Surgical Therapy to Atlantoaxial Instability

Paul Cooke, OMS II MU-COM and David Dufeau, PhD MU-COM

Pcooke508@marian.edu
ddufeau@marian.edu;

MARIAN UNIVERSITY
Indianapolis
College of Osteopathic Medicine
3D Visualization Laboratory

Introduction

Atlantoaxial instability (AAI) is a term that is used to describe instability at the atlantoaxial joint of the cervical spine. This is often from alar ligament instability causing the dens of the axis to be prone to move posterior or sublux. The inferior portion of the medulla oblongata and the superior portion of the spinal cord can be compressed by the posterior movement of the dens causing life-threatening effects. In this presentation, a surgical therapy to atlantoaxial instability will be examined for the purpose of educating future medical students. We will specifically be examining AAI with spina-bifida occulta at C1.

Methods

Using the image databank Horos, a file containing CT images of the skull and cervical spine was obtained. This data set contained a patient with apparent spina-bifida occulata at the atlas (C1) causing spinal instability at the atlanto-axial joint.

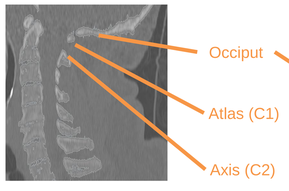

Figure 1: Sagittal view of cervical spine CT

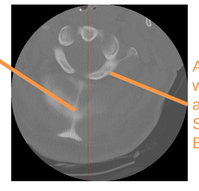

Figure 2: Transverse view of the atlas CT

Additionally, a CT of the corrective-surgical therapy was also obtained. These CT image sets were then analyzed and 3D rendered using Amira. A 3D print was also obtained using the softwares Meshmixer and Formlabs. A 3D print was completed using Form Labs Form 3 Resin printer.

Results

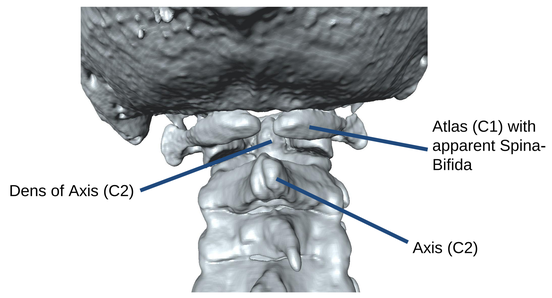

Figure 3: Presented above left is the 3D visualization of the cervical spine with apparent spina-bifida at the atlas (C1).

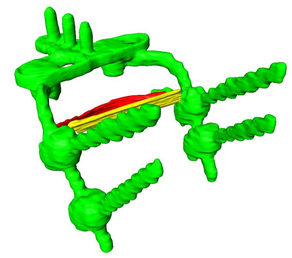

Figure 4: Presented above right is the 3D visualization of the hardware used to correct the spinal abnormality.

Figure 6: Presented below is the 3D print of the spine and occiput.

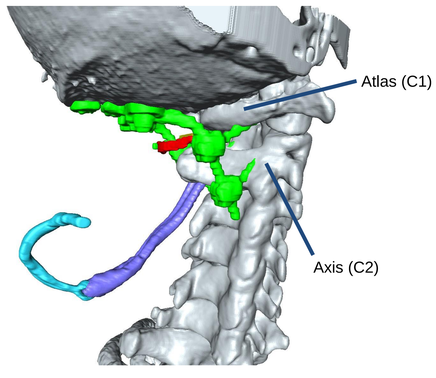

Figure 5: Presented above is the 3D visualization of the corrective hardware installed on the spine. *Note: unknown surgical artifact likely used to manage CSF in blue and purple.*

Discussion

Our intent for this project was to use the 3D imaging and printing technology to better educate future medical students about the spinal corrections available for AAI. Additionally, 3D imaging, and printing technology provides unique clarity to anatomical structures. Finally, these images and 3D prints allow for viewing of the therapy for atlantoaxial instability and subluxation.

Conclusion

The researchers have found that through using the 3D visualization technology, one can create accurate and intricate images of the atlantoaxial joint of the spine and a corrective surgery for AAI. Both the 3D images and the physical 3D print show great promise in teaching future medical students of both spina-bifida of the atlas and AAI causing subluxation at the atlantoaxial joint.

Figure 7: Presented above a 3D print of the cervical spine and ociput with the corrective hardware installed.

Future Developments

The researchers hope to further develop 3D visualization software for the purpose of medical student education. They plan to promote the use of 3D visualization as a teaching method for medical students.