Atlanto-axial facet joint distraction using interfacet cages for basilar invagination in Chiari malformation – video

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Introduction

Basilar invagination is defined by the upward migration of the odontoid process into the foramen magnum, leading to compression of the medulla oblongata at the cranio-cervical junction (CCJ). The condition may be congenital or acquired. Traditional management in symptomatic patients involved transoral odontoid resection and anterior decompression, but this approach carries significant morbidity. In 2004, Goel et al. introduced C1–2 joint cage distraction as a technique to restore odontoid alignment by distraction and posterior fixation.
Here, we report the case of a 33-year-old patient who developed progressive basilar invagination ten years after decompression for Chiari type I malformation. Surgical management consisted of C1–2 cage distraction to correct odontoid displacement, combined with expansile duroplasty and posterior cervical fusion from C1 to C5.

Surgical Case Presentation

History

We present the surgical case of a 33 years old woman suffering from Chiari malformation. The patient underwent previous decompression surgery of the posterior fossa with duraplasty 10 years ago. Now she developed new symptoms with severe headaches, numbness in bilateral hands which are most pronounced on extension, stabbing pain which occurs mainly when she's breaking suddenly while driving in the car. The lower extremities are not affected.

Clinical exam

Neurological examination revealed mild weakness of the left upper extremity, most pronounced in the interossei and biceps muscles (4/5 strength), along with bilateral upper extremity numbness. Hyperreflexia was noted in the left upper extremity, with a positive Hoffmann sign on the left. Local tenderness was present on palpation at the level of the C2 vertebra.

Imaging

Imaging showed severe Chiari malformation with herniation, tonsillar descent of about 3 cm, kinking of the spinal cord at the level of the odontoid tip, but no signs of syringomyelia. Additional anterolisthesis of C3 over C4 was present.

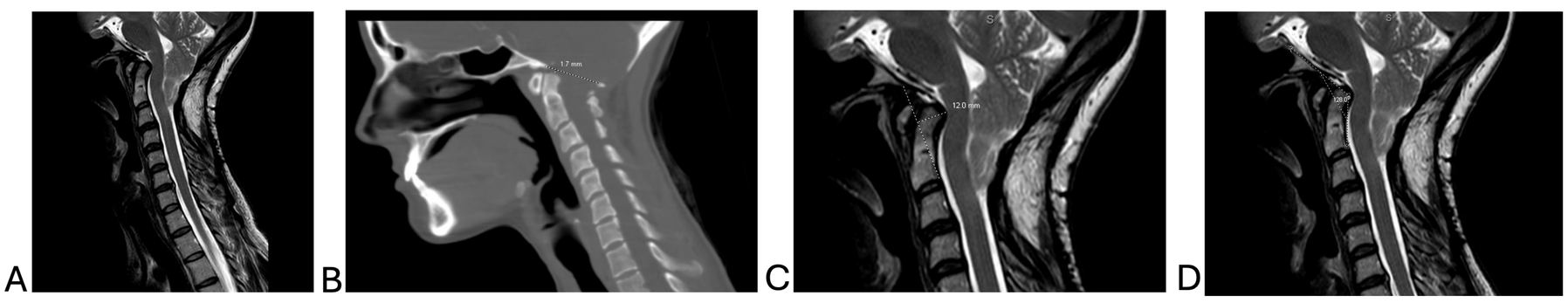

Figure 1.: Preoperative imaging
(A) Sagittal MRI showing the severe Chiari malformation with tonsillar herniation and descent of 3cm
(B) Sagittal CT-scan shows the tip of the dens 1.7mm below Mc Rae's line, normal value 5mm (+/- 1.8mm)
(C) The posterior Basion-C2 line pBC2 measures 12mm, pBC2 > 9mm is abnormal
(D) The Clivo-Axial angle is 128°, normal value 150-165°

Surgery

The patient was positioned prone on a Jackson table with 10 lb of cervical traction applied using Gardner–Wells tongs. Intraoperative neuromonitoring, including motor evoked potentials (MEPs), somatosensory evoked potentials (SSEPs), and electromyography (EMG), was utilized. A posterior midline cervical incision was performed, and the C1–2 joints were identified following bilateral transection of the C2 nerve roots. The posterior aspects of the C1–2 joints were widened using a drill to facilitate cage placement. Interfacet cages were inserted with gentle mallet taps. Posterior cervical fusion was then achieved using a screw-and-rod construct extending from C1 to C5. Under microscopic visualization, the dura was opened, and scar tissue as well as arachnoid adhesions were released. The cerebellar tonsils were reduced using bipolar coagulation. An expansile duraplasty was performed prior to routine closure.

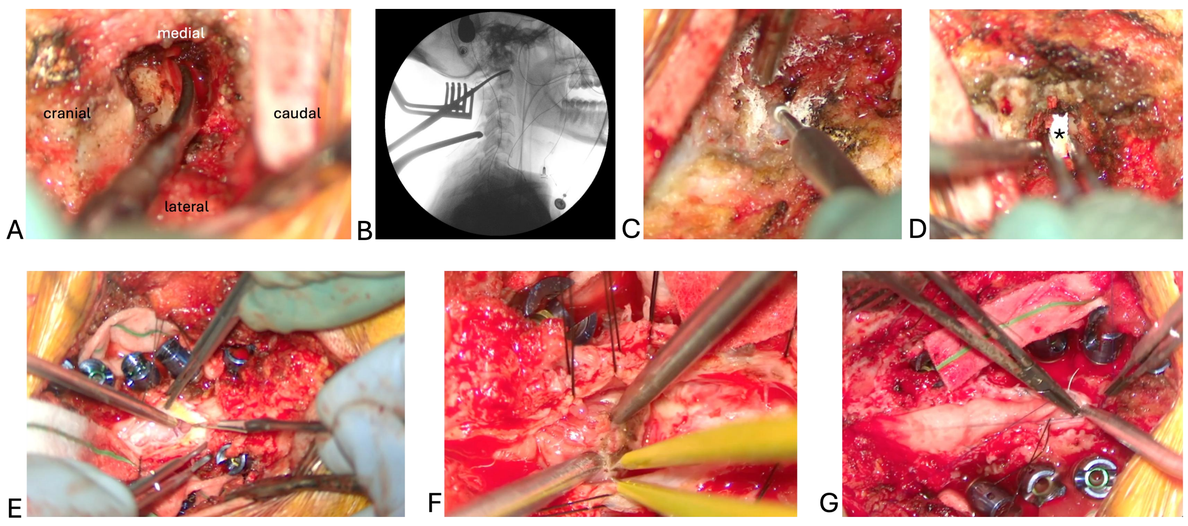

Figure 2.: Intraoperative presentation and imaging
(A) A Freer elevator is positioned in the left C1-2 joint after transsection of the left C2 nerve root
(B) Fluoroscopy image of the Freer elevator positioned in the C1-2 joint
(C) Careful widening of the left C1-2 joint using a drill
(D) Intraoperative view showing the C1–2 interfacet cage (asterisk) positioned prior to final insertion with gentle mallet taps.
(E) Midline durotomy
(F) Shrinkage of cerebellar tonsils with bipolar forceps
(G) Expansile duraplasty

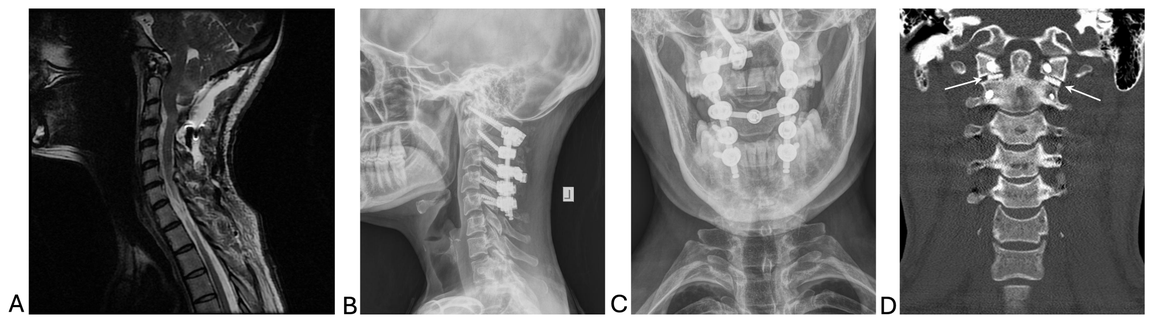

Figure 3.: Postoperative imaging
(A) Sagittal MRI showing the improvement and decompression of tonsillar herniation
(B) Sagittal cervical X-ray. Posterior cervical fusion C1-C5
(C) Coronal X-ray of the cervical spine
(D) Coronal CT-scan of the cervical spine with presentation of the C1-2 interfacet cages arrows

Conclusion

Atlantoaxial cage distraction is an effective strategy to realign the CCJ in cases of basilar invagination. This method offers a less morbid alternative to transoral odontoid resection, avoiding complications such as dysphagia, pharyngeal plexus injury, and infection.

References

1. Transoral anterior decompression for treatment of unreducible atlantoaxial dislocations. *Surg. Neurol.* **23**, 244–248 (1985).
2. Goel, A. Treatment of basilar invagination by atlantoaxial joint distraction and direct lateral mass fixation. (2004) doi:10.3171/spi.2004.1.3.0281.