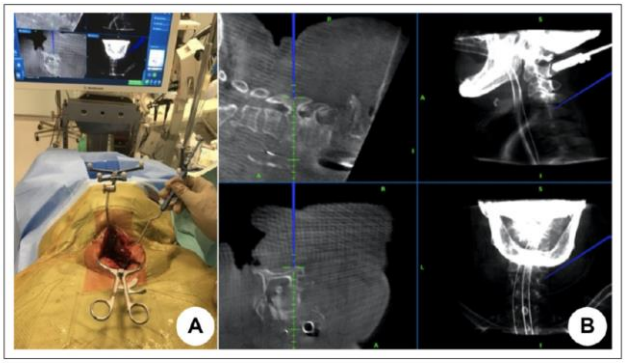

Figure 1. Verification process for the registration of navigated instruments.

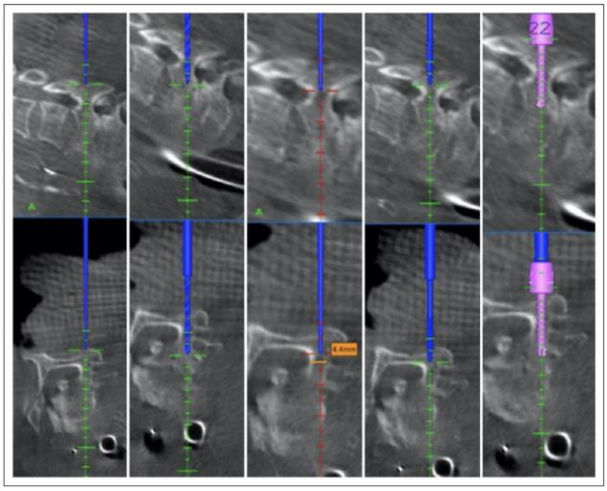

Figure 2. Sequence of cervical pedicle screw (CPS) insertion under O-arm-based 3-dimensional navigation.

Table 1. Patient Characteristics.

Sample size	82
Age, y, mean (range)	58.9 (12-82)
Gender, male:female	60:22
Ethnicity, n	
Chinese	63
Malay	9
Indian	5
Others	5
Pathology, n	
Congenital	1
Trauma	20
Infective	5
Inflammatory	3
Malignancy	13
Degenerative	40

Table 2. Distribution of Cervical Pedicle Screws and Pedicle Breaches.

	Total No. of Pedicle Screws		Total No. of Pedicle Breaches			Pedicle Breaches											
						Grade 0		Grade 1		Grade 2		Grade 3		Medial		Lateral	
Cervical Level	n	%	n	%	95% Confidence Interval	n	%	n	%	n	%	n	%	n	%	n	%
C2	42	14.1	7	16.7	0.070-0.314	35	83.3	6	14.3	0	0.0	1	2.4	1	14.3	6	85.7
C3	28	9.4	6	21.4	0.083-0.410	22	78.6	6	21.4	0	0.0	0	0.0	2	33.3	4	66.7
C4	30	10.1	5	16.7	0.056-0.347	25	83.3	4	13.3	1	3.3	0	0.0	0	0.0	5	100.0
C5	48	16.2	16	33.3	0.204-0.484	32	66.7	9	18.8	5	10.4	2	4.2	2	12.5	14	87.5
C6	52	17.5	17	32.7	0.203-0.471	35	67.3	12	23.1	4	7.7	1	1.9	1	5.9	16	94.1
C7	97	32.7	17	17.5	0.106-0.266	80	82.5	14	14.4	3	3.1	0	0.0	3	17.6	14	82.4
Total	297	100.0	68	22.9	0.182-0.281	229	77.1	51	17.2	13	4.4	4	1.3	9	13.2	59	86.8