Journal of Clinical Orthopaedics and Trauma xxx (2018) 1–4

Contents lists available at ScienceDirect

Journal of Clinical Orthopaedics and Trauma

journal homepage: www.elsevier.com/locate/jcot

Cervical pedicle screw guiding jig, an innovative solution

Abhishek Kashyap [a], Shreesh Kadur [b, *], Abhishek Mishra [b], Gaurang Agarwal [b], Abhay Meena [b], Lalit Maini [a]

[a] Department of Orthopaedics, Maulana Azad Medical College and Lok Nayak Hospital, New Delhi, India
[b] Maulana Azad Medical College and Lok Nayak Hospital, New Delhi, India

ARTICLE INFO

Article history:
Received 9 June 2018
Accepted 14 July 2018
Available online xxx

Keywords:
Pedicle screw
Cervical spine
3d printing
Jig

ABSTRACT

Pedicle screws are one the commonest used modality in spinal instrumentation. However, the method of pedicle screw fixation in cervical spine as compared to thoracic and lumbar spine is still technically demanding because it carries the risk of catastrophic damage to the surrounding neurovascular structures We have utilized virtual planning and 3D (3-dimension) printing to develop a patient specific jig to guide the accurate placement of pedicle screws. A patient with bifacetal dislocation C7 over D1 classified as flexion-distraction injury type 3 who was planned for decompression and fusion by posterior instrumentation at C6, C7, D1 and D2 was selected. A CT scan with 1 mm cuts was used to produce DICOM images of the same. Using these DICOM images virtual planning was done on MIMICS and 3 MATICS software to create patient specific jigs. These jigs were then 3D printed using a 3D printer and used for accurate placement of pedicle screws intra-operatively after adequate sterilization. Our procedure is low cost but high technology based. It is simple, accurate, and very cost effective. The technology transfer is very easy and can be adopted easily.

1. Introduction

Pedicle screws are one the commonest used modality in spinal instrumentation. However, the application of pedicle screws in cervical spine is limited as compared to thoracic and lumbar spine because of and small pedicle size and close proximity to the surrounding structures. Most surgeons use lateral mass screws and anterior instrumentation frequently due to better safety and shorter learning curve. The pedicle screw fixation technique in cervical spine offers biomechanical advantages over lateral mass screw technique because of its firm hold along the three columns of the spine.[1,2]

We have utilized virtual planning and 3D (3-dimension) printing to develop a patient specific jig to guide the accurate placement of pedicle screws.

2. Case history

A 45 year old male with fall of heavy object presented 2 days after the injury. Patient had complete quadriplegia with bowel bladder involvement graded as ASIA-A (American Spine Injury Association).[3] The radiological work up of the patient included X-rays, CT (computed tomography) scan (Fig. 1) with 1 mm cuts and MRI (Magnetic Resonance Imaging). Diagnosis of bifacetal dislocation C7 over D1 classified as flexion-distraction injury type 3 was made. Patient was planned for decompression and fusion by posterior instrumentation at C6, C7, D1 and D2 was made.

3. Surgical jig development and its application

3.1. Jig development

The virtual planning was done using CT scan with 1 mm cuts to produce Digital Imaging and Communications in Medicine (DICOM) images. DICOM images were imported to MIMICS software ver17 and 3D reconstruction of the desired surgical area was created.

The 3d model of the cervical spine was exported as. stl (steriolithography) file and transferred into 3 MATICS ver13. software The guiding cylinders trajectory of pedicle screw at the desired level was placed virtually with the 3D model (Fig. 2). Cylinders

* Corresponding author. #52, flat no: 202, Saathwik Residency, Ramanjaneya Nagar, Chikkalsandra, Banagalore, 560061, India.
E-mail addresses: kashyap.dr@gmail.com (A. Kashyap), shreesh90@gmail.com (S. Kadur), mishra.abhishek85@gmail.com (A. Mishra), gaurang140389@gmail.com (G. Agarwal), abhijnvk@gmail.com (A. Meena), lalit_maini@rediffmail.com (L. Maini).

https://doi.org/10.1016/j.jcot.2018.07.010
0976-5662/

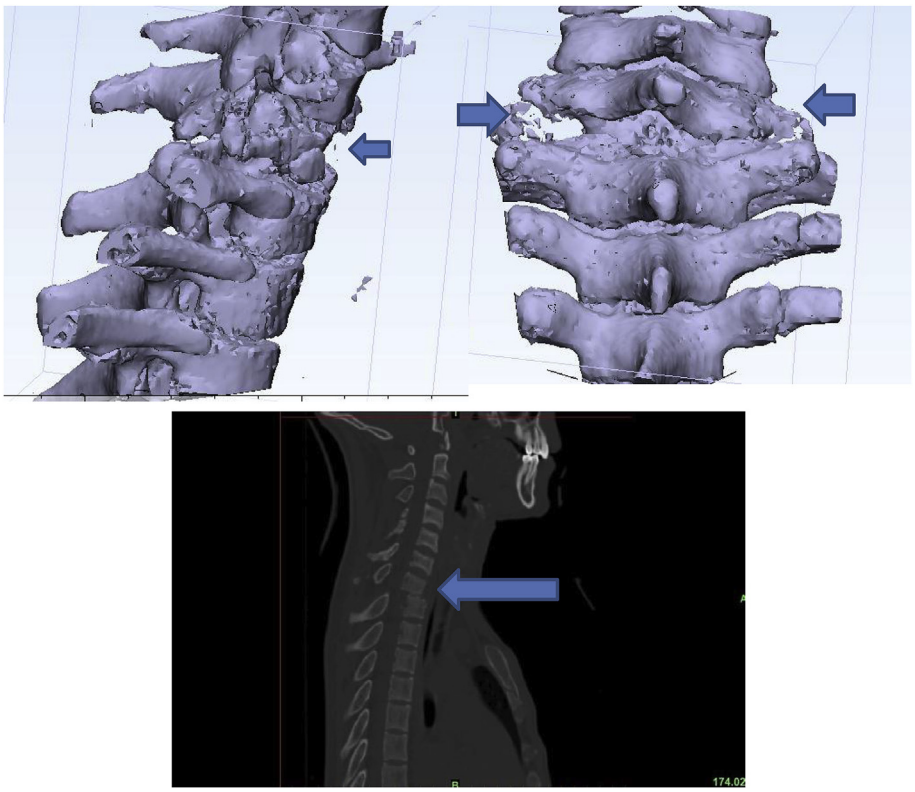

Fig. 1. 3D RECON and sagittal view of CT scan with arrows showing bifacetal dislocation of C7 over D1.

were made hollow to pass k-wires. The model and the screws were evaluated by Slicing and Transparency tool for assessing the pedicle breech. The posterior surface of lamina and lateral mass were marked to create a surface over which a structure was built. The right and left jigs were then connected by a bridge (Fig. 2). Similar jig was created for C7 level also. Jigs and the spine model of the patient were 3D printed as FDM. Jigs were tested again with the guiding wires (Fig. 3). All of the guide wires were found appropriate. The printed jigs were sterilized using ETO (ethylene trioxide).

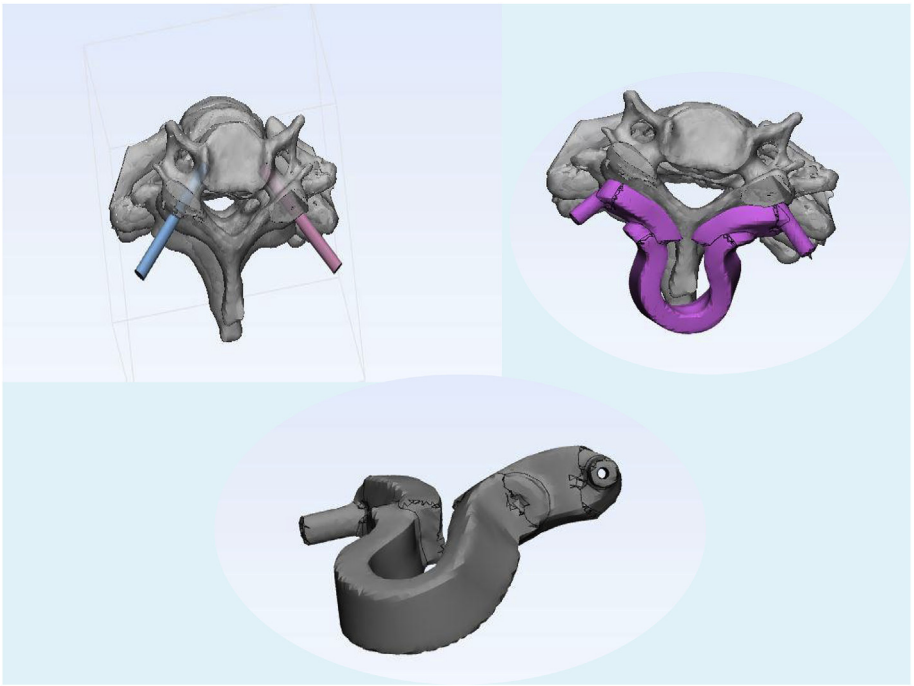

Fig. 2. Showing guiding cylinders for pedicle screw trajectory, anticipated jig model placed over posterior elements of the spine and the 3d model of the jig.

Please cite this article in press as: Kashyap A, et al., Cervical pedicle screw guiding jig, an innovative solution, Journal of Clinical Orthopaedics and Trauma (2018), https://doi.org/10.1016/j.jcot.2018.07.010