

# Plain Radiography

Last updated: June 3, 2019

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<b>SPINAL X-RAY</b> – see p. D70 >>	

Plain radiography, although still employed, is not routine in initial investigation - *insensitive, nonspecific, redundant* (even if abnormalities are seen, it is rare that findings provide sufficient information for management).

## Retained general indications for X-ray:

**SKULL** – calcifications, congenital anomalies, osteolytic / osteoblastic disorders, some trauma cases.

**SPINE** – fractures / dislocations, degenerative conditions, evaluation of instability.

## SKULL X-ray

- about *vascular grooves* in inner table – see TrH5 p.
- about *intracranial calcifications* – see S70 p.
- *pacchionian depressions* extend max 2.5-3.0 cm from midline; any inner table depression beyond that distance should be considered something else (e.g. erosion secondary to neoplasm).
- beyond age 3 yrs., *cranial sutures* appear similar to adults.

## Standard planes & lines:

### Lines:

1. **Anthropological base line:**
  - a) **Reid's or Frankfurt line** - from lower margin of orbit to superior border of external auditory meatus.
  - b) **orbitomeatal (OM) line** - from outer canthus to centre of external auditory meatus.
2. **Auricular line:** perpendicular to above, drawn vertically through external auditory meatus.
3. **Interpupillary line:** through both pupils.

### Planes:

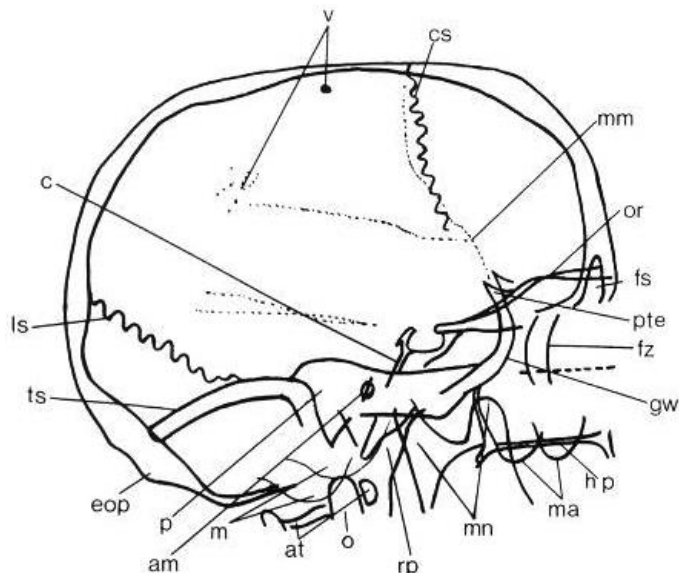
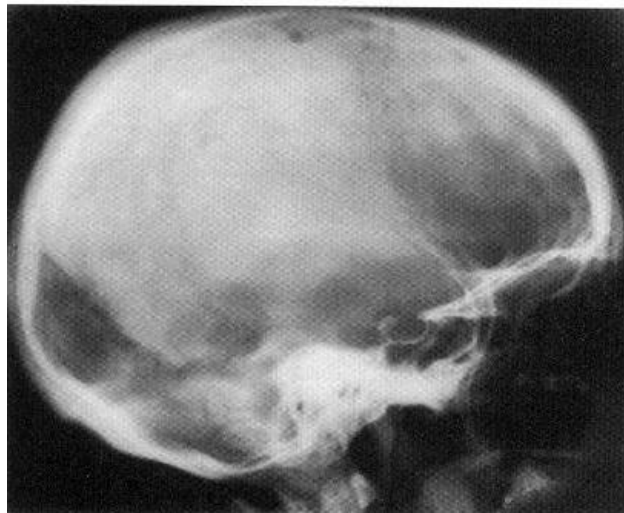
1. **Medial sagittal plane** - anatomical midline.
2. **Horizontal (Frankfurt) plane** - contains both anthropological base lines; corresponding **orbitomeatal plane** includes both orbitomeatal lines.
3. **Frontal biauricular (coronal) plane:** perpendicular to both preceding planes, passing through external auditory meatus.

## LATERAL VIEW

- frontal, parietal, temporal, and occipital bones, sella turcica, orbital roofs, mastoid region, lateral aspect of facial bones.

- lateral view is **sufficient as single view in many clinical circumstances**.

Beam is centred 25 mm anterior to **external auditory meatus** and 10 mm above **orbitomeatal line**, thus placing sella turcica in centre of beam; anterior clinoid processes and orbital roofs on two sides should be superimposed.



a = alveolus; ac = air cells in petrous bone; at = atlas; c = clivus; cc = carotid canal; co = cochlea; cs = coronal suture; csp = cervical spine; ds = dorsum sellae; eam = external auditory meatus (superimposed on lateral projection); eop = external occipital protuberance; es = ethmoid sinus; eu = Eustachian tube; fm = foramen magnum; fo = foramen ovale; fs = frontal sinus; fsp = frontal spinosum; fz = frontozygomatic synostosis; gw = greater wing of sphenoid bone; h = hyoid bone; hp = hard palate; iam = internal auditory meatus (superimposed on lateral projection); il = innominate line; iof = inferior orbital fissure; iop = internal occipital protuberance; it = inferior turbinate; lo = lateral wall of orbit; ls = lambdoid suture; lw = lateral wall of maxillary antrum; m = mastoid process; ma = maxillary antrum; mm = groove for middle meningeal artery; mn = mandible; mw = medial walls of orbit and maxillary antrum (superimposed); np = nasopharynx; ns = nasal septum; o = odontoid; or = roof of orbit; os = occipital squame; oss = ossicles (auditory); p = petrous bone; pc = posterior clinoid process; pr = petrous ridge; ps = planum sphenoidale; pt = pterygoid plates; pte = pterion; rp = retropharyngeal soft tissue; sg = groove for superior sagittal sinus; sof = superior orbital fissure; sps = sphenoid sinus; sr = sphenoid ridge; ss = sagittal suture; tm = temporomandibular joint; tr = tympanic ring; ts = groove for transverse sinus; tt = temporal tubercle; v = venous markings; z = zygomatic arch.

## AP (FRONTO-OCCIPITAL) VIEW

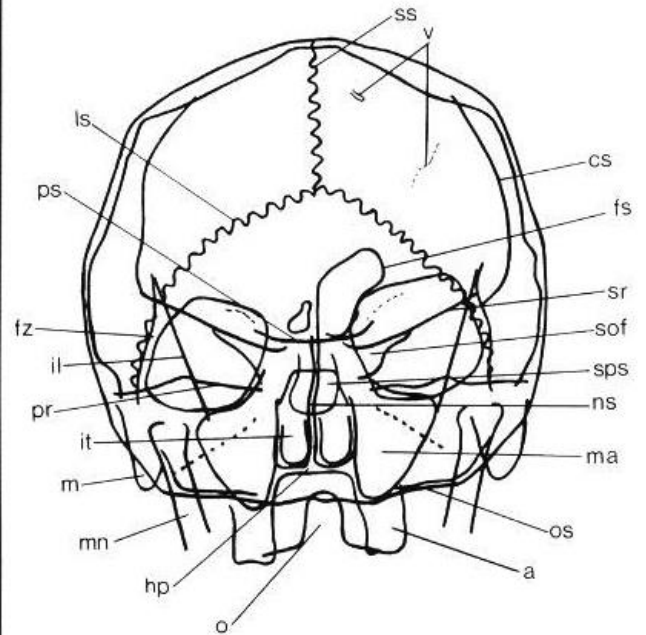
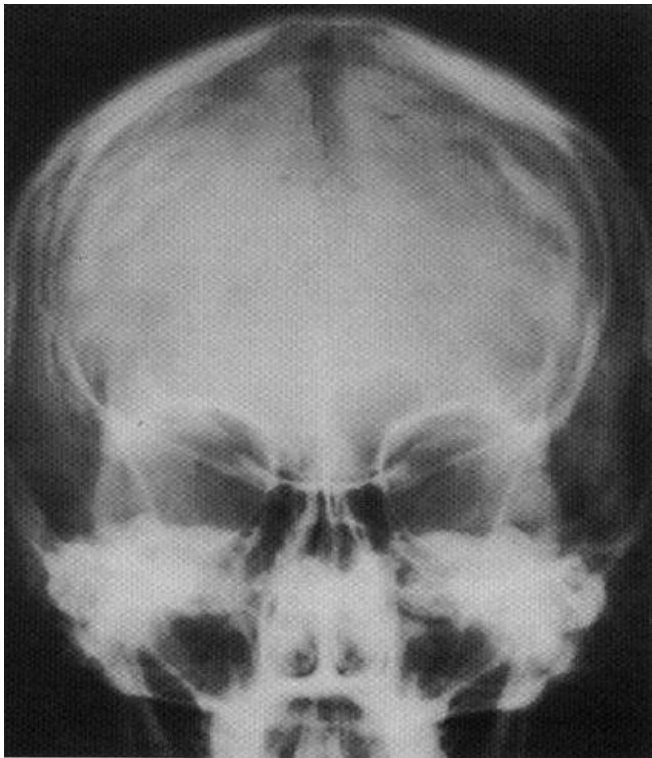
- **should not be used** - causes magnification and blurring of more important anterior structures!

## PA (OCCIPITOFRONTAL) VIEW

- frontal and ethmoidal sinuses, frontal bones, nasal cavity, superior orbital rims, mandible.

Rest **nose** and **forehead** on cassette - midsagittal and orbitomeatal planes are perpendicular to film; beam centered on nasion.

- many individuals have asymmetrical temporal fossae, and best **method of assessing rotation** is to identify **anterior structure** (such as base of nasal septum), and more **posterior structure** (such as odontoid) - if these are not in same sagittal plane, radiograph is not adequate.



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### CALDWELL (S. 25° PA) VIEW

- **orbital structures** (unobstructed by petrous ridges)

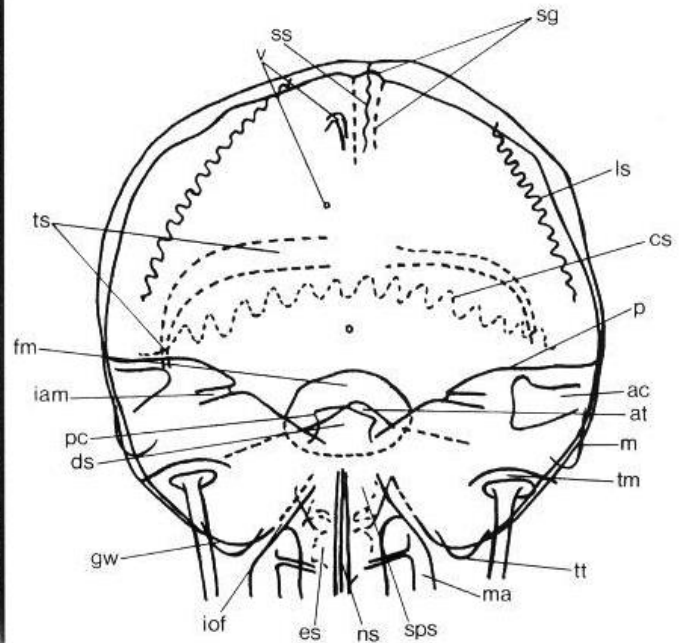
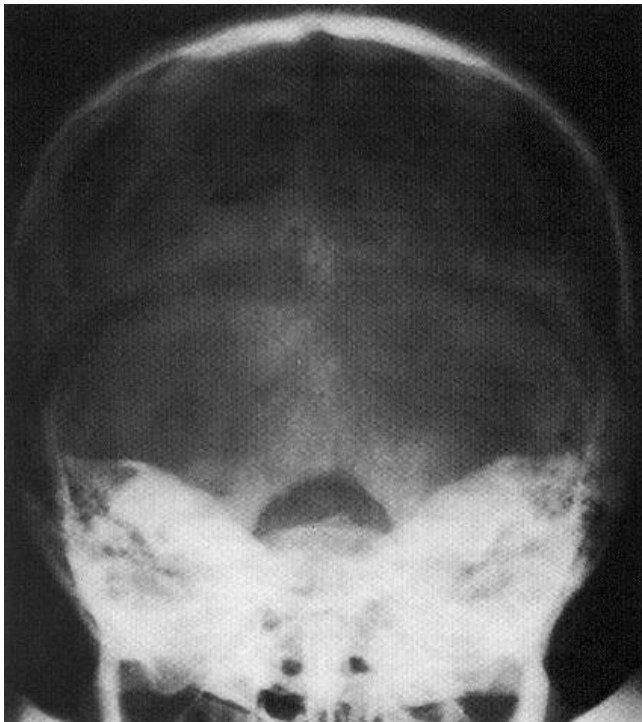
Patient position as for PA view, but tube is angled 20-25° caudally → **petrous ridges** project at or near **inferior orbital margins**.

### TOWNE (S. HALF-AXIAL AP, 30° AP) VIEW

- foramen magnum, entire occipital bone, dorsum sellae, petrous & mastoid region.

Place **occiput** on cassette (with orbitomeatal or anthropological line perpendicular to it).

- angle tube 30° caudally (gives effective caudal angulation of 25–40°) - beam is centered on foramen magnum.
- take care not to exclude anterior temporal and facial regions from film: on nonisocentric units they may appear elongated, because of distortion introduced by angling tube to film.



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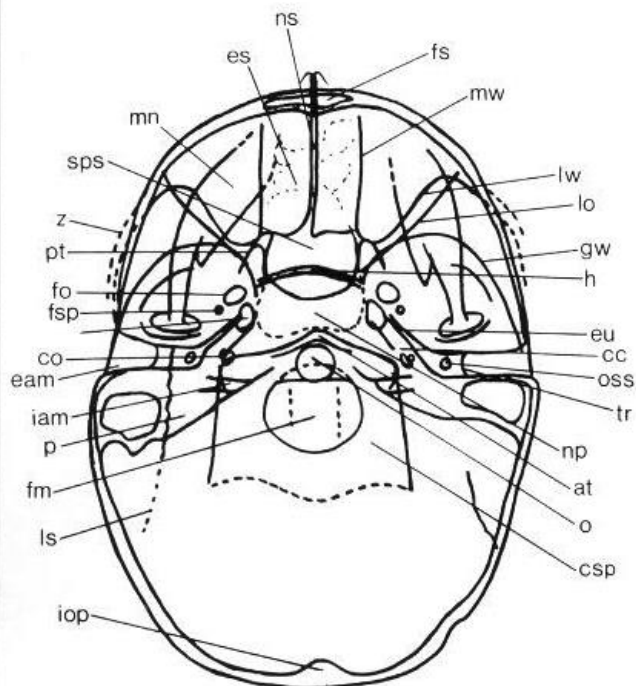
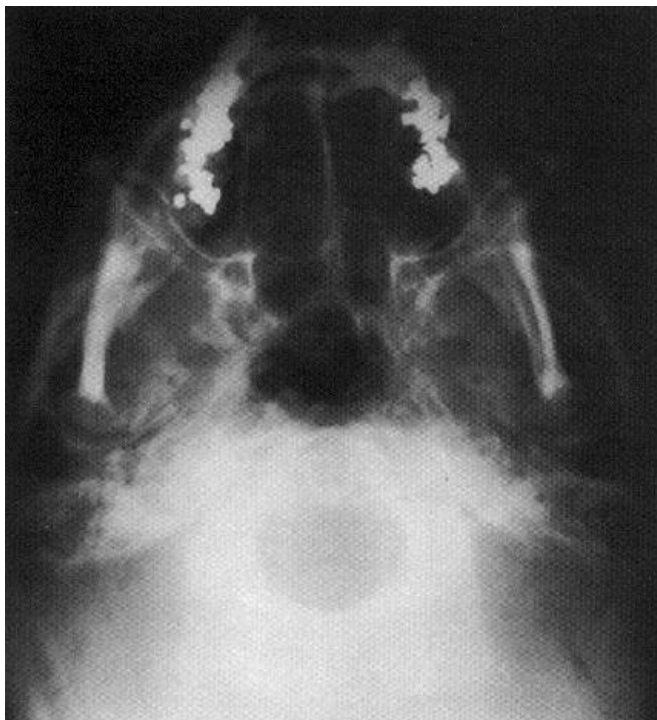
### SUBMENTOVERTICAL (S. BASE, AXIAL) VIEW

- skull base.

With patient supine, neck is fully hyperextended (thick pillow is placed under shoulders) - anthropological line is parallel with film; median sagittal plane is again perpendicular to it.

- beam is centred on biauricular line, halfway between angles of mandible.
- satisfactory radiograph - angles of mandibles lie just anterior to middle ear cavities.





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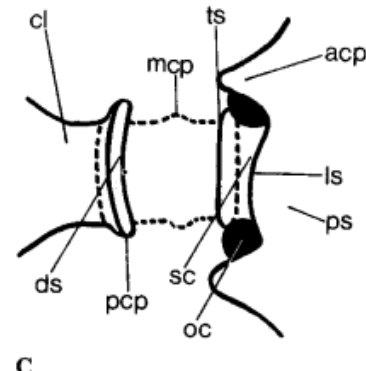
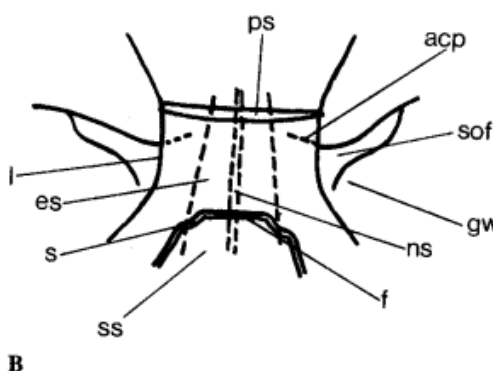
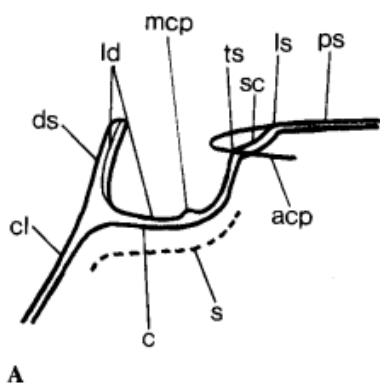
**SELLAR REGION**

Diagram of sellar region:

Lateral projection

Frontal projection

From above



acp = anterior clinoid process; c = cortical bone lining sphenoid sinus; cl = clivus; ds = dorsum sellae; es = ethmoid sinus; f = floor of sella turcica; gw = greater wing of sphenoid; l = lamina papyracea; ld = lamina dura (cortical bone lining sella turcica); ls = limbus sphenoidale; mcp = middle clinoid process (inconstant); ns = nasal septum; oc = optic canal; pcp = posterior clinoid process; ps = planum sphenoidale; s = carotid sulcus; sc = sulcus chiasmaticus; sof = superior orbital fissure; ss = sphenoid suture; ts = tuberculum sellae.

## TEMPORAL BONE

**CT** is study of choice for evaluating temporal bone!

- before thin-section high-resolution CT, many X-ray views and modifications were used.

Today, only few views are used:

### STENVERS VIEW

– oblique projection (angled 45° forward) to provide unobstructed view of **petrous bone, bony labyrinth, internal auditory canal.**

### SCHÜLLER VIEW

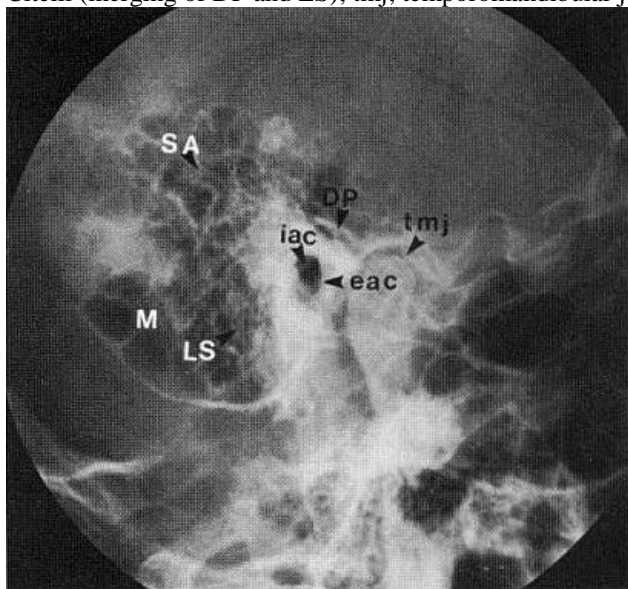
– along ear canal – demonstrates **mastoid air cells.**

### LATERAL MASTOID VIEW

- to confirm diagnosis of acute mastoiditis or substantiate previous mastoid disease.

Lateral (Law) projection;

M, mastoid air cells; DP, dural plate; LS, area of anterior wall of lateral venous sinus; SA, sinodural angle or angle of Citelli (merging of DP and LS); tmj, temporomandibular joint; eac, external auditory canal; iac, internal auditory canal.



## CRANIAL FORAMINA AND CANALS

Foramen/canal [location]	From → To	Contents	Size	Best projection	Notes
<b>OPTIC CANAL</b> [basisphenoid]	orbital apex → middle fossa	CN2 and sheath; ophthalmic artery	6 mm ø, 8 mm length	optic canal view (Rhese)	1 mm difference in size suspicious; keyhole and figure of eight variants
<b>SUPERIOR ORBITAL FISSURE</b> [between greater and lesser sphenoid wings]	orbital apex → middle fossa	CN3, 4, 5 <sub>1</sub> , 6; superior ophthalmic vein; middle meningeal artery branch	very variable	occipitofrontal	thin greater wing may simulate erosion of lower border
<b>FORAMEN ROTUNDUM</b> [greater sphenoid wing]	middle fossa → pterygopalatine fossa	CN5 <sub>2</sub> , artery of foramen rotundum	3–4 mm ø	occipitofrontal	may be surrounded by extensive sphenoid sinus
<b>PTERYGOID (VIDIAN) CANAL</b> [body of sphenoid]	foramen lacerum → pterygopalatine fossa	vidian nerve and artery	smaller than f. rotundum	occipitofrontal	

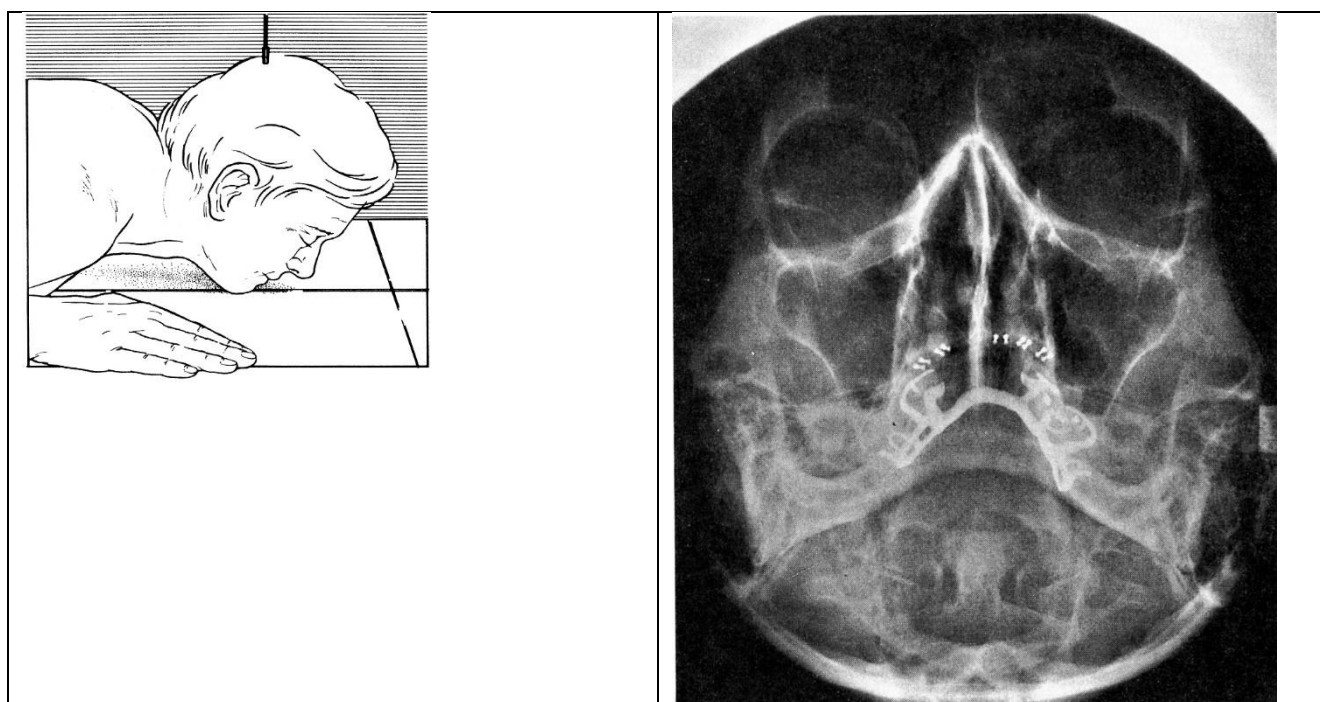
<b>FORAMEN OVALE</b> [greater sphenoid wing]	middle fossa → infratemporal fossa	CN5 <sub>3</sub> , accessory meningeal artery; veins	5 × 9.5 mm	submentovertical	frequently poorly seen; may be confluent with f. spinosum
<b>FORAMEN SPINOSUM</b> [greater sphenoid wing]	middle fossa → infratemporal fossa	middle meningeal artery	2.5–3 mm, rarely 5 mm	submentovertical	may be double
<b>CAROTID CANAL</b> [petrous temporal]	skull base → middle fossa	ICA and sympathetic plexus	6–9 mm ø; ≥ 1.5 cm length	submentovertical	runs posteromedial to eustachian tube; rarely passes through middle ear
<b>INTERNAL AUDITORY MEATUS</b> [petrous temporal]	posterior fossa → inner ear	CN7-8 and dural sheath; internal auditory artery	5–6 mm height	Stenvers	height difference of ≥ 2 mm is suspicious
<b>JUGULAR FORAMEN</b> [between petrous temporal and basiocciput]	posterior fossa → extracranial jugular fossa	<b>pars nervosa:</b> CN9, inferior petrosal sinus. <b>pars vascularis:</b> CN10-11, internal jugular vein, ascending pharyngeal and occipital artery branches	11 × 17 mm; right often larger	under-tilted submentovertical	pars nervosa and vascularis may be separate
<b>FORAMEN MAGNUM</b> [basiocciput]	posterior fossa → cervical spinal canal	medulla oblongata, meninges and ligaments; CN11 (spinal root); vertebral and spinal arteries and veins	30 × 35 mm	lateral; submentovertical	shape very variable
<b>HYPGLOSSAL (ANTERIOR CONDYLAR) CANAL</b> [occipital condyle]	foramen magnum → medial to jugular fossa	CN12; branch of ascending pharyngeal artery	5 mm ø	reversed Stenvers: Stockholm 'C'	

**FACIAL X-ray**

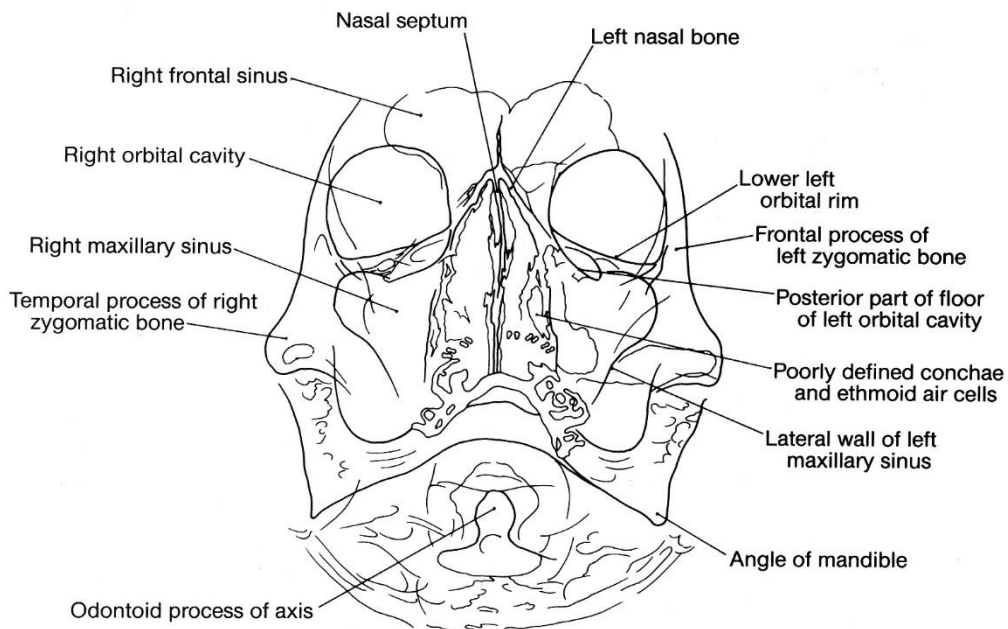
**WATERS' (OCCIPITOMENTAL) VIEW**

- **single** <http://home.mdconsult.com/das/book/body/0/624/I106.fig> - top **best view** for initial evaluation of **maxilla, maxillary sinuses, floors and inferior rims of orbits, zygomatic bones.**

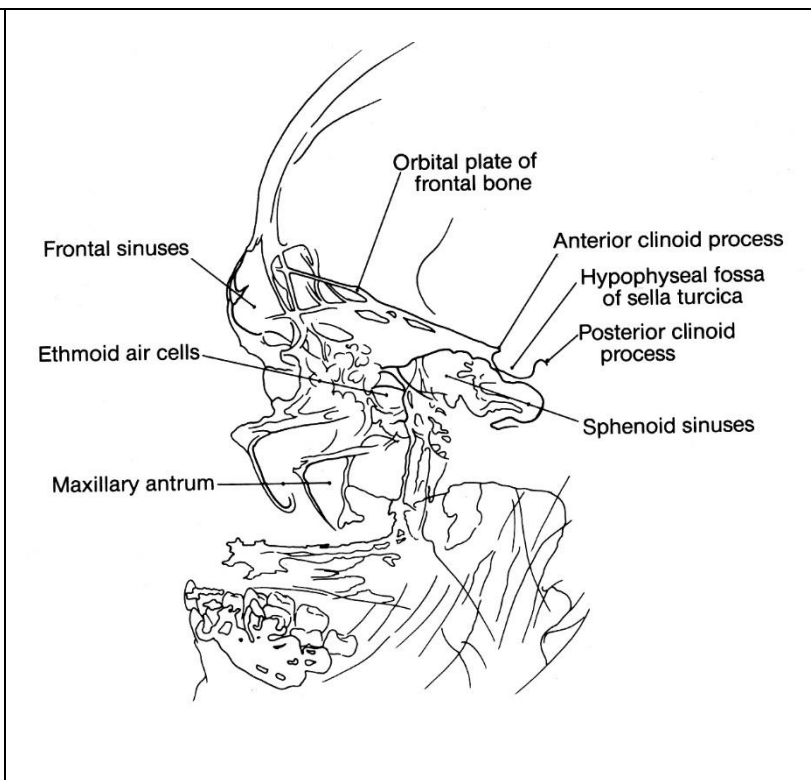
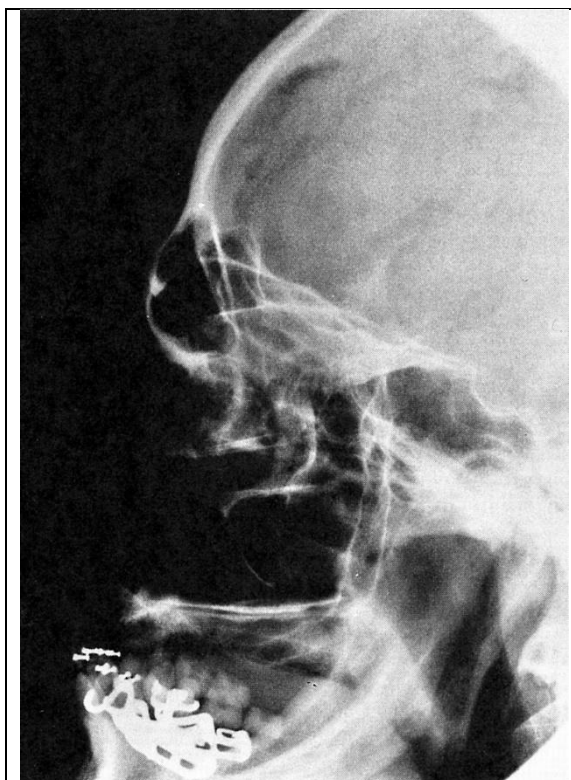
Angled frontal projection - **orbitomeatal line** at 37° angle from film.







**LATERAL VIEW**





BIBLIOGRAPHY for ch. "Diagnostics" → follow this [LINK >>](#)

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**Viktor's Notes<sup>SM</sup> for the Neurosurgery Resident**  
Please visit website at [www.NeurosurgeryResident.net](http://www.NeurosurgeryResident.net)