

# Cranial Nerve Injury in Endoscopic Endonasal Approach to Skull Based Surgery: A Systematic Review

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## Background

- The endoscopic endonasal approaches (EEA) to skull base tumors provide superior visualization of cranial nerves (CN) provides superior visualization of CN at the skull base foramina.<sup>1,2</sup>
- Cranial neuropathies following EEA may have significant impact on patient's functional outcomes and quality of life and remain underexplored.
- Objective:** Characterize the number of reported CN injuries in EEA in skull base surgery

## Results

- Across 177 papers, a total of 859 cranial nerve injuries were reported with an average of 5.03 +/- 8.70.
- Pituitary tumors demonstrate the highest frequency of CN II and CN VI injuries, while chordoma and chondrosarcoma show primarily affecting CN VI, patterns consistent with clival involvement.
- Sellar and suprasellar sagittal approaches show the highest density of CN II and CN VI injuries. Clival approaches predominantly were associated with CN VI injury.
- Full injury was observed in 38.42%** (330/859) of the reported injuries and partial nerve **recovery was in 10.48%** (90/859).
- The most common pathology was **pituitary tumors (34.49%**, 297/859) followed by not stated pathologies (28.34%, 244/859).
- The most common injured nerve was the **abducens nerve (24.39%**, 210/859) followed by **optic nerve (23.69%**, 204/859), and then the olfactory nerve (12.78%, 160/859).
- The unspecified approaches were the most common approaches (45.76%, 394/859), followed by **sellar** approaches in the sagittal plane (34.38%, 296/859), and then lateral approaches in the coronal plane (9.06%, 78/859).

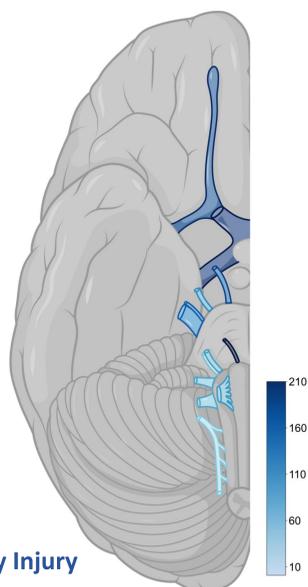


Figure 2. Anatomical Density Map by Injury

## Conclusions

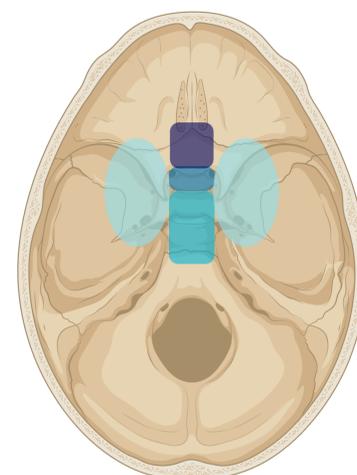
- There is a notable gap in the understanding of iatrogenic CN associated with the EEA to skull base surgery.
- Further research is needed to consider CN injuries and their effect on functional status and quality of life.

## References

<sup>1</sup>Borg, A. et al. Endoscopic Endonasal Anterior Skull Base Surgery: A Systematic Review of Complications During the Past 65 Years. *World Neurosurg* 95, 383-391 (2016).  
<sup>2</sup>Porras, J. L., Rowan, N. R. & Mukherjee, D. Endoscopic Endonasal Skull Base Surgery Complication Avoidance: A Contemporary Review. *Brain Sci* 12 (2022).

## Methods

- Design:** We conducted a systematic review following PRISMA guidelines, with key search terms of skull base surgery, endoscopy, endonasal, CN, and complications.
- Eligibility Criteria:** Primary studies exploring CN injury in any EEA were included. Studies were excluded if the injury was attributed to the pathology.
- Screening and Data Extraction:** Studies underwent two rounds of dual, independent screening. Data extraction included: study characteristics, CN injured, type of intraoperative neuromonitoring, type of post-operative injury management, and intervention used to reduce CN injury, if applicable.
- Analysis:** Each surgical approach was grouped into one of four approach divisions for analysis.



- Sagittal-Extended Sellar
- Sagittal-Sellar
- Sagittal-Clival
- Coronal

Figure 1. Classification of EEA Approaches

Pathology	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	U
Chondrosarcoma	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	9 (42.9%)	9 (42.9%)	0 (0.0%)	0 (0.0%)	2 (9.5%)	1 (4.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Chordoma	0 (0.0%)	1 (1.7%)	1 (1.7%)	1 (1.7%)	3 (5.0%)	44 (73.3%)	0 (0.0%)	1 (1.7%)	2 (3.3%)	1 (1.7%)	0 (0.0%)	2 (3.3%)	4 (6.7%)
Craniopharyngioma	2 (2.9%)	54 (77.1%)	7 (10.0%)	0 (0.0%)	0 (0.0%)	6 (8.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.4%)
Meningioma	3 (6.8%)	12 (27.3%)	5 (11.4%)	1 (2.3%)	4 (9.1%)	14 (31.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (11.4%)
Not Stated	30 (12.3%)	52 (21.3%)	22 (9.0%)	7 (2.9%)	4 (1.6%)	72 (29.5%)	0 (0.0%)	0 (0.0%)	2 (0.8%)	4 (1.6%)	0 (0.0%)	6 (2.5%)	45 (18.4%)
Other	2 (2.6%)	5 (6.5%)	12 (15.6%)	1 (1.3%)	23 (29.9%)	26 (33.8%)	4 (5.2%)	1 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (3.9%)
Pituitary	122 (41.1%)	80 (26.9%)	60 (20.2%)	2 (0.7%)	2 (0.7%)	26 (8.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (1.7%)
Schwannoma	0 (0.0%)	0 (0.0%)	2 (5.1%)	0 (0.0%)	20 (51.3%)	13 (33.3%)	4 (10.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Sinonasal Malignancy	1 (12.5%)	0 (0.0%)	1 (12.5%)	0 (0.0%)	1 (12.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (12.5%)	1 (12.5%)	0 (0.0%)	1 (12.5%)	2 (25.0%)

Figure 3. Heatmap of CN Injuries by Pathology

Approach	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	U
Coronal 1, Lateral Approaches	0 (0.0%)	0 (0.0%)	6 (7.7%)	1 (1.3%)	34 (43.6%)	22 (28.2%)	8 (10.3%)	0 (0.0%)	3 (3.8%)	2 (2.6%)	0 (0.0%)	2 (2.6%)	0 (0.0%)
Endonasal Intraorbital	0 (0.0%)	0 (0.0%)	6 (75.0%)	0 (0.0%)	2 (25.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Sagittal 1, Sellar	121 (40.9%)	81 (27.4%)	36 (12.2%)	6 (2.0%)	12 (4.1%)	38 (12.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.7%)
Sagittal 2, Suprasellar	1 (1.6%)	37 (60.7%)	22 (36.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.6%)
Sagittal 3, Clival	0 (0.0%)	0 (0.0%)	1 (4.8%)	0 (0.0%)	0 (0.0%)	17 (81.0%)	0 (0.0%)	1 (4.8%)	1 (4.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (4.8%)
Sagittal 4, Extended Sellar	0 (0.0%)	2 (66.7%)	1 (33.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Unspecified	38 (9.7%)	84 (21.4%)	38 (9.7%)	5 (1.3%)	18 (4.6%)	133 (33.8%)	0 (0.0%)	1 (0.3%)	3 (0.8%)	5 (1.3%)	0 (0.0%)	7 (1.8%)	61 (15.5%)

Figure 4. Heatmap of CN Injuries by Surgical Approach