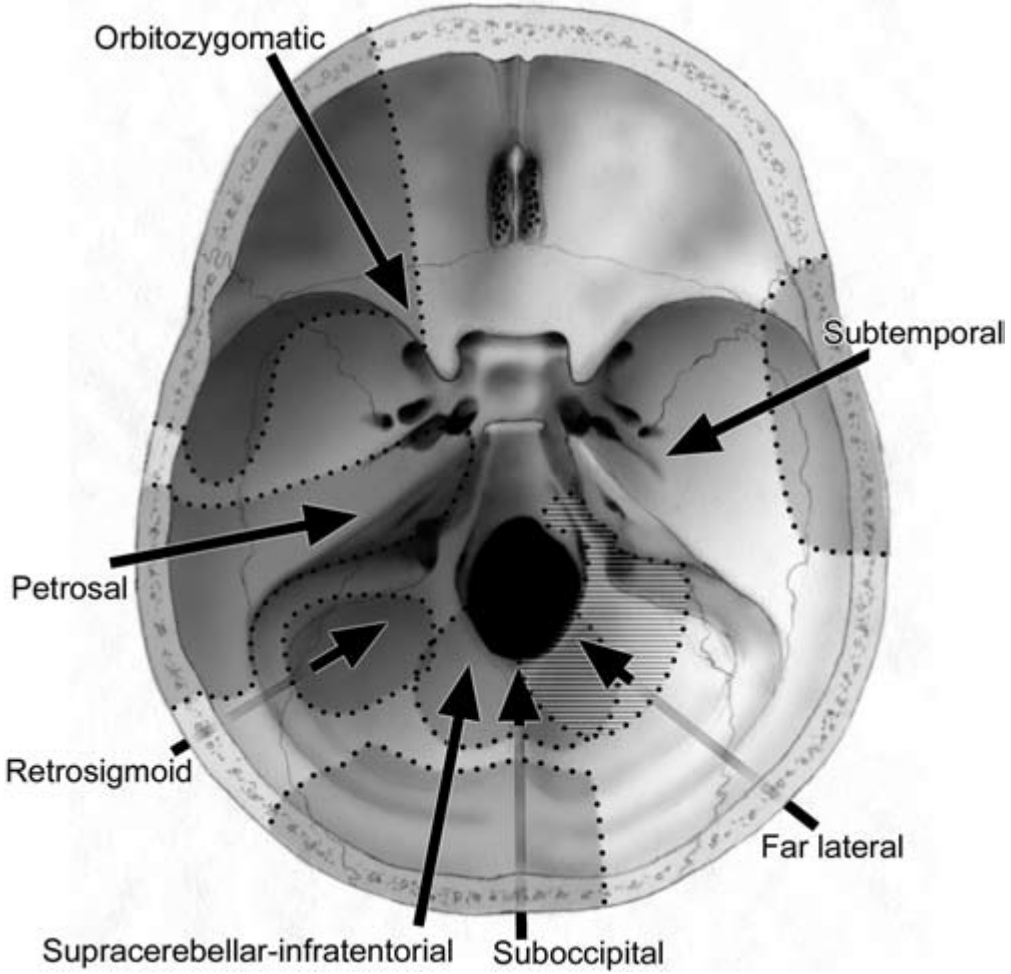
Safe corridors for brain stem surgery

- Brainstem is highly complex structure containing various cranial nerve nuclei, ascending and descending tracts, making it one of most difficult structure to access and operate.

- Median sulcus
- Sulcus limitans - motor nuclei are medial
  sensory nuclei are lateral
- Median eminence – facial colliculus, hypoglossal triangle
  vagal triangle and area postrema.
- straie medullaris – cochlear fibres of VIII nerve

Approach to brainstem



Schematic drawing illustrating the most common surgical approaches used for different areas of the brainstem.

Neurosurg Focus 29 (3):E9, 2010

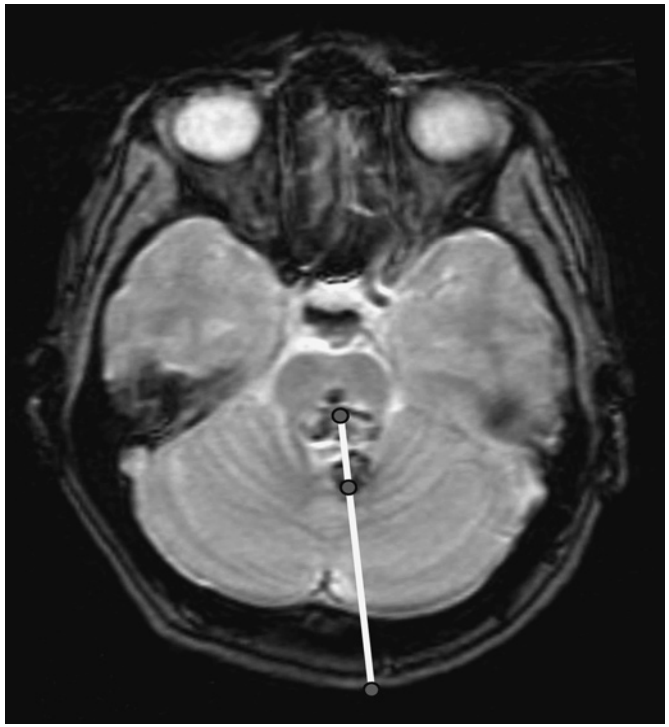
Choice of approach

- Location of lesion
- Area to which lesion come close to pial surface
- Clinical status of patient
- Comfort of individual surgeon

- If lesion abutting pial surface then direct access to lesion.
- The 2-point method was used as an objective means to choose the surgical approach
- One point is placed in the center of the lesion, and a second point is placed either where the lesion comes closest to a pial surface or at the safest entry point into the brainstem.

Brown AP, Thompson BG, Spetzler RF. The two-point method: evaluating brain stem lesions. BNI Q. 1996;12(1):20-24.

- MLSOC



- Planned approach for ventral lesions

Ventral/ lateral	
rostral to cranial nerve V	Transsylvian / subtemporal
Between lower nerve and cranial nerve V	Presigmoid / retrosigmoid
Caudal to lower group	Far lateral

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Dorsal	
Midbrain	Suboccipital transtentorial/ supracerebllar infratentorial
Floor of fourth ventricle	Transcerebellomedullary fissure
Medulla	intertonsior

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- Surgically treatable lesion present on dorsal part of brainstem are easily approachable than ventral part of brainstem.

Pons

- Ponto-mesencephalic sulcus to ponto-medullary sulcus
- Trigeminal nerve defines limit of pons proper medially and middle cerebellar peduncle laterally.
- MCP

Pons

- Ventral and ventro-lateral pons approached by

  Retro sigmoid approach

  Pre sigmoid approach

  Trans petrosal approach

Safe entry zone for ventro lateral pons

Peritrigeminal safe entry zone in the ventrolateral pons . - between emergence of fifth and seventh nerve . Area is located medially to fifth and lateral to pyramidal tract.

- Peri trigeminal area - transverse fibers are directed horizontally or slightly obliquely so myelotomy should be in horizontal direction.

- Surgical window –

  Horizontal – 4.64mm (3.8 – 5.6 mm)
  Vertical - 11.2 mm (9.5- 13.1mm)

Structure	dysfunction
Pontine nuclei	C/L hemiataxia
Corticospinal tract	C/L UMN weakness
Middle cerebellar peduncle	Ipsilateral hemiataxia
Trigeminal nerve (motor /sensory nulcei)	Loss of sensation over face and weakness of muscle of mastication
Medial lemniscus	Loss of posterior column sensation
MLF	INO

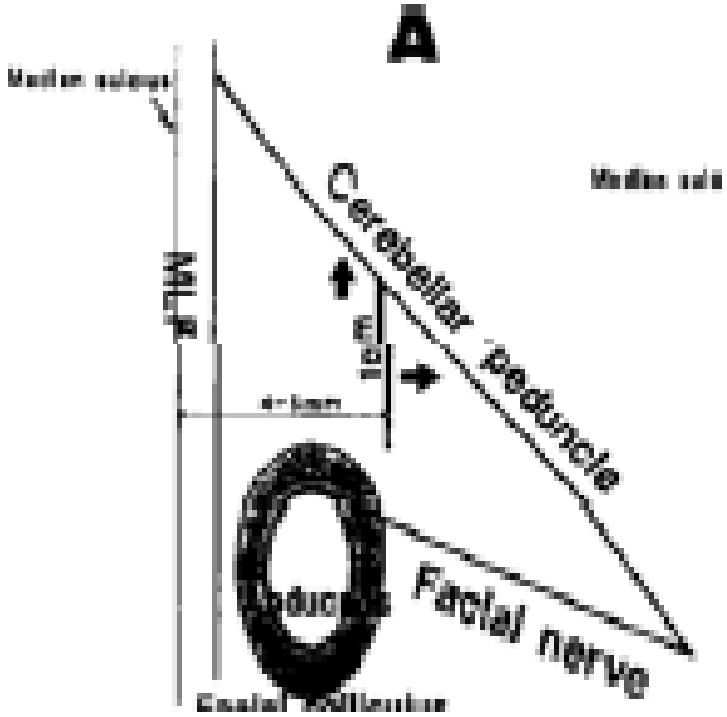
Dorsal pons

- Upper part (2/3) of floor of fourth ventricle

- Dorsal pons approached by

    telo-velar trans cerebellar medullary fissure

    transvermian



1 cm longitudinal incision from edge cerebellar peduncle and 5mm lateral to median sulcus

Length of incision – 7mm

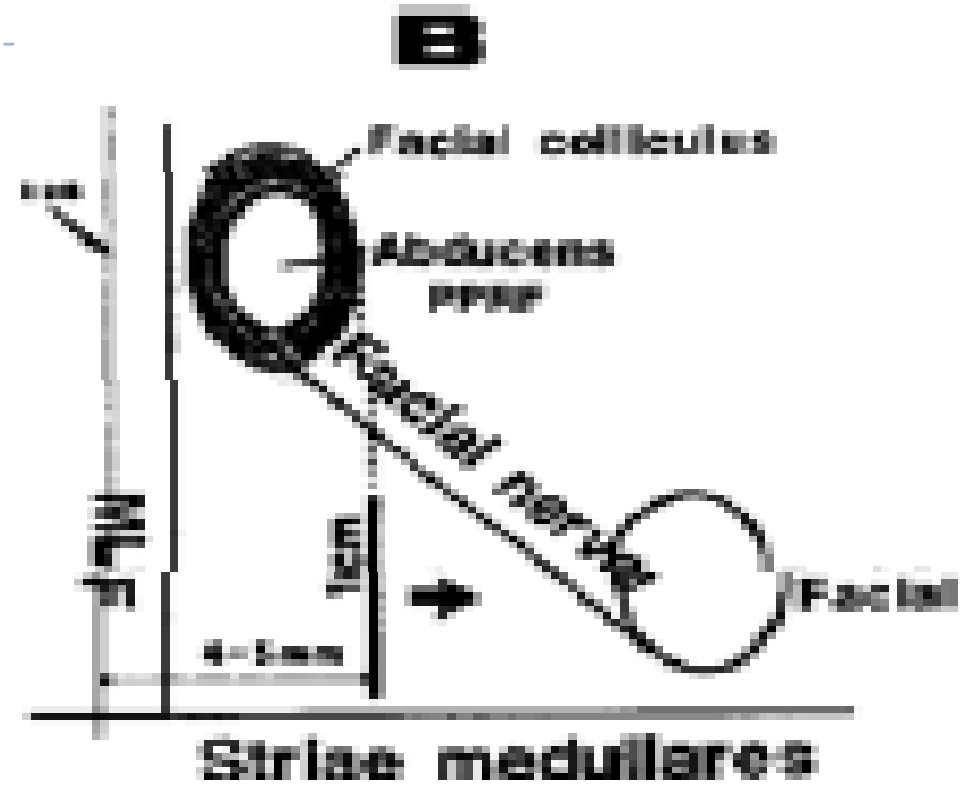
Brainstem retracted – laterally and rostrally

Kyoshima K,Kobayashi S et al.A study of safe entry zones via the floor of the fourth ventricle for brain-stem lesions. Report of three cases. JNS 1993

Suprafacial triangle

position relative to surgery	Structure	Symptoms
Lateral	SCP , trigeminal nuclei	Hemiataxia , sensorimpairment of face
medial	MLF	Gaze palsy , nystagmus
Rostral	SCP , 3rd and 4 th nuclei and nerve	Hemiataxia, 3rd and 4th palsy
Caudal	Nucleus of 6th nerve PPRF Facial nerve	6th nerve palsy Lateral gaze palsy Facial nerve palsy
Ventral	Medial lemniscus Lateral spinothalamic tract Corticospinal tract	Ataxia, depth perception impairment , analgesia Motor impairment

Infra facial triangle



1cm longitudinal incision above striae medullaris and 5 mm lateral ot median sulcus

Brainstem can be retracted laterally only.

Kyoshima K,Kobayashi S et al.A study of safe entry zones via the floor of the fourth ventricle for brain-stem lesions. Report of three cases. JNS 1993

Infra facial Triangle

Position relative to surgery	Structure	Symptoms
Lateral	Facial nerve (deeper) Vestibular nerve	Facial nerve palsy Nystagmus
Medial	MLF	Nystagmus
Rostral	Nucleus of 6th nerve PPRF VII nerve	Abducens palsy Lateral gaze palsy Facial nerve palsy
Caudal	Nuclei of lower cranial nerve	Swallowing impairment , dysarthria
Ventral	Medial lemniscus Lateral spinothalamic tract Corticospinal tract	Ataxia, depth perception impairment Analgesia Motor impairment

Ventral medulla

- Approached by

  far lateral approach

Safe corridors -

at level of retro olivary sulcus

between cranial nerve 12 and C1 at level of anterolateral sulcus

- No evidence that isolated lesion of olivary body causes permenant deficits.

- Retro –olivary area is safest approachable area over anterolateral brainstem.

- Surgical window –

  cranio-caudal - 13.5 mm

  transverse - 7 mm

  antero-dorsal - 2.5mm

Structure	dysfunction
pyramid	UMN weakness
Inferior olivary nucleus	Tremor and ? Cerebllar sign
Nucleus ambigus	Ipsilateral paralysis of palate , pharynx, larynx,
Hypoglossal nucleus	Tongue weakness

Dorsal medulla

- Approach by MLSOC

- Safe corridors –

  Posterior median fissure

  Posterior intermediate sulcus

  posterior lateral sulcus

- Posterior median fissure – below obex ,between nucleus of gracile fasciculus

- posterior intermediate sulcus – between gracile and cuneate fascile

- Posterior lateral sulcus - between cuneate fascile medially and spinal trigeminal tract and nucleus laterally

Midbrain

Superior limit - optic tract
Inferior limit - pontomesencephalic sulcus

Cerebral peduncle

Tegmentum

Tectum

- Lateral mesencephalic sulcus - limits between ventro-lateral midbrain and posterior midbrain.

- Posterior midbrain – quadrigeminal plate and superior and inferior colliculi.

Midbrain

- Approached by (for central midbrain)

  pterional craniotomy (trans sylvian approach)

  FOZ craniotomy

Ventro lateral midbrain

- Approach by

  Transsylvian route

  subtemporal – transtentorial

  subtemporal - transpetrosal

- safe entry zone is lateral mesencephalic sulcus (LMS)

- Lateral mesencephalic sulcus -

  minimum working distance – 4.9 mm
  maximum working distance – 11.7 mm
  mean +- SD - 8.2 +- 1.76 mm

Structure	Dysfunction
Crus cerebri	C/L UMN weakness
Substantia nigra	Parkinsonism
Medial lemnisucs	C/L hemianesthesia of trunk and extermity
MLF	INO
Red nucleus	C/L Ataxia and tremors

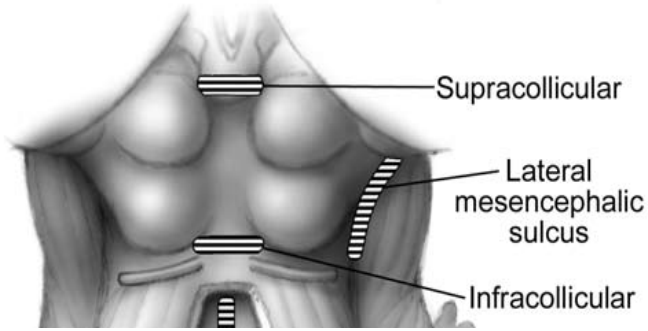
Approach to posterior midbrain

- Supra cerebellar infratentorial approach

median	-	MLSOC
lateral	-	Paramedian SOC
exterme lateral	-	RMSOC

Safe entry zone for posterior midbrain

- Supracollicular area
- Infracollicular area



Structure	Dysfunction
Superior colliculus	Pupillary disturbance, gaze palsy
Inferior colliculus	Difficulty in localizing sound in space

Thank you