Maximizing the Sub-Temporal Window: Tailored Modular Exposure of Middle Fossa, Posterior Fossa, and Combined Lesions

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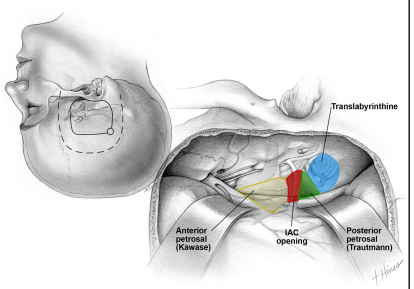
Introduction: The optimal surgical approach to complex extra-axial petroclival lesions—such as meningiomas, schwannomas, epidermoid tumors, and chordomas—remains strongly debated. These lesions are deep, intimately associated with critical neurovascular structures, and demand surgical approaches tailored to lesion's unique anatomic relationships to minimize surgical morbidity while optimizing extent of resection. We evaluated the volume of bone removal required and surgical working area developed by modular transpetrous expansions of the standard sub-temporal window.

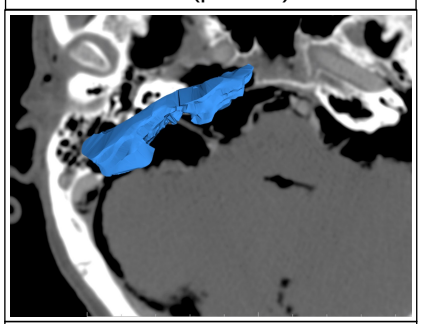
Modular Expansions of Subtemporal Window

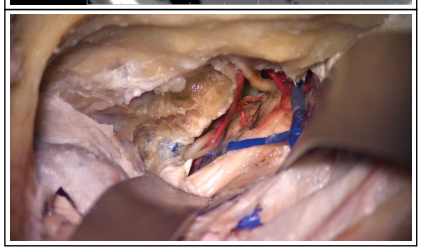


Methods: Cadaveric heads (N=5) were fixed in formaldehyde prior to undergoing high resolution computed tomography (CT) scan. A sub-temporal craniotomy was performed and then followed by modular transpetrous extensions in the following sequence: anterior petrosectomy; partial-posterior petrosectomy; internal acoustic canal (IAC) exposure; and middle-fossa translabyrinthine extension. A high-resolution CT scan was obtained after each modular expansion; overlapped to the preoperative CT; and bone removal volumes were calculated. BrainLab image-guidance was used to measure the working area created by each modular expansion; OsiriX MD reconstructions were used to quantify the bone volume removed.

Approach/Expansion	Mean Bone Volume Removed (cm^3)	Mean Working Area (mm^2)
Kawase/Anterior Petrosectomy	1.3 cm^3	24.2 mm^2
Unroofing IAC	0.3 cm^3	32.8 mm^2
Modified Poster Petrosectomy	4.3 cm^3	67.0 mm^2
Translabyrinthine	7.1 cm^3	81.7 mm^2

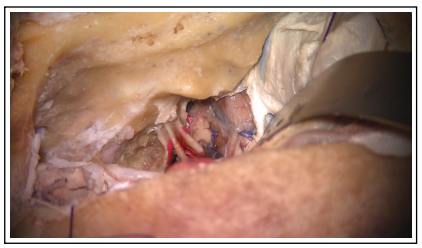
Each modular expansion resulted in significantly larger working area ($p<0.05$)

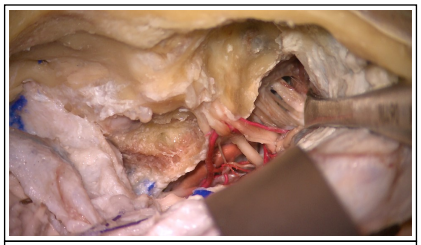


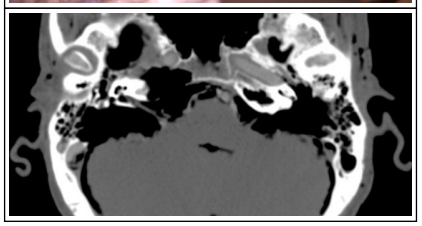


Results: A Kawase approach was performed without opening the IAC, requiring mean bony removal of 1.3cm3 to produce a mean working area of 24.2mm2. Unroofing the IAC required mean bony removal of 0.3cm3 [0.2-0.4cm3] and yielded an increased working area of 32.8mm2. Next, a modified posterior petrosectomy was performed (drilling of Trautmann's Triangle) with mean bony removal of 4.3cm3; the working area increased to 67.0mm2. A translabyrinthine extension was performed requiring mean bony removal of 7.1cm3 to create a final working area of 81.7cm2. Each modular transpetrous extension of the sub-temporal window resulted in statistically significant increases in surgical working area ($p<0.05$).

Conclusions: Each modular expansion of the sub-temporal craniotomy window resulted in progressively increased surgical working area ($p<0.05$). The combination of an anterior and partial -posterior petrosectomy provided the greatest increases in middle and posterior fossa exposure. By utilizing modular transpetrous extensions, skull-base surgeons can maximize the sub-temporal window to tailor exposure of petroclival lesions of the lateral skull base from CN-III to CN-IX while preserving hearing.







Learning Objectives

(1) Describe principles and pertinent operative anatomy of the sub-temporal window and its transpetrous modular extensions.
(2) Discuss, in small groups, how the different modular extensions of the sub-temporal window can be used to expand the surgical exposure to lateral skull base lesions from the petroclival junction to the cerebellopontine angle.
(3) Identify an effective modular expansion of the sub-temporal window to effectively address sample case presentations.

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