

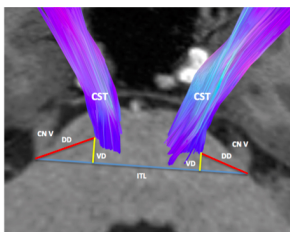
Introduction

We describe a safe entry zone to the ventrolateral pons located just above the point where the trigeminal nerve emerges from the pons. We refer to this approach as “epitrigeminal”. To our knowledge, this safe entry zone has not been described before literature.

Methods

To define the inter-subject variability of the surgically relevant anatomy related to this approach, we performed an anatomical study using the high-definition fiber-tractography (HDFT) maps of 77 normal subjects (154 sides). HDFT dissections were also used to compare the epitrigeminal approach to the other known approaches accessing the ventrolateral pons. We also present an illustrative case of a cavernous malformation spanning the entire pons, which was approached through the epitrigeminal safe entry zone and a subtemporal transtentorial surgical corridor.

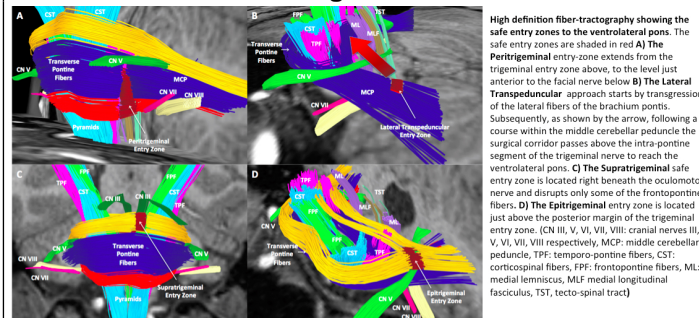
Figure 1



Surgically Relevant Distances and Inter-subject Variability. CST: corticospinal tracts. DD: Direct Distance of epitrigeminal zone from posterolateral CSTs. ITL: Inter-trigeminal line connecting the two epitrigeminal zones. VD: Vertical Distance of posterolateral CSTs from ITL.

	Handedness						ANOVA P value
	Right Handed (N=61)		Left Handed (N=10)		Ambidextrous (N=6)		
	Mean, SD (mm)	Range (mm)	Mean, SD (mm)	Range (mm)	Mean, SD (mm)	Range (mm)	
Vertical Distance, Right	3.46, 1.96	-1.32 to 7.46	3.99, 1.48	1.32 to 6.29	2.83, 1.43	1.29 to 5.00	0.481
Vertical Distance, Left	3.78, 1.86	-2.34 to 8.16	4.37, 1.96	1.25 to 8.71	3.04, 1.87	1.00 to 5.00	0.387
Paired T-test P value	0.071		0.494		0.478		
Inter-trigeminal Distance	39.1, 2.5	33.7 to 45.0	38.9, 2.4	36.3 to 42.6	38.8, 2.4	35.0 to 45.3	0.927
Direct Distance, Right	12.48, 1.76	9.03 to 17.00	11.7, 1.31	10.10 to 14.00	12.16, 1.82	9.57 to 14.20	0.400
Direct Distance, Left	12.77, 1.88	8.68 to 16.3	12.79, 1.98	9.00 to 15.70	12.72, 1.65	11.10 to 14.90	0.997
Paired T-test P value	0.229		0.122		0.322		

Figure 2



Safe Entry Zone (alternative names)	Brief Anatomical Description	Surgical Corridor (s)	Advantages	Disadvantages
Peritrigeminal (a.k.a. lateral pontine)	Triangular area stretching from CN V to CN VII/VIII	Retrosigmoid, Preisigmoid, Extended Middle Fossa (Kawase's)	No temporal lobe retraction, Good exposure for caudal ventrolateral pontine lesions.	Not suitable for lesions significantly extending above the level of CN V, or those without any lateral extension
Lateral Transpeduncular (a.k.a. supratrigeminal)	Entry zone in the lateral brachium pons, with an intrapontine trajectory coursing above the intra-pontine segment of CN V	Retrosigmoid craniotomy	No temporal lobe retraction, Good exposure for rostral ventrolateral pontine lesions	Not suitable for lesions with significant extension below the level of CN V, or those without any lateral extension. Relies heavily on image guidance.
Supratrigeminal	Area extending ~4mm inferiorly from CN III, midline or paramidline	Cranio-orbitozygomatic craniotomy with dissection of the membrane of Lilequist.	No temporal lobe retraction. More suitable for retroventral lesions in the pons without significant lateral extension.	Extensive craniotomy. Long and narrow surgical corridor. Limited exposure other than the midline rostroventral pons.
Epitrigeminal	Area just above the trigeminal entry zone.	Subtemporal transtentorial approach.	Versatile for pontine lesions with either significant rostral, or caudal extensions.	Temporal lobe retraction. Likely not ideal for lesions without any lateral extension.

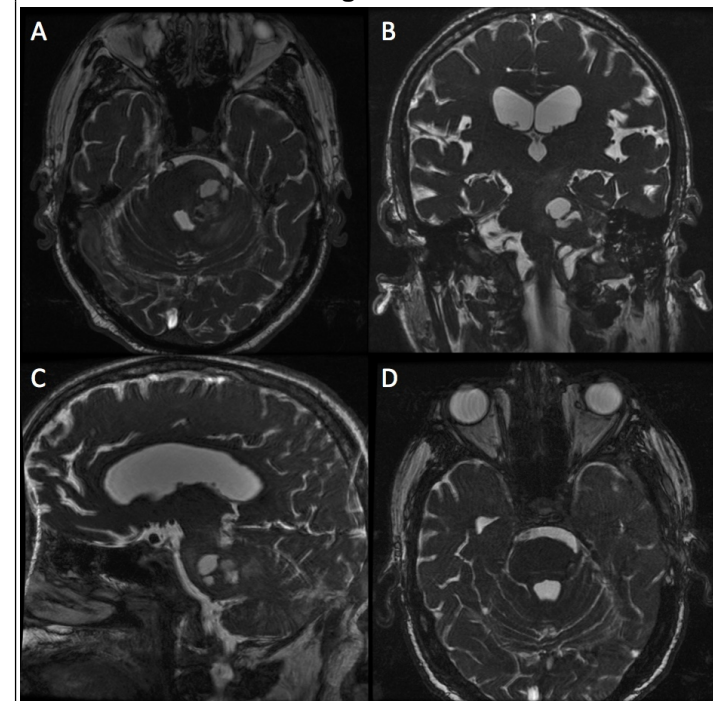
Results

The average direct distance of the corticospinal tracts from the trigeminal entry zone was 12.6 mm (8.7 mm to 17mm). The average vertical distance was 3.6 mm (-2.3mm to 8.7mm). The mean distances did not differ significantly from side to side, or across any of the groups studied: right handed, left handed, and ambidextrous (Figure 1). When compared to the other known safe entry zones to the ventrolateral pons, a possible advantage of the epitrigeminal approach is an angle of attack that provides access to lesions that extend both above and below the trigeminal nerve. A possible disadvantage is the need for temporal lobe retraction (Figure 2). The patient in the illustrative case had a complete resection of the lesion, as well as improvement in his symptoms (Figure 3).

Conclusions

The epitrigeminal entry zone to the brainstem appears to be safe, and effective for treating intrinsic ventrolateral pontine pathology. Familiarity with the subtemporal transtentorial approach, and the reliable surgical landmark of the trigeminal entry zone should make this a straightforward approach.

Figure 3



Axial (A), Coronal (B) and Sagittal (C) T2 weighted images showing a cavernous malformation spanning the entire ventrolateral pons, extending both above and below the level of the trigeminal nerve. Post-operative imaging showed complete resection of the lesion (D)

Learning Objectives

By the conclusion of this session the participants should be able to 1) describe the anatomic nuances, as well as the indications of the epitrigeminal approach to the brainstem. 2) Discuss the anatomic variability of the surgically relevant fibertracts in the ventrolateral pons. 3) Discuss the indications, advantages and disadvantages of all the approaches and safe entry zones to the ventrolateral pons.