Endoscopic Transconjunctival Transorbital Transmaxillary Approach to the Upper Cervical Spine: Surgical Anatomy

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Abstract

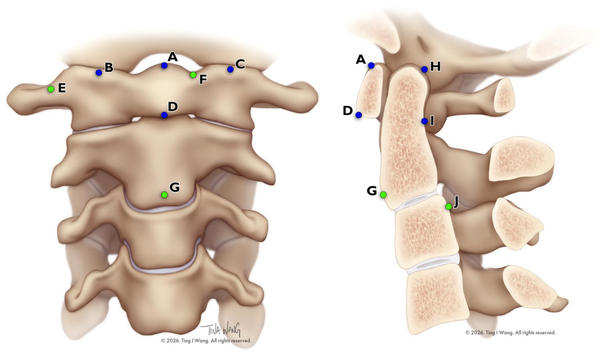
Objectives: Step-by-step description of the Endoscopic TransConjunctival approach to reach the Upper Cervical Spine (ETC-UCS), emphasizing its surgical nuances and comparing its benefits to the standard extended endoscopic endonasal approach (EEA).

Introduction

The transorbital route to the UCS has not been described before in literature. This novel study could address the limitations of EEA.

Methods and Materials

Five colored-injected formalin-fixed cadaveric heads were utilized for the left-sided ETC-UCS to evaluate ten target points per specimen (Fig. 1). In phase 1 (superficial/bone), an EEA to expose the carniocervical junction (CCJ), and to identify XYZ values of the most caudal CCJ/UCS midline & the most lateral points (Fig. 1, *points A-D*). Then a transconjunctival inferior fornix approach was done to identify the most lateral and most caudal UCS midline points (Fig. 1, *points E-G*).
In phase 2 (deep/dura), drilling via EEA was accomplished to identify dural points (Fig. 1, *points H & I*), followed by transconjunctival drilling to identify the most inferior UCS midline point (Fig. 1, *point J*).
All target points were identified using the navigation system to recognize its' XYZ values, and the pertinent surgical freedom was assessed (Fig. 2 & 3).
The necessary statistics were achieved, distances were determined, and the Wilcoxon two-sample tests were used to compare the pure EEA to the transconjunctival/transorbital approach. The P-values were calculated.



1	A	Anterior tubercle upper midline, Nasal approach superficial on bone
2	B	Right extreme lateral (EL) C1 arch, Nasal approach superficial on bone
3	C	Left extreme lateral (EL) C1 arch, Nasal approach superficial on bone
4	D	Inferior point midline Nasal approach superficial on bone
5	E	Rt extreme lateral (EL) C1 arch, ORBITAL approach superficial on bone
6	F	Left extreme lateral (EL) C1 arch, ORBITAL approach superficial on bone
7	G	Inferior point midline ORBITAL approach superficial on bone
8	*H*	At the level of the Anterior tubercle upper midline, Nasal approach deep on dura
9	*I*	Inferior point midline, Nasal approach deep on dura
10	*J*	Inferior point midline, ORBITAL approach deep on dura

Figure 1: The target points.

	Endonasal	Transorbital	P value
AB vs AE	16.824 (7.050)	24.20 (7.714)	0.2101
AC vs AF	13.042 (2.168)	9.794 (2.416)	0.0601
AD vs AG	10.892 (2.776)	30.904 (6.391)	0.0122*
HI vs HJ	9.72 (3.517)	32.246 (4.688)	0.0119*

Table 1: Mean (standard deviation) were presented.
P values are from Wilcoxon two-sample tests.
*p-value<0.05; **p-value<0.01; ***p-value<0.001

Results

There is no significant difference between the transnasal group vs the transconjunctival/transorbital group regarding lateral access (both contralateral and ipsilateral).
There is significant difference between the two groups in terms of caudal access, the transorbital group can reach significantly more caudal on the anterior aspect of the vertebral body [30.9 (6.39) vs 10.9 (2.78) mm, P=0.01] and on the dura surface [32.2 (4.69) vs 9.7 (3.52) mm, P=0.01] (Table 1).

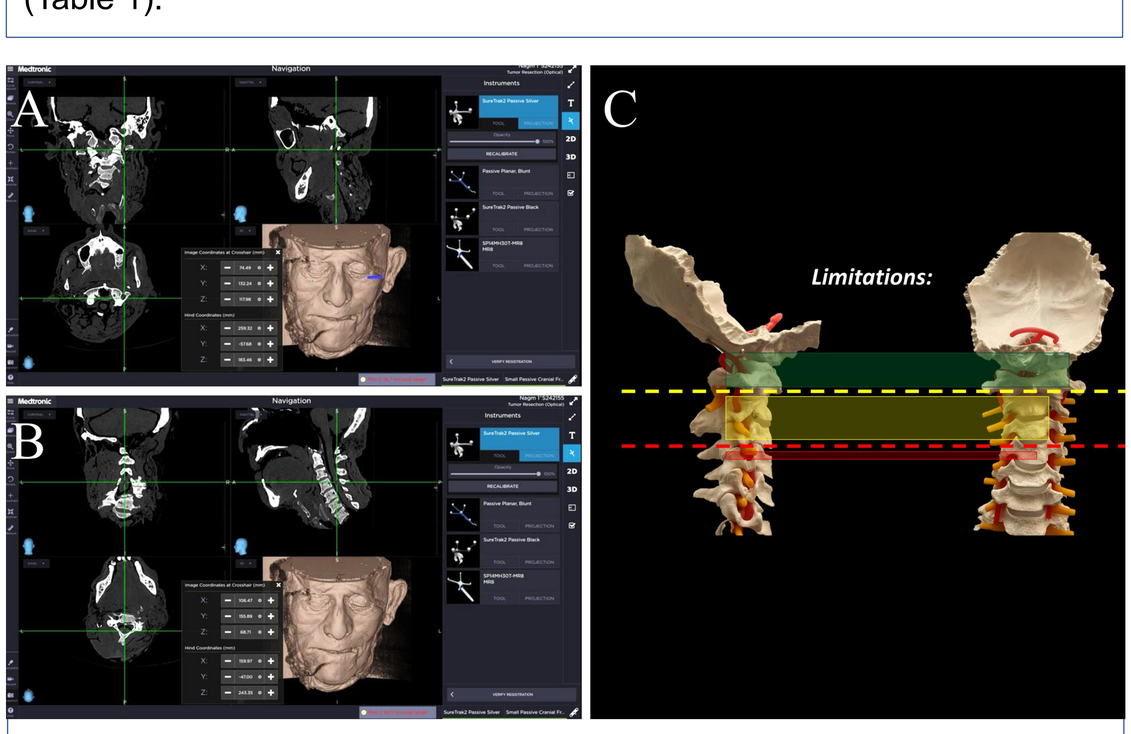


Figure 2: A navigation snapshot showing the contralateral C1 foramen transversarium line is easily accessible via left ETCOX (A), XYZ values of the most inferior point that can be reached via ETCOX (B), and color coded surgical freedom and limitations (C).

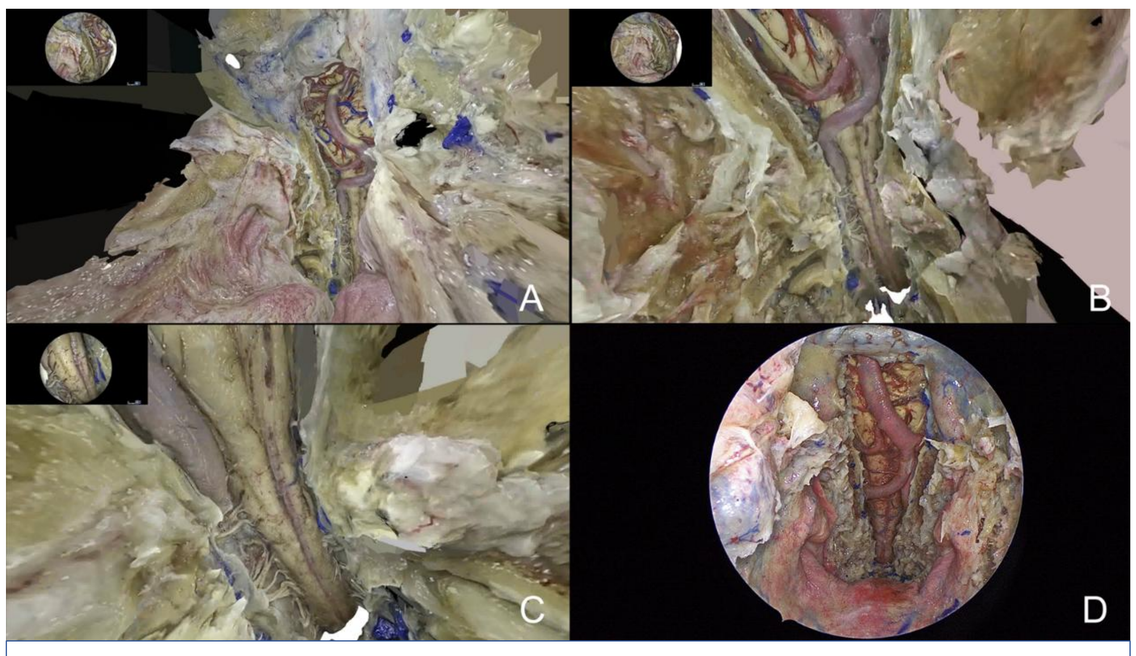


Figure 3: 3D anatomical model created via reality capture showing the ETCOX whole surgical freedom (A,B and C). The 2D endoscopic view via EEA after completing the ETCOX showing the UUCS drilling and upper spinal cord.)

Discussion

Adding ETCOX approaches is promising for extradural lesions in the anterior foramen magnum and extending to UCS. This study did not include transoral approach as a comparison or intradural lesions. Besides, new innovative instruments remain necessary for this approach. Clarifying the surgical targets and structures-at-risk benefits the realization of limitations and providing prospective feedback for operative theatres.

Conclusions

ETC-UCS can reach significantly more caudal on the anterior aspect of the vertebral body and on the dura surface.

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