Stepwise Technique for Safe Exposure of the Paraclinoid, Parasellar and Paraclival ICA for Endoscopic Endonasal Approach: Technical Nuances

Thibault Passeri MD[1], Rakhmon Egamberdiev MD[1], Gianluca Fabozzi MD[1], Ivo Peto MD[1], Hussam Abou-Al-Shaar MD[1], Ali Alattar MD[1], Eric W. Wang MD[2], Carl H. Snyderman MD[2], Paul A. Gardner MD[3], Garret Choby MD[2], Georgios A. Zenonos MD[1]

Departments of Neurological Surgery[1] and Otolaryngology[2], University of Pittsburgh Medical Center
Department of Neurosurgery[3], NYU Langone Health

Introduction

Over the past decade, endoscopic endonasal surgery (EES) has become a cornerstone in the treatment of skull base pathologies. Expanded lateral corridors in EES often require exposure of the internal carotid artery (ICA), increasing the risk of a rare but potentially devastating complication. We describe a stepwise strategy to optimize safe ICA exposure and review our institutional experience with injuries during bone removal.

Methods

Anatomical dissections were performed on silicone-injected cadaveric heads to define safe techniques for exposing the paraclinoid (PClin), parasellar (PS), and paraclival (PCliv) ICA segments. In addition, a retrospective review of all patients who underwent EEA at our institution between June 1998 and January 2025 was conducted to identify cases of intraoperative ICA injury specifically occurring during the exposure phase.

Results

STEPWISE SURGICAL CONCEPT & TECHNIQUE

Our approach emphasizes stepwise "**eggshell" drilling**, **controlled fracture**, and **circumferential removal** of bony protuberances to ensure safe ICA exposure.

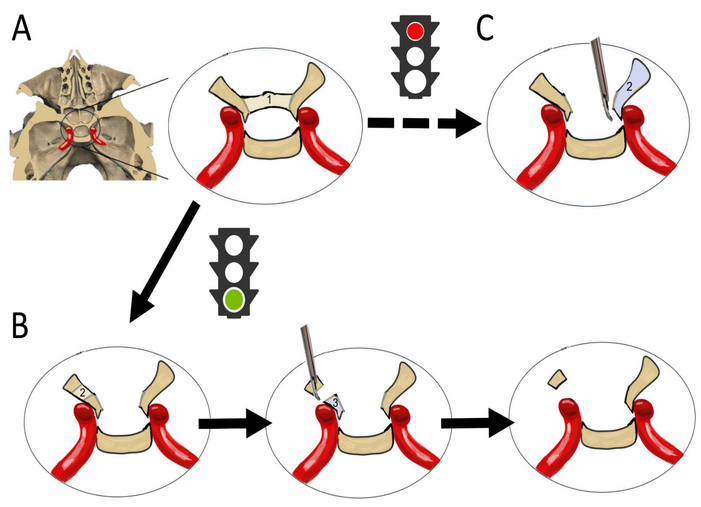

Figure 1: Illustration of the "stepwise circumferential removal of the bony spike" concept. A. The bony spike between the sella and the medial ICA wall corresponds to either the medial opticocarotid recess or the middle clinoid process. **B.** Removal of the bony spike using the stepwise circumferential technique. The bone overlying the sella and its floor is first removed. The spike is then safely eliminated by skeletizing the ICA, followed by en bloc extraction with the tip of the Kerrison, without biting. **C.** A hazardous method consists of medial-to-lateral removal with biting maneuvers from the sella toward the ICA, as sharp spikes markedly increase the risk of direct ICA wall injury.

For the **PClin/PS segments** (Figure 2A), key steps include:
(1) Opening the sella to the medial opticocarotid recess (MOCR)
(2) Sellar floor drilling
(3) Unroofing the anterior cavernous sinus wall
(4) Inferior-to-superior ICA skeletonization to the distal dural ring
(5) En bloc removal of the middle clinoid process
(6) Tuberculum margin drilling
(7) Optic canal unroofing
(8) MOCR removal

For the **PCliv segment** (Figure 2B):
(1) Opening the sella to the medial opticocarotid recess (MOCR)
(2) Sellar floor drilling
(3) Unroofing the anterior cavernous sinus wall
(4) Anterior ICA skeletonization
(5) Drilling of the middle/lower clivus
(6) En bloc resection of the medial wall and posterior bone behind the ICA

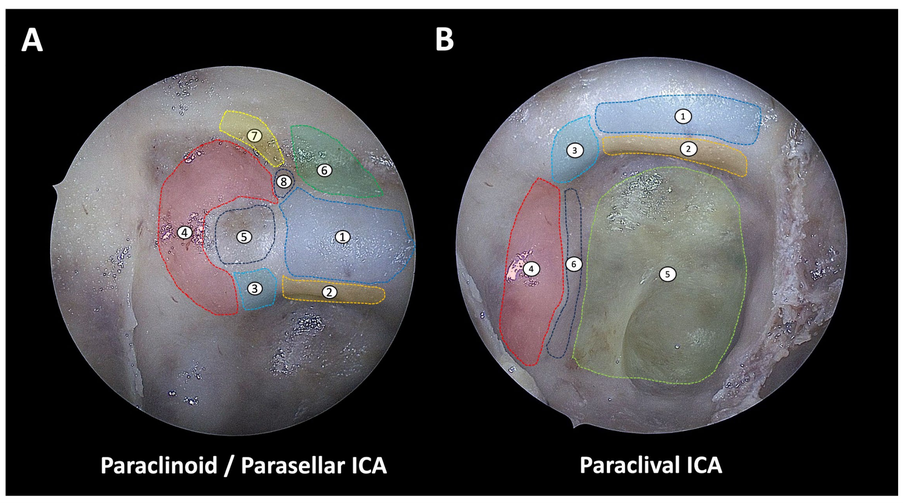

Figure 2. Stepwise dissection of endoscopic endonasal exposure of the parasellar (PS) , paraclinoid (PClin) & paraclival (PCliv) segments of the ICA

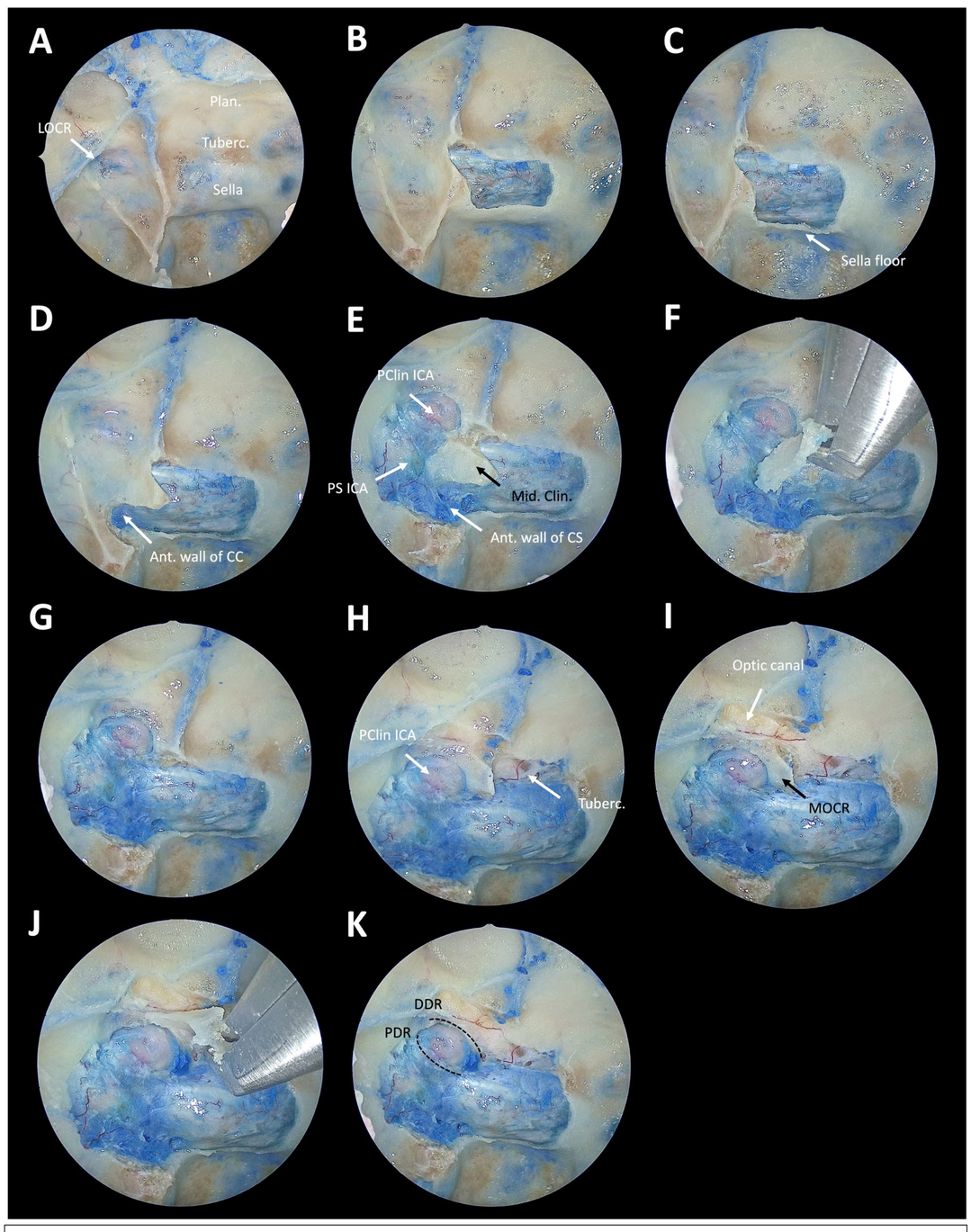

Figure 3. Stepwise dissection of endoscopic endonasal exposure of the PS and PClin segments of the ICA (right side)

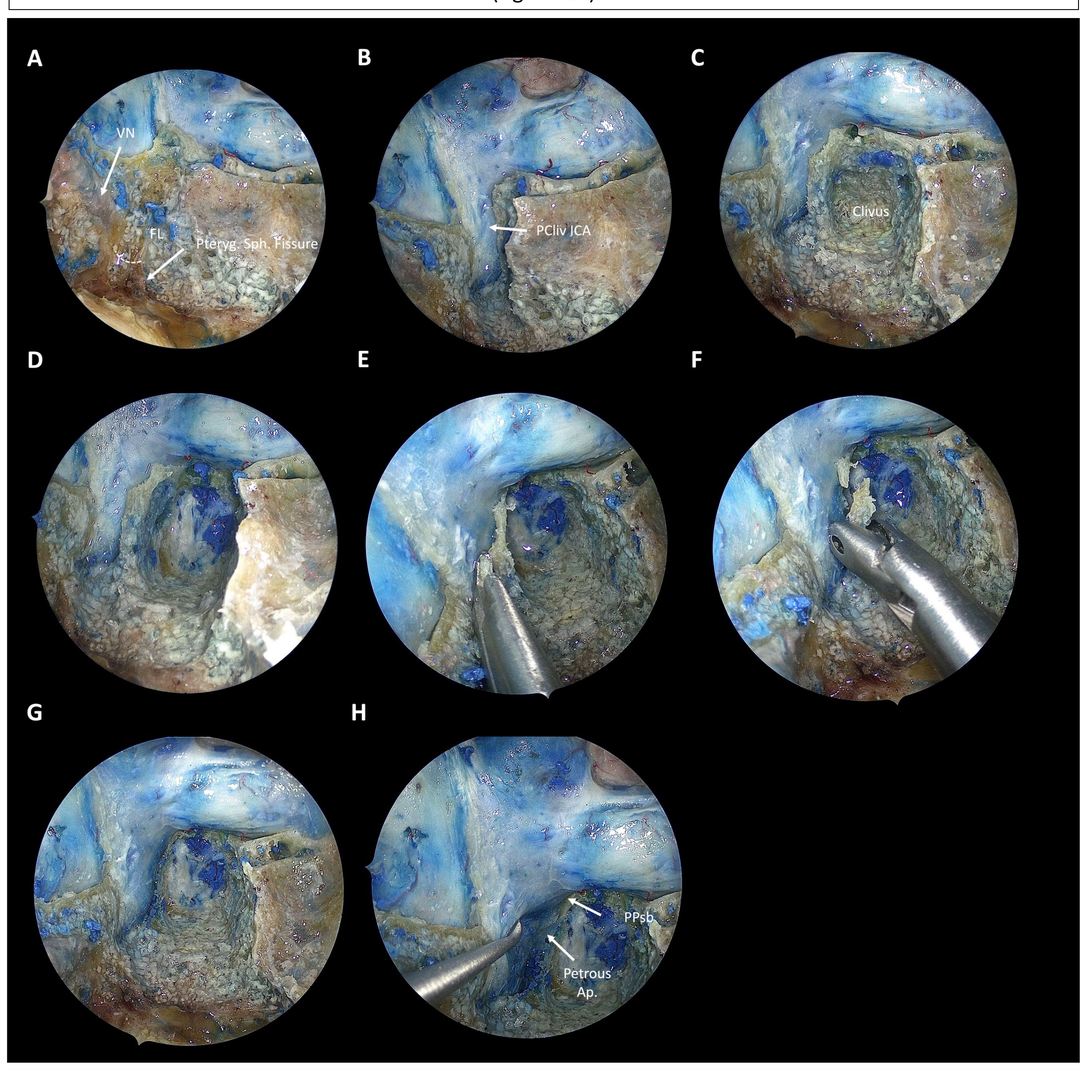

Figure 4. Stepwise dissection of endoscopic endonasal exposure of the PCliv segment of the ICA (right side)

STEPWISE SURGICAL CONCEPTS & TECHNIQUE

We identified 4925 EES procedures for various skull base pathologies from June 1998 to January 2025 during which at least one carotid was exposed. Of these cases, ICA injury occurred in 5 cases (0.1%) during bone removal. Among these, 3 occurred at the PS segment and 2 at the PCliv segment. Postoperatively, ICA sacrifice was necessary in 3 cases. No patient died during the procedure but one patient succumbed to postoperative cardiac ischemia.

Conclusions

Safe ICA exposure during EES requires a combination of comprehensive anatomical knowledge, careful preoperative imaging assessment, and adherence to a stepwise, meticulous surgical technique. This structured approach is critical to minimize the risk of ICA injury during bone removal and to improve patient safety in complex skull base procedures.