The Importance of Open Reduction of Kyphotic Clivo-axial Angle in Patients with Cervico-Medullary Syndrome Due to Basilar Invagination: Cohort Analysis of 10 Adult Subjects
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Introduction
The influence of a kyphotic clivo-axial angle (CAA) on outcome following decompression of Chiari I Malformation is established. \(^1\)\(^2\)\(^3\)\(^4\)\(^5\)\(^6\)\(^7\)\(^8\) Approximately 50% of patients with Chiari I malformation have a kyphotic CAA (<135°) \(^4\), considered a form of basilar invagination. \(^1\)\(^4\)\(^5\)\(^6\)\(^7\).

Traditional measurements of basilar invagination do not account for cervico-medullary angulation over the odontoid, and fail to account for resulting ventral brainstem compression. \(^4\)\(^8\)

This study informs the emphasis of intraoperative reduction of kyphotic CAA, fusion and stabilization when treating cervico-medullary syndrome that results from various forms of basilar invagination.

Methods
With IRB approval, ten adult subjects were enrolled prospectively with cervico-medullary syndrome and kyphotic CAA underwent posterior, open reduction of kyphotic CAA, fusion, and stabilization. \(^3\) Parametric and non-parametric statistical tests were performed on Visual analog scale (VAS), Oswestry, ASIA, Karnofsky, SF12 (physical and mental components), Brainstem Disability Index (BDI) \(^7\) preoperatively and at 12-months.

Results
Mean CAA increased from 135.8° to 163.7° (normal =165°). One returned to OR for superficial infection. Improvement reached statistical significance: VAS (p.0009), Oswestry (p .006), ASIA (p.004), Karnofsky (p.0003), SF36 (mental p.008, physical p.001).

Non-parametric Wilcoxon signed-rank tests were statistically significant (p<0.02).

Conclusions
Cervico-medullary syndrome in the setting of kyphotic CAA is improved following normalization of craniocervical relationship through the open reduction of kyphosis of the CAA, fusion and stabilization.

Learning Objectives
By the conclusion of this session, participants should (1) understand the importance of the clivo-axial angle and ventral brainstem compression to certain cases of cervico-medullary syndromes (2) evaluate situations in which open reduction, fusion, and stabilization should be considered.

References
In the normal case, there is minimal spinal cord strain
Abnormal Cranio-cervical junction

In the case of hypermobility and kyphotic clivo-axial angle, spinal cord strain can reach up to 20%.