



Patient Positioning in Neurosurgery and Principles of Making a Craniotomy

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Introduction

- Patient positioning critical and vital
- Control of bleeding and ventilation
- Sir Victor Horsley in 1906 used ‘ fork rest of professor Frazier’
- Head rest- an extension attached to the operating table
- Horsley and Krause also proposed the use of lateral position for posterior fossa surgeries





- Schede in 1905 used sitting position with patient leaning far forward
- de Martel in 1913 used sitting position and took credit for its routine use in posterior fossa surgeries
- He introduced a special chair and head fixation holder
- Theoretical advantage of lowering ICP and venous bleeding with risk of syncope and the inability to disarrange the draping from this position

- Bailey



The correct position





- In early years- trial and error
- Today though standardized, not absolute
- Factors associated:
 1. Age
 2. Site and nature of lesion
 3. Head position in relation to heart
 4. Position of anesthesiologist/ nurse
 5. Microscope and other imaging equipment
- Pediatric patients present a different set of considerations
- Some operations have more than one acceptable position



Supine



Indications

- Most of the cranial procedures
- Anterior cervical spine
- Anterior approaches to the lumbar spine
- Carotid endarterectomies

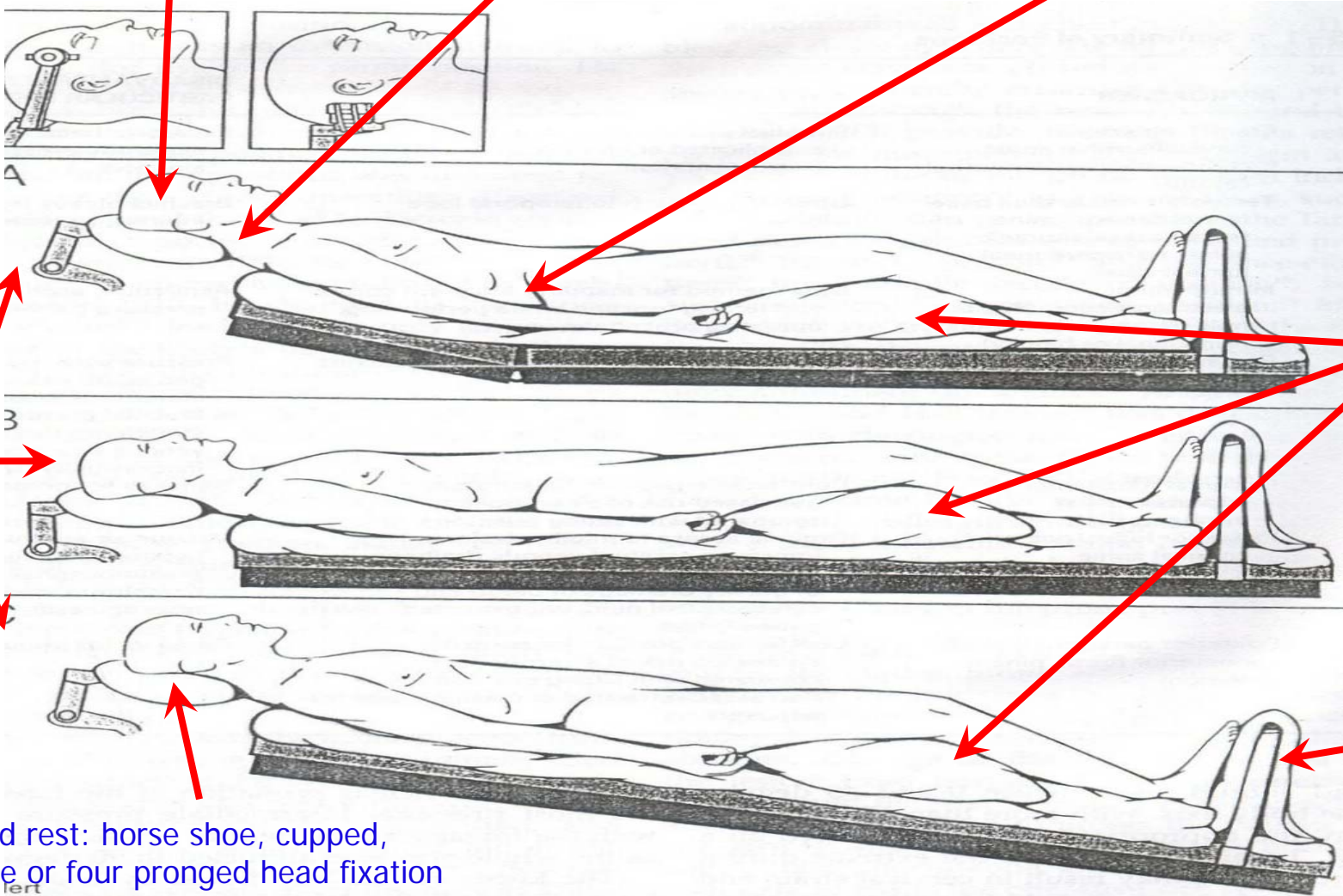


■ Head : 0-45 degrees

Neck rotation > 45 degrees-raise shoulder
Head beyond table

Upper extremities- adducted

Head elevation: reverse trendelenburg, flex table



Knees flexed- sciatic nerve injury
Compressive stocking
sequential compression

foot board

Head rest: horse shoe, cupped,
three or four pronged head fixation



Positioning

- Extreme turning of head causes:
 - vertebral compression- brainstem ischemia
 - jugular compression- raised ICP, brain swelling an bleeding
- Pressure on the ulnar nerve least in supine position
- Avoid prolonged pressures, stretching
- Pin sites not on sinus regions, with at least one dependant

-Prielipp et al ulnar nerve pressure. Influence of arm position and relationship to somatosensory evoked potential. Anesthesiology: 91: 345-354: 1999



Lateral position



Indications

- Temporal craniotomies
- Skull base procedures
- Posterior fossa explorations
- Lateral approaches to the cervical spine
- Trans thoracic and retroperitoneal approaches to the thoracic and lumbar spine
- Extremely obese or kyphotic patients
- Unilateral herniated discs- offending side up
- Lumboperitoneal, syringoperitoneal shunts

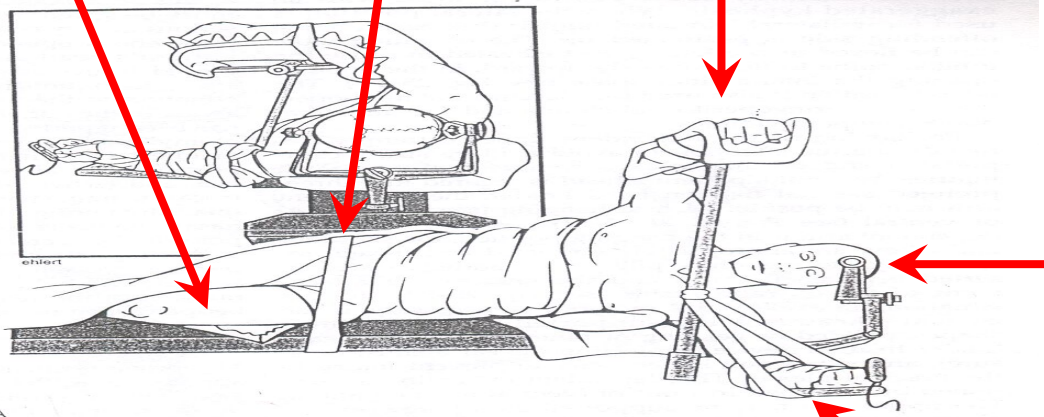


Patients trunk support: tapes, brace, straps

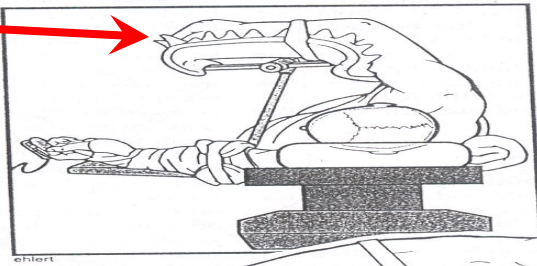
Pillow positioned between legs

hand in hanging or ventral position

Shoulder/ elbow abducted and flexed respectively resting on a pillow or padded board



Three point fixation
-axillary artery
-brachial plexus injury
Dependant extremity



Dependant leg flexed: avoid pressure -fibular head and peroneal nerve

Operating table flexed, kidney rest

Horse shoe rest: axillary role

Positioning

- Dependant portion outstretched in front of patient
- Upper arm on a pillow or air-plane arm rest, or along the upper torso with shoulder taped- park bench position
- This position advocated by Dr. Cone

-Gilbert RGB et al: specific intracranial operations. In anesthesia for neurosurgery; 1966, 119-151



Prone position



Indications

- Posterior fossa surgeries
- Sub- occipital regions
- Posterior approaches to the spine





Technique

- Femoral, distal pulses checked
- Genitalia should lie free
- Extremes of head rotation and neck extension to be avoided
- In cases cord compromise- patient may be placed in halo frame before turning him



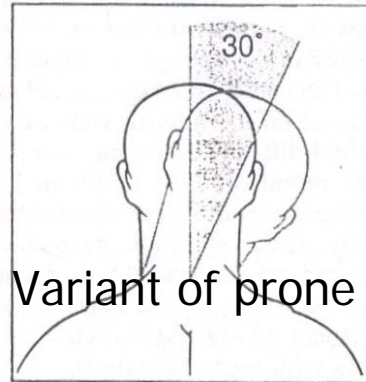
Kneeling position

- Advantage:
 - IVC pressure lowest in kneeling position
- Disadvantages:
 - More time to position
 - Mechanical injuries
 - Difficulty in changing curvature
 - Hypotension
- Rarely: DVT
 - Pulmonary embolism
 - Renal failure
 - Post operative pain



Concorde position

Head higher than heart
Three point fixation



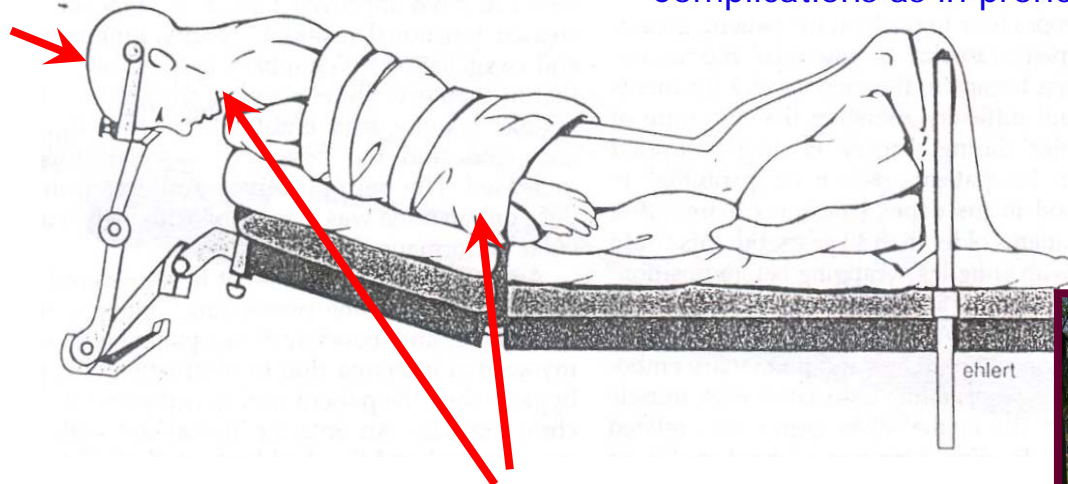
Variant of prone position

Variant of prone position

Occipital trans-tentorial,
supra cerebellar infra-
tentorial approach

Less venous embolism
fatigue

Complications as in prone



Head flexed with extension of thoraco-lumbar region



Sitting position



Indications

- Posterior fossa
- Cervical cord
- Sub temporal approaches







Somato sensory monitoring

Monitoring: Doppler, TEE, CVP, fraction excretion of nitrogen capnography, continuous capnography, per-cutaneous oxygen measurement



Advantages and Disadvantages

- Advantages: Midline lesions
 - Low ICP
 - Improved venous drainage
 - Drainage of blood and CSF
 - Unobstructed view of patients face
 - Less cerebellar retraction
- Complications: air embolism, hypotension, postoperative tension pneumocephalus, sub dural hematoma, quadriplegia and discomfort in upper extremities



Other complications

- Both brain and spinal cord at increased risk of cerebral ischemia in the presence of mass lesions *–Ernst PS et al intracranial and spinal cord hemodynamics in the sitting position in dogs in the presence and absence of ICP: Anesthesia analgesia: 1990*
- Precautions: echocardiography, CVP, slow positioning, antigravity suit inflated with air
- Other rare complications: supra tentorial hematoma, cerebellar hemorrhages, peripheral nerve palsies, traumatic elbow dislocations



Three quarter prone



Indications

- AKA semi prone/ lateral oblique
- Parieto occipital regions
- Posterior fossa/ CP angle
- Pineal and vermian region
- Advantage: comfortable for the surgeon with less risk for embolism, Less retraction



Brachial plexus

- Supine in semi sitting/ semi fowler's position
- Head turned to opposite side
- Ipsilateral arm- patients side, abducted 50 deg, arm rest
- Place roll beneath medial aspect of scapula



Trans- sphenoidal procedures

- Supine- horse shoe rest, c-arm fluoroscopy, head tilt of 15-20 degrees
- 10 degree head elevation with indwelling LP drain

-Banerji AK et al: trans nasal approach to pituitary adenomas. Neurol india: 34: 183: 1986



Complications

Position	Complications
Supine	excessive head rotation, pressure sores, alopecia
Prone	pressure sores, vascular compromise, brachial plexus injuries, stretch injuries, blindness, embolism, anesthetic problems
Concorde	same
Three quarter prone	same
Lateral	brachial plexus injuries, stretch injuries, pressure palsies
Awake	aspiration, asphyxiation, pressure palsies



Sitting vs prone position

Sitting	Prone
<p>Advantages: Low ICP</p> <ul style="list-style-type: none">Improved venous drainageDrainage of blood and CSFUnobstructed view of patients faceLess cerebellar retraction	<ul style="list-style-type: none">Easy to positionGood access to lesionComfortableLess complications
<p>Complications: air embolism(30- 60%) , hypotension, postoperative tension pneumocephalus, sub dural hematoma, quadriplegia and discomfort in upper extremities</p>	<p>pressure sores, vascular compromise, brachial plexus injuries, stretch injuries, blindness, embolism (<5%), anesthetic problems</p>

Craniotomy principles



Skin flaps- historical perspective



Skin flaps

- Neolithic period in 2000 B.C
- Trepanations made followed by scrapings of the skull till holes
- 19th century- trephines
- 1889 Wagner first osteoplastic bone flap
- Gigli saw for craniotomy- Obalinski in 1897
- Electric and gas powered high speed drills



Anatomic and neurovascular considerations

- 5 layers of scalp:
 - Skin
 - Subcutaneous tissue
 - Galea
 - loose areolar tissue
 - periosteum



Land marks

- Nasion
- Bregma
- Lambda
- Inion
- Pterion:
Middle meningeal
artery
- Asterion:
Transverse sigmoid
junction



Nerves

- Fronto- temporal branch:
 - anterior branch
 - middle branch
 - posterior branch
- Middle division: 1 cm anterior to superficial temporal artery, subgaleal pad of fat

*dissect between
superficial and deep layers of
superficial temporalis fascia*



Blood supply

- Superficial temporal artery
- Occipital artery
- Posterior auricular artery
- Supra orbital and trochlear vessels



Planning

- Position of lesion
- Position of important structures
- Contingency plan for enlarging incision
- Obtain adequate closure



Principles

- General principals:
 1. surgical exposure of the lesion
 2. neuro vascular supply
 3. cosmetic effect
- Types: Random pattern
 - Based on named vessel
- Length not > 1.5 times base
- Integrity of major vascular flap to be maintained
- Incision in hair containing region
- No crossed incisions



Principles

- Skin incised with galea
- Pressure over the scalp
- Periosteum raised with scalp or separately
- Raney's clips, bipolar, Dandy's clamps
- Adequate retraction
- Inner surface protected with moistened gauze
- Roller gauze
- Dissect in interfascial fat which is encountered in 4 cm of orbital rim



Bicoronal/ Souttar flaps



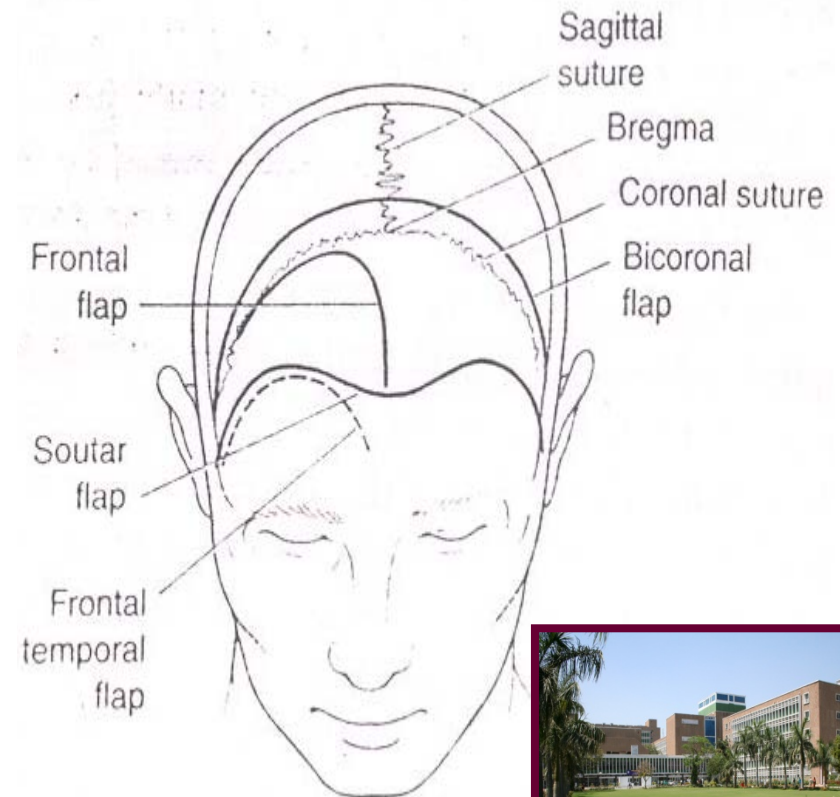
Bicoronal/ Souttar flaps

- Large exposures of anterior cranial fossa and sella
- Fronto temporal lesions and cranial base
- Superior to zygomatic arch, 1 cm anterior to tragus- extends over the bregma to the corresponding site on the opposite side
- Reflect up to orbit rim
- Supraorbital/ trochlear vessels



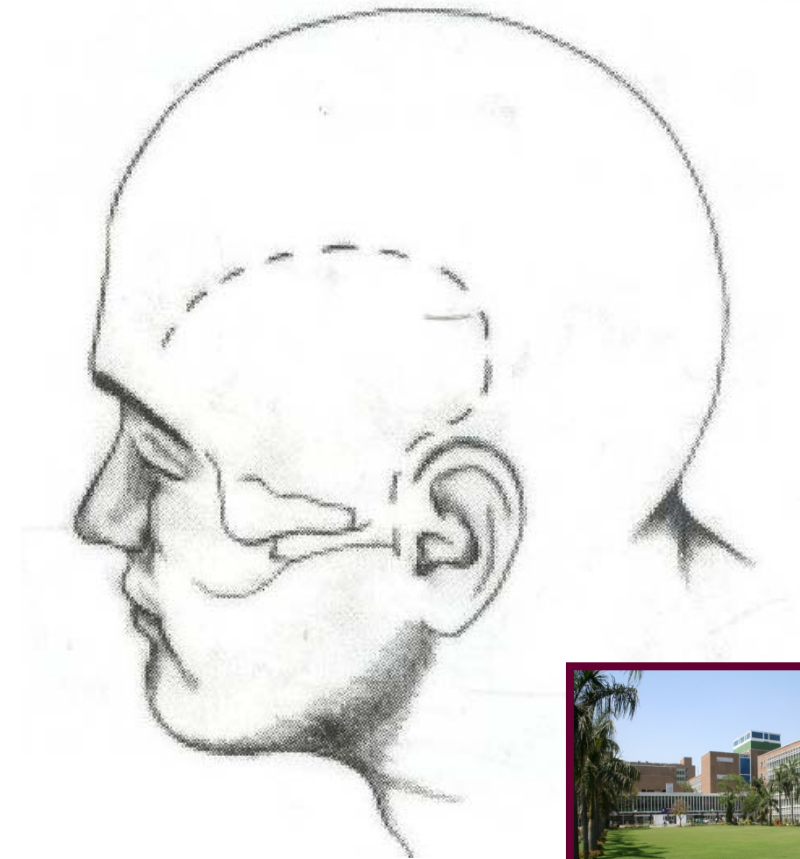
Frontal flap

- Exposes anterior frontal lobe
- Begins along coronal suture and curves anteriorly along the midline preferably ending at hair line



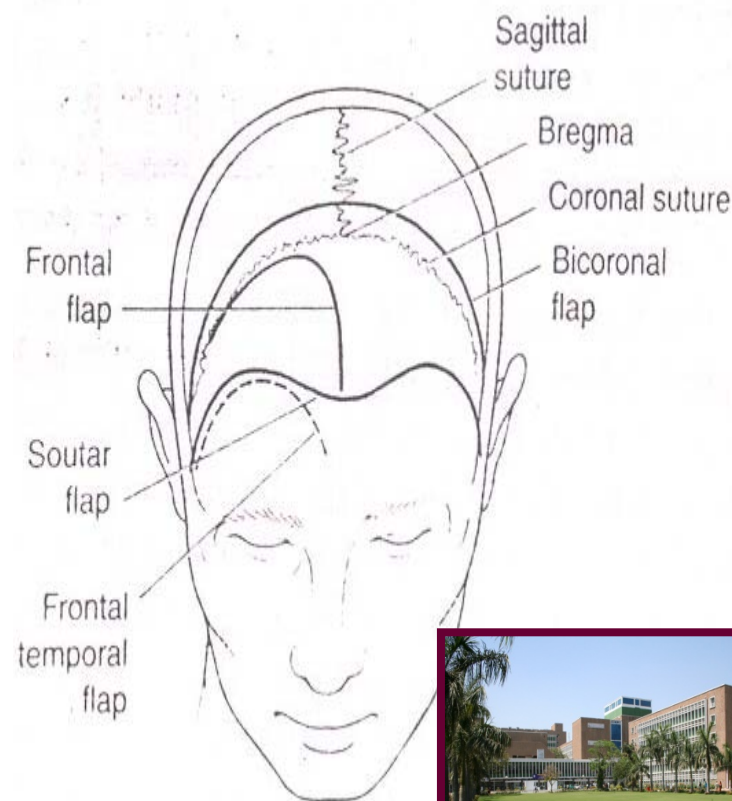
Temporal flap

- Anterior temporal lobe and sub temporal access
- Based on zygoma
- Goes behind the ear
- Extends anteriorly just behind the superior temporal line to the hair line



Fronto-temporal flap

- Used for most pterional craniotomies
- Combines frontal and temporal skin flaps
- Extends from zygoma to 1-2 cm off the frontal midline following a curve behind the natural hair line
- Temporalis muscle either dissected or reflected as a separate layer
- In the later instance a cuff is left superiorly so as to suture it



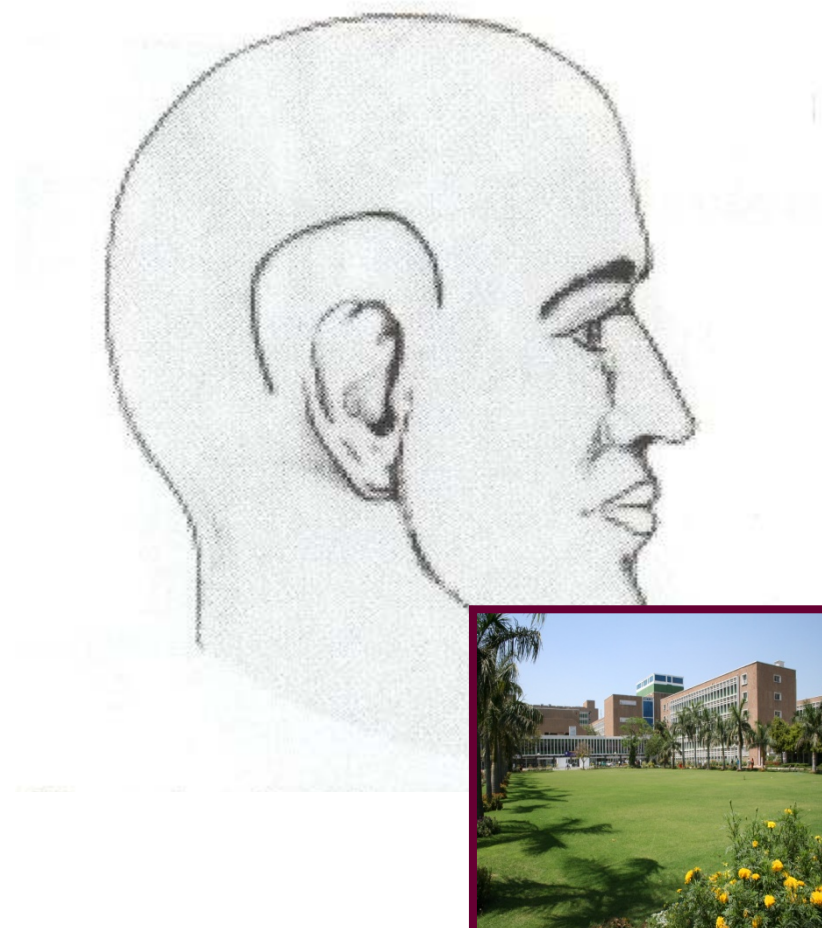
Question mark skin flap

- Cranial trauma
- Exposure to whole hemisphere
- Based on zygoma
- Blood supply from superior temporal and supra orbital vessels
- Curves around 3.5 cm posterior to external auditory meatus
- Anterior limb extends to hair line



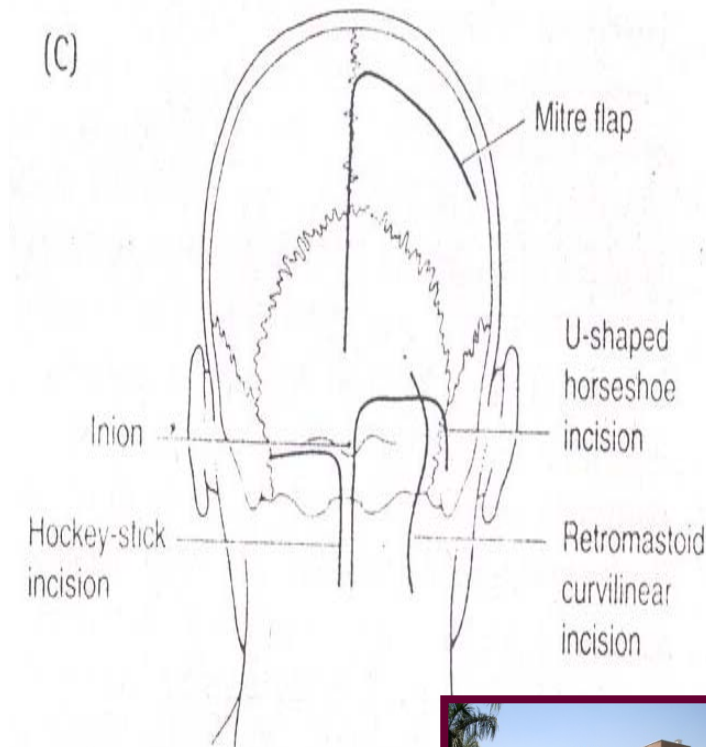
Horse shoe skin flap

- Expose any portion of cerebral convexity
- Inverted “U” shaped with base directed towards vascular supply
- Subtemporal exposure: anterior limb 1 cm anterior to the tragus
- For anterior transcallosal approaches: over coronal suture



Mitre skin flap

- Mitre hats worn by bishops
- Occipital lobe, posterior falx and superior tentorial surface
- Inion to vertex: vertical limb
- Upper limb then falls over posterior parietal region towards the ear
- Blood supply from the occipital artery



Linear and curvilinear incisions

- Limited exposures
- Simplicity
- E.g.: MLSOC

RMSOC

Hockey stick incisions

Linear incisions for temporal lobe and sub temporal access



Principles of craniotomy

- Preoperative review of patient
- Preparation of scalp
- Positioning of patient on the table
- Scalp toilet
- Marking of the incision
- Draping



Types of craniotomies

- Flap craniotomy
- Trephine craniotomy
- Flap craniotomy: Osteoplastic
Free bone flap



Bone flaps

- Most direct access to target
- For cerebral convexity directly centered over the lesion
- Skull base lesions should be at the cranial base
- Number of burr holes varies
- Separation of underlying dura
- Beveling effect



- If dura is lacerated during cutting, saw should be turned off and removed backwards via entrance hole
- Air cells opened: remove the mucosa
 - pack with betadine soaked spongstan
 - pack with bone wax
 - cover it up with vascularized tissue



- Proposed bony cuts over the sinuses should be done last-vascularity adherence
- Cut sinus can be sewn/ tamponade
- Bony bleeds stopped with bone wax
- Penfield's retractors to separate dura
- Epidural tacking sutures to control epidural bleeding before opening dura
- Others don't in order to protect cortical blood vessels with an intervening brain spoon
- Tailor to avoid dural venous channels



Opening of Dura mater

- Manually palpate the dura
- Dura opened as straight, curved or flap like incisions
- Flaps based towards sinuses
- Opened with sharp hook and knife
- Incision further opened with dural scissors
- Placement of cottonoid along the intended incision
- Suitable cuff of dura around the bone for suturing later



Closure

- Closure in layers
- Check for BP- valsalva maneuver
- Hitch suture
- Water tight but not tension
- Bone flap replacement
- Skin closed in two layers



Frontal/ Bifrontal bone flaps

- Skin incisions: frontal, hockey stick, three quarters suture
- Suitable for frontal lobe, sub-frontal approaches to anterior skull base, and trans cortical access to ventricles
- Burr holes: key point, anterior midline just above skull base, multiple holes placed close together at midline
- Avoid entering orbit
- If orbit breached: bipolar cautery and close with bone wax
- Last burr hole place posterior to key burr hole

- An extended frontal or bi-frontal craniotomies for exposure of sella, anterior cranial base
- Supine with head extended for these
- Holes placed on either sides of sagittal sinus and intervening bone is removed with rongeurs or drill
- Either removed as single piece or conversion of frontal flap to bi-frontal flap
- Combining a frontal flap with pterional flap

- Goals of surgery dictate the craniotomy
- Bilateral orbital craniotomies may be added to minimize frontal lobe retraction
- Dural openings for a unilateral frontal craniotomy usually consist of flap reflected towards sagittal sinus
- For bi-frontal access transverse incision will suffice
- Superior sagittal sinus will have to be ligated on both sides

Fronto-temporal (pterional) bone flap

- Popularized by Yasargil
- Most useful for aneurysms of anterior circulation, basilar top, also tumors of retro orbital, parasellar and subfrontal areas
- Usually performed through right side
- Supine position with head end elevated to 30 degrees and rotated by the same to opposite side
- Skin incision through standard fronto temporal skin incisions

- Temporalis muscle dissected or reflected
- Bone flap centered over the pterion
- Key burr hole, frontal burrhole, posterior burr hole, last burr hole just above the zygoma
- Further bone may be removed from the inferior temporal squama
- To improve vision, drill the sphenoid ridge
- Dural flap based on the orbit

- Addition of orbito-zygomatic craniotomy will allow for a more lower and anterior approach
- Suited for para-sellar, inter peduncular lesions
- Pterional+ anterior temporal craniotomy= upper basilar aneurysm



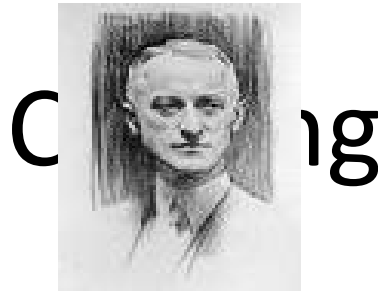
“ during all operations upon the brain, care must be exercised to avoid undue pressure on the thorax and abdomen which might interfere with respirations. Top of the table must be arranged to allow change of position”

“ operating room should be warm”

“ while operating on the cerebrum shoulders and thorax too be elevated to little less than 45 degrees. On operating on the side or posterior aspect of the head it is best to posture the patient on his side and allow his head to extend beyond the edge of the table. In all instances the assistant holds the head firmly with the fingers opposed to the jaws and cheeks.”

Surgery of the brain and spinal cord on personal experiences

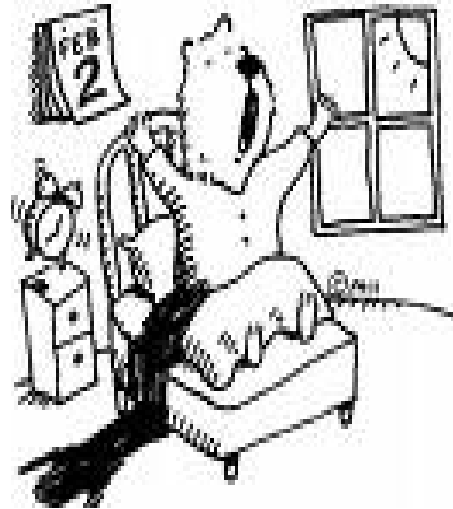




- In his report to chief surgeon:
*“ordinary pillows and sand bags are desirable. In order to get proper elevation of the head so that it can stand free of the surrounding, one or two sandbags, measuring 8*8*3 inches covered with rubber sheet, will be found convenient. A secure arrangement to prevent there slipping in the course of prolonged operation is essential”*
- He also used a horseshoe head rest to allow for access to patients head and neck in the prone position



Awake craniotomies



CP angle tumors

- Supine
- Lateral
- Three quarters prone
- Prone
- Sitting



Indications and Technique

- Mapping speech, motor sensory cortex
- Intractable epilepsy
- Tumors in eloquent areas
- Stereo-tactic biopsies, DBS, chronic SDH, thermo-coagulation of brain lesions



Technique

- Simple head rest or pin fixation may be used
- Maintenance of airway paramount importance
- Possibility of venous air embolism
- Monitoring of ETCO₂ by nasal catheter
- Appropriate padding
- Catheterization



Nerves

- Occipital branch of posterior auricular nerve- superior nuchal line- no deficits
- Supra orbital nerve- notch
- In 8-53% of patients foramen- open it up
- Supra trochlear nerve
- Temporal scalp supplied by auricular temporal branch of mandibular nerve
- Greater occipital nerve supplies upto vertex



Thank you

