Comparative Anatomical Assessment of the Contralateral Precaruncular Approach to the Supraoptic Triangle: A Cadaveric Study

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Background

The supraoptic triangle (SOT) is a dural–bony region over the superior optic canal and anterior clinoid base, bounded inferiorly by the optic nerve, laterally by the LOCR, and superomedially by the planum sphenoidale. Despite expanded endonasal approaches, lateral and deep SOT exposure remains limited by the optic nerve and ICA.

Conceptual framework – Surgical freedom

Surgical freedom quantifies proximal instrument maneuverability at a fixed distal target.
A standardized 3D triangulation framework normalized to πL^2 was used for cross-approach comparison.

Objective

To evaluate whether the **contralateral precaruncular (CPC)** transorbital route enhances access to the SOT compared with standard endonasal approaches.

Methods

A transtuberculum–transplanum exposure was performed in four cadaveric heads (seven sides), and the parameters were analyzed across three surgical corridors: ipsilateral endonasal (IpsiEA), contralateral endonasal (ContraEA), and CPC. The CPC was performed through a medial conjunctival incision between the caruncle and plica semilunaris. After gentle periorbital dissection, the lamina papyracea was exposed and opened, allowing communication with the nasal cavity.

Parameters defined

Working distance – linear distance (mm) to SOT
Fencing angle – angular divergence of extreme trajectories
Angles of attack – vertical and horizontal vectors
Surgical freedom – % of theoretical πL^2 envelope
Area of exposure (AOE) – dural area (mm²)

Paired *t*-tests ($\alpha = 0.05$).

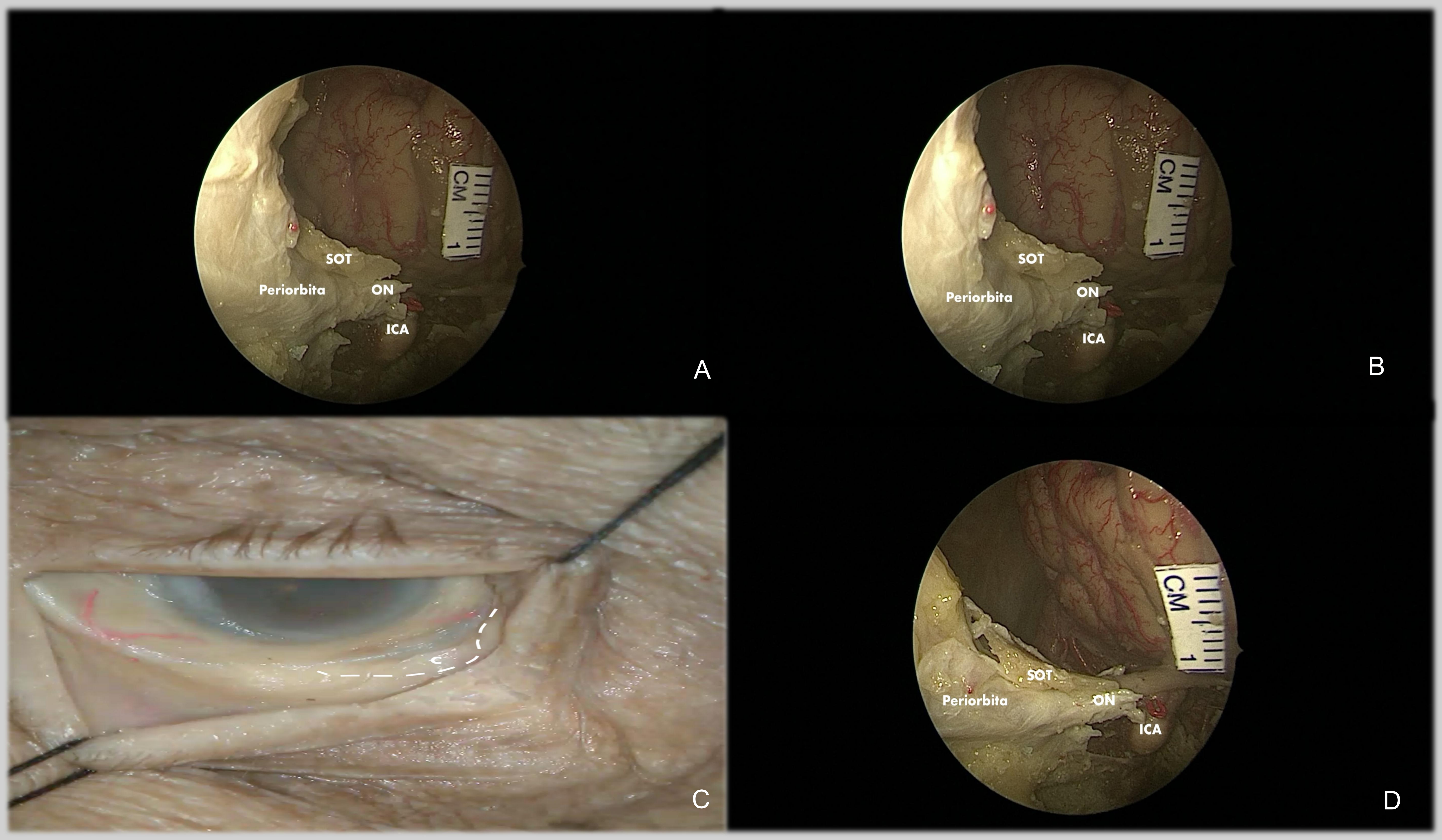

Figure 1.
Cadaveric dissection of the supraoptic triangle (SOT) via IpsiEA, ContraEA, and CPC approaches.

Demonstrates the optic nerve (ON), internal carotid artery (ICA), and supraoptic triangle (SOT).
(A) IpsiEA – Ipsilateral endonasal approach.
(B) ContraEA – Contralateral endonasal approach.
(C) Precaruncular incision used for the CPC approach.
(D) CPC – Contralateral precaruncular approach (right-sided cadaveric specimen).

Results

CPC showed the shortest working distance, widest fencing angle, and greatest surgical freedom ($p < 0.01$).
AOE did not differ significantly ($p > 0.6$).

Table 1 — Quantitative comparison of the three approaches to the supraoptic triangle.

Parameter	IpsiEA	ContraEA	CPC	p-value
Working distance (mm)	78.0 ± 7.1	78.9 ± 6.8	**51.3 ± 8.3**	< 0.001
Fencing angle (°)	–	18.9 ± 0.9	**59.1 ± 9.8**	< 0.01
Surgical freedom (% sphere)	0.399	0.973	**1.525**	< 0.01

Mean ± SD values for working distance, fencing angle, and surgical freedom. The CPC route showed the shortest working distance, widest fencing angle, and highest surgical freedom ($p < 0.01$).

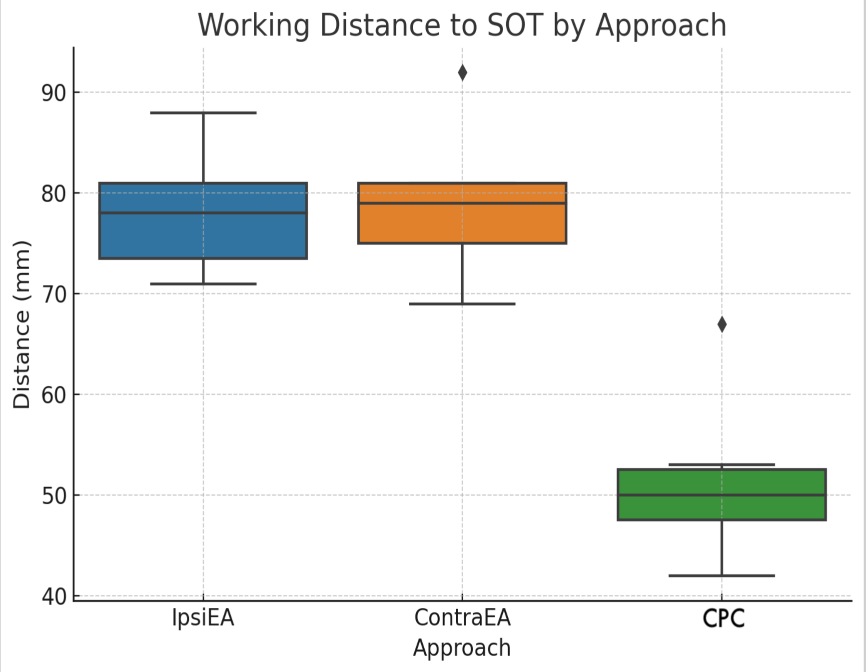

Fig. 2 — Working distance to the supraoptic triangle.
Boxplot showing significantly shorter distance for **CPC** compared with both endonasal routes ($p < 0.001$).

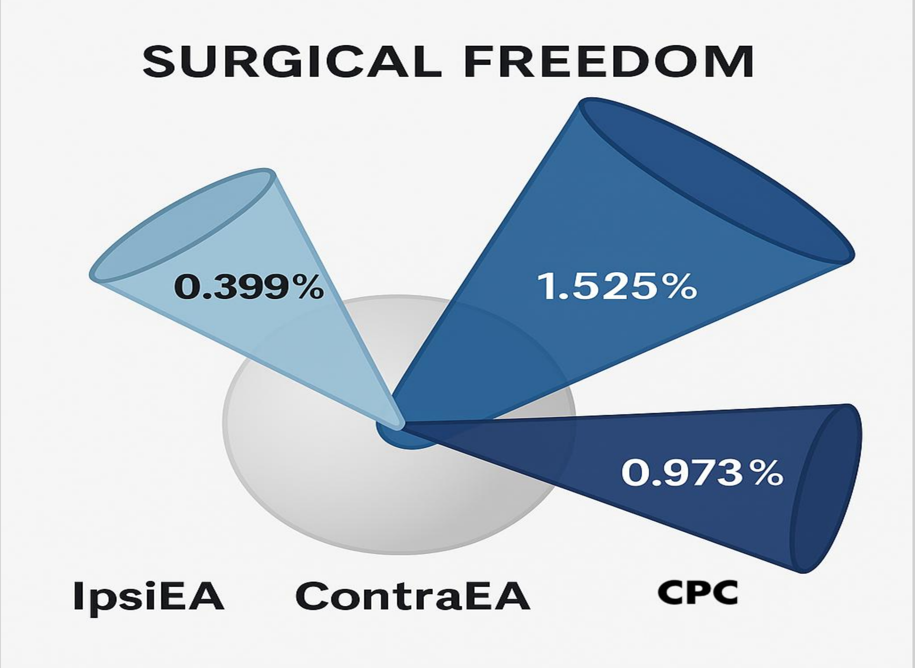

Fig. 3 — Surgical freedom.
Cone diagram illustrating working envelopes: **CPC = 1.525 %**, **ContraEA = 0.973 %**, **IpsiEA = 0.399 %** ($p < 0.01$).

Conclusion

In this cadaveric study, the **contralateral precaruncular approach (CPC)** provided a **shorter working distance** and **wider angular access** to the supraoptic triangle compared with both ipsilateral and contralateral endonasal routes.
These findings highlight the **anatomical feasibility and potential advantages** of the CPC corridor for reaching the **lateral optic canal and anterior clinoid region**, supporting its role as a **complementary route** in selected skull base scenarios.

References:

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