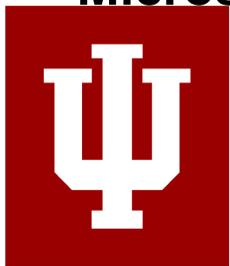


Microsurgical and Endoscopic Anatomy of the Condyle, Jugular Tubercle, Condylar Fossa, and Hypoglossal Canal: A Cadaveric Study



Elena Rosellini, MD^{1,2,3}; Aysu Kabakci, MD^{1,2}; Sergio Farias, MD^{1,2}; Gabriel V Rosales, MD^{1,2}; Cezar K Prigenzi, MD^{1,2}; Gean Franco Gerbino

^{1,2}, Federico Pessina, MD³ Joao Paulo Almeida, MD, PhD^{1,2}

¹Department of Neurosurgery, Indiana University, Indianapolis, IN, US

²Almeida's Skull Base Lab, Wile Hall, IU Health

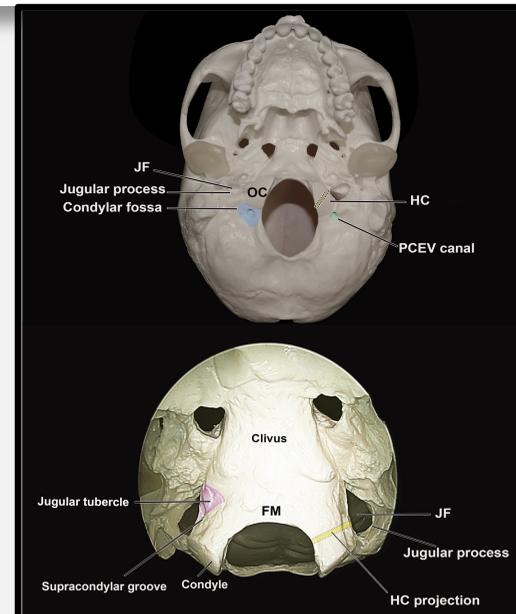
³Humanitas University, Department of Neurosurgery, Milan, Italy



INTRODUCTION:

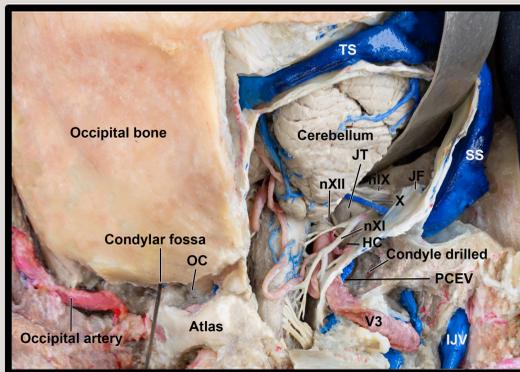
The craniovertebral junction represents one of the most technically demanding regions in neurosurgery, where millimetric inaccuracies may result in severe neurological morbidity or craniocervical instability¹. This area constitutes a critical surgical gateway for the management of ventral brainstem lesions, foramen magnum meningiomas, and vertebrobasilar pathologies². Despite decades of anatomical and technical refinement, surgical approaches to this region remain conceptually divided between transcranial and endoscopic trajectories, each offering complementary yet inherently incomplete perspectives of the same anatomical structures³.

The understanding of the relationships between occipital condyle (OC), jugular tubercle (JT), hypoglossal canal (HC), condylar fossa is of major importance for skull base surgeons to reach foramen magnum (FM) and inferior clivus region microscopically and endoscopically. The aim of this cadaveric study is to describe the relationships of these structures in a microsurgical and endoscopic perspective.



METHODS:

Five silicone injected formalin flushed alcohol preserved cadaveric head specimens were dissected microscopically and endoscopically. Endoscopic dissections were performed using 0° and 30° endoscopes. Every step of the approach was photographed in 2D and 3D formats with photogrammetry models.



RESULTS:

Microsurgically, a standard far-lateral approach, condylar fossa and trans condylar variants were performed. Endoscopically, a “far-medial” expanded endoscopic endonasal transclival (EETA) approach with transcondylar and transJT expansions were performed.

Far-Lateral Approach

The OC is the central bony landmark in this approach, often obscuring the view of the anterior brainstem and vertebral artery. The OC projects downward along the lateral edge of the anterior half of FM⁴.

The condylar fossa is a concave region located above the atlanto-occipital joint, posterior to the OC, guiding to the posterior margin of the OC. It is an important landmark during resection of the posterior portion of the JT, enabling preservation of the atlanto-occipital joint in a trans condylar fossa approach⁵.

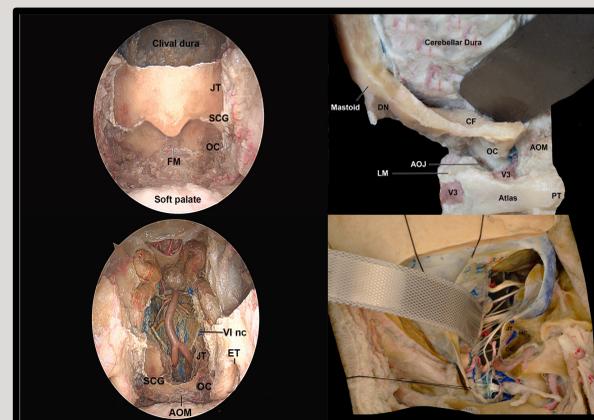
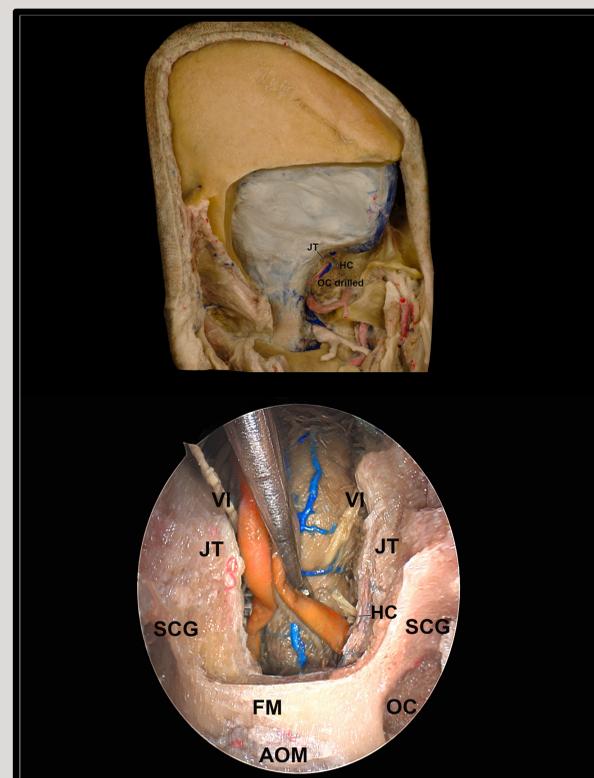
The JT is a smooth bony eminence situated on the intracranial surface at the junction of the basilar and condylar portion of occipital bone. Together with the OC, it forms part of the lateral bony wall of the foramen magnum. Resection of the lateral aspect of the JT constitutes a critical step in the transcondylar and condylar fossa approaches to visualize the lower clivus and brainstem without causing craniocervical instability⁴.

The HC is found approximately at the superior and midpoint of the condyle. The intracranial end of the HC is located at the junction of posterior and middle third of the condyle while the extracranial end is at the junction of anterior and middle third.

Endoscopic Endonasal Transclival Approach (EETA)

In EETA, after drilling the lateral inferior clivus, two compartments divided by the HC are exposed: the JT superiorly, the condylar compartment inferiorly. The condylar fossa is not visualized endoscopically.

The superior tubercular compartment corresponds anatomically to the ventral aspect of the JT. Its inferior border is defined by the HC, while its lateral border is demarcated by the jugular foramen. The external opening of the HC is a key landmark located on the face of the lower clivus, just superior to the OCs. A feature called the supracondylar groove (SCG) on the anterior surface of the condyle serves as a reliable landmark for locating the HC's external orifice. The HC and its external opening are situated just posterior and lateral to the supracondylar groove. This makes the groove a highly reliable predictor of the canal's location⁶.



SUMMARY: This study clarifies key microsurgical and endoscopic anatomical landmarks around the foramen magnum, aiding surgical planning and enhancing skull base surgical education.

REFERENCES:
3D MODELS:

