Radiography of The Skull

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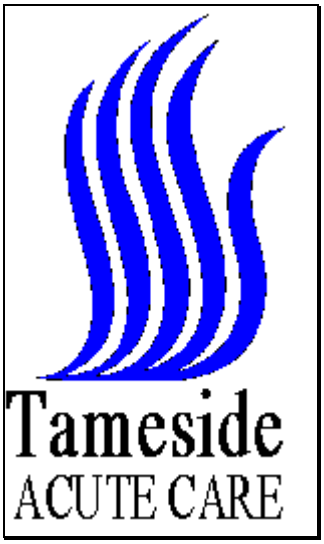


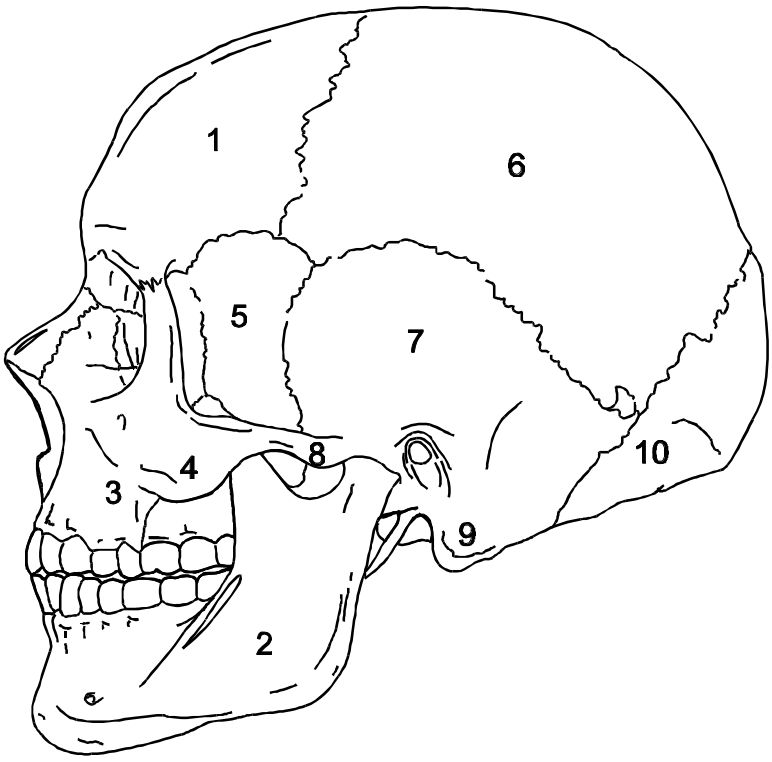
Basic Osteology, Revision

Basic Anatomy:

The skull encloses and protects the brain and its related structures. It is a solid bony box with a 'back' consisting of the occipital and parietal bones; a 'top' consisting of the frontal bone and two parietal bones joined by the sagittal suture; right and left sides consisting of the parietal and squamous temporal bones, a 'front' consisting of the frontal bone and facial structures and a floor consisting of the occipital bone, petrous temporal and sphenoid bones.

The cranium is made up of 8 bones and the facial skeleton of 14 bones, with the exception of the mandible all are immovable and joined by sutures. The most complex part is the base which contains numerous foramina for the passage of arteries veins and cranial nerves.

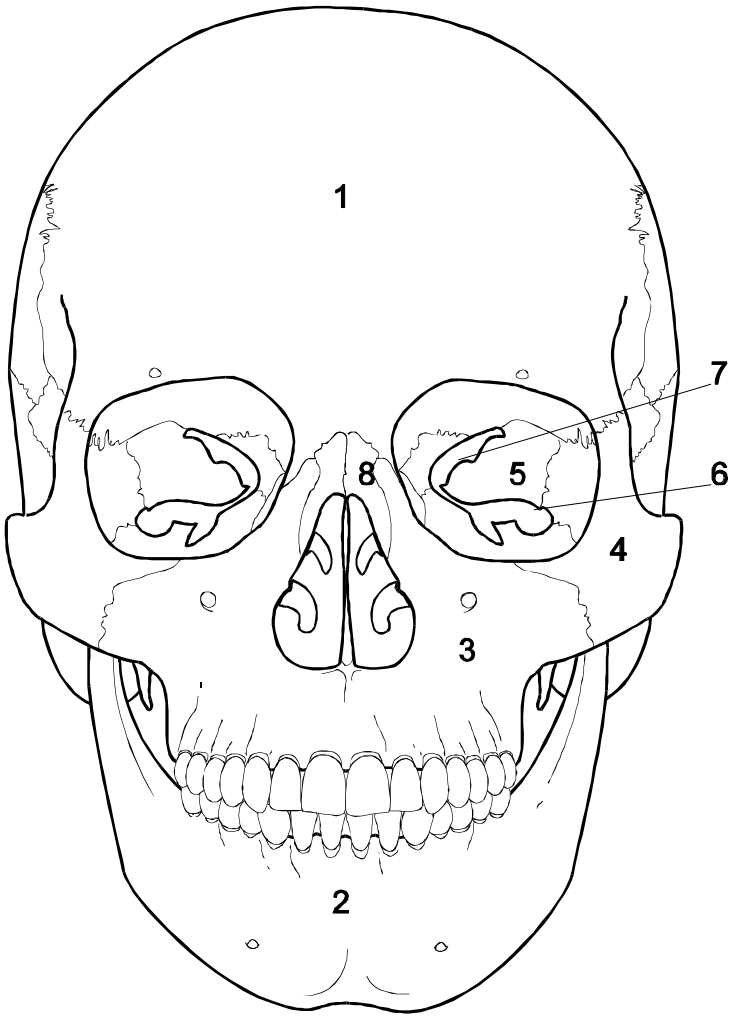
Lateral Skull Anatomy



Key.

1. Frontal Bone
2. Mandible
3. Maxilla
4. Zygoma
5. Greater wing of sphenoid
6. Parietal bone
7. Squamous temporal bone
8. Zygomatic arch
9. Mastoid process of temporal bone
10. Occiput.

Frontal Aspect of Skull,



Key.

1. Frontal bone
2. Mandible
3. Maxilla
4. Zygoma
5. Greater wing of sphenoid
6. Inferior orbital fissure
7. Superior orbital fissure
8. Nasal bone

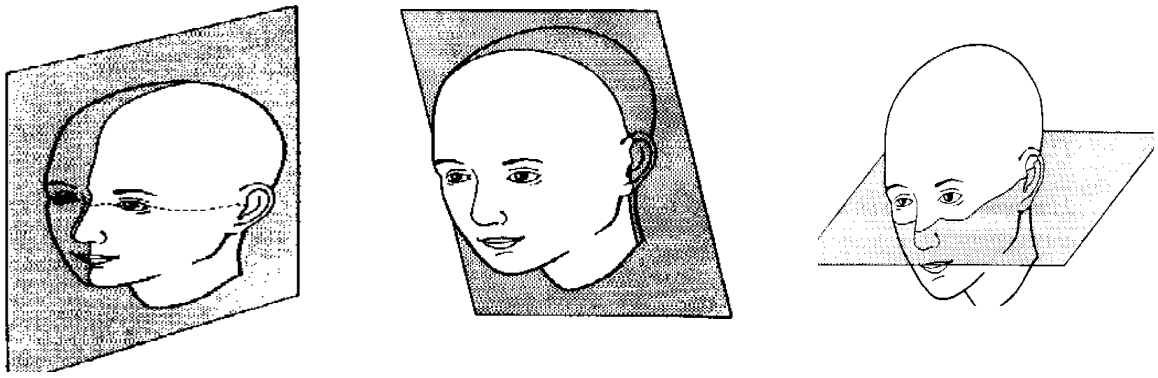
Major Landmarks used for skull radiography:

1. Vertex
2. External Occipital Protuberance (E.O.P.)
3. External Auditory Meatus
4. Outer Canthus Of Eye.
5. Infra-orbital point
6. Nasion
7. Glabella

Baselines, Body Planes and Major Landmarks

Accurate location of these lines, planes and points is essential to ensure accurate and reproducible positioning necessary for high quality imaging of the skull and facial bones. Traditionally the planes and points have frequently used peoples names E.g. Reid's Baseline but convention is now regarded as being as follows.

Major body planes used in Skull radiography



Median Sagittal *Auricular* *Anthropological*

The Median Sagittal plane.

A vertical plane dividing the skull into 2 symmetrical right and left halves when viewed from the anterior aspect.

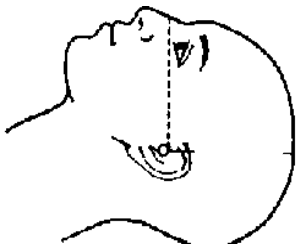
The Anthropological plane,

This plane splits the skull into upper and lower halves passing along the anthropological baseline lines.

The Auricular plane.

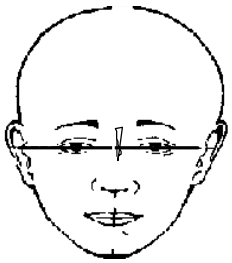
This plane divides the skull into anterior and posterior compartments along the Auricular lines.

Major Baselines used in Skull Radiography



Anthropological

Orbital Meatal



Interpupillary

The Anthropological line

The Isometric "Baseline" which runs from the inferior orbital margin to the upper border of the external auditory meatus (EAM)

The Orbital-Meatal Line

The original "Baseline" which runs from the Nasion through the outer canthus of the eye to the centre of the external auditory meatus.

The Interpupillary line

The line connects the centres of the orbits and is at 90 degree to the median sagittal plane.

The Auricular Line (No Diagram)

This line passes at 90 degrees to the anthropological line through the centre of the external auditory meatus.

Note: there is a difference of 10 to 15 degrees between the Orbital-Meatal line and the anthropological line.

Indications, Royal College of Radiologists Guidelines

Taken from The Royal College Of Radiologists Publication Making The Best Of A Department Of Radiology, Guidelines For Doctors November 1993.

CIRCUMSTANCE	GUIDELINES	EXCEPTIONS
Cerebral symptoms with focal signs or symptoms,	Lateral only in most cases	Localisation of calcifications
Cerebral symptoms without focal signs or symptoms	Not recommended routinely	
Head Injury	Not recommended routinely	Selective radiography of patients with the presence of any of the following Suspected penetrating injury CSF or blood loss via the nose Blood discharge from the ear Loss of consciousness Head injury + major trauma Possible head injury with difficult patient, stroke seizure or mental handicap.
Head injury with alcoholic intoxication which may prevent proper clinical examination.	X-Ray may be helpful if the patient's condition allows the taking of diagnostic quality films.	
Epilepsy (Children)	Not recommended routinely	
Head injury children	Not recommended routinely	Selective use as per adults
Sinusitis	Sinuses are poorly developed under 6-9 years, radiography of limited use in this age group.	

Contra Indications:

There are few if any contra indications other than that alternative forms of imaging may be preferable or the fact that X-Ray imaging may be considered inappropriate in some cases where treatment will not be affected by the result of X-Ray examination.

A contra indication to the use of ionising radiation is the use of imaging in order to reduce the possibility of medico legal litigation and for psychological reassurance of the patient.

Radiological Diagnostic features

Radiological signs of Cranial and Intra-cranial Abnormalities.

Head Injuries

Types of Fracture	Radiological Features
Linear #	Sharp translucent line, may be straight or angled, may cross vascular grooves and cause sutural widening.
Depressed #	May have curvilinear dense edges, more serious than simple #, tangential projections may be required.
Base of skull #	Suggested by air fluid (blood) level in sphenoid sinus, CSF rhinorrhoea and or bleeding from the ear.

Radiological Diagnostic features cont.

Abnormalities of the Skull and Facial Bones

Cause	Radiological Features
Enlargement of Skull Vault	
Children	
Hydrocephalus	Sutural diastasis, increased convoluted markings, "copper beaten skull"
Raised intra cranial pressure	Bulging of fontanelle in infancy.
Adults	
Acromegaly	Enlarged frontal sinuses and mandible, erosion and enlargement of sella turcica
Paget's disease	Thickened skull vault, increased density of vault and facial bones.
Increased Density	
Localised	
Hyperostosis frontalis	Symmetrical thickening of the inner table of skull vault, usually in women, of no significance.
Meningioma	Area of localised sclerosis, possible enlarged groove of feeding artery.
Fibrous displasia	Asymmetrical, affecting the facial bones maxilla and base of skull.
Generalised	
Paget's disease	Irregular sclerosis with thickened vault.
Secondary deposits. e.g. prostate & breast	Irregular sclerosis, thickened vault.
Lytic lesions	
Childhood	
Secondary deposits, neuroblastoma, leukaemia	Variable appearances, Sutural deposits may mimic sutural diastasis.
Eosinic granuloma, Histiocytosis X	Transradient defect with bevelled edges.
Adults	
Myelomatosis	Rounded translucent (2-10mm) multiple 'holes'
Secondary deposits	Generally ill defined translucent patches.
Hyperparathyroidism	Mottled appearance of 'pepper pot' skull.
Paget's	Sharply defined zones affecting large areas of the vault.

Radiological Diagnostic features cont.

Radiological signs of Cranial and Intra-cranial Abnormalities. Cont.

Pathological Intracranial Calicification

Increased Density	
Vascular	**Radiological features**
Atheroma	Curvilinear calcifications in the carotid syphon.
Aneurysm	Related to main arteries.
Angioma	Any site both spotty and curvilinear
Tumours	
Meningioma	Dense calcifications in the tumour, may produce localised sclerosis.
Craniopharyngioma	Deformed sella turcica with calcification intra or supra sella.

Patients Preparation:

Basic psychological preparation with reassurance and explanation of technique.

Normal patient examination interview. Ref.: 'Radiography of the Head' by Pamela Kimber. Churchill Livingstone, 1983

Patients referred for skull radiography may be worried and anxious about the outcome. Many, but not all such patients, are difficult to handle and need special care. Some will be mentally disturbed, Patients Preparation:

unconscious or unable to co-operate; the assistance of a nurse or other competent person may be required. An understanding and tolerant attitude exhibited by the radiographer always helps.

Time taken to explain the test to the patient is never wasted.

Before starting any examination, the identity of the patient must be checked by the radiographer; a patient may answer to a name not his/her own and this is particularly true for some disorientated patients attending for skull imaging.

All detachable foreign opacities such as jewellery chains, spectacles, hearing aids, earrings, wigs and false hairpieces and false eyes must be removed from the head and neck. It is not usually necessary to remove false teeth.

It is important to remember the dignity of the patient, and essential to have clean hands and a clean table/buck top and clean immobilisation aids at all times.

Immobilisation:

Full immobilisation is essential for high quality diagnostic imaging, the use of velcro binders and pads will assist in immobilising the patient in most cases.

Accessories:

Fine and standard/regular resolution, film speed screen combinations in an assortment of sizes.
Pads and immobilisation aids.
Cones and Plates to fit equipment being used.
Hard surface disinfectant for bucky board or head support.

Radiation Protection:

Radiation protection in line with local and national guidelines in particular the NRPB publications regarding dose reduction. The most radiosensitive organs involved are the eyes and thyroid gland, the use of beam limiting cones and diaphragms is adequate in most cases, direct lead rubber gonad protection when the central ray is directed towards the gonads is probably not necessary but may be considered good practice.

The most effective method of dose reduction is careful technique to avoid the need for repeat radiographs.

Films Screen and Grids:

Stationary fine line grids with a ration of 10 or 12 to 1 are found in most Isocentric units.

The CRT4 unit has an 8:1 moving grid.

General purpose film screen combinations (Speed 400 to 800) are the best compromise of dose and image quality.

Baselines and Angles

The descriptions of positioning which follow will use the following conventions.

1. Basic Skull and facial Bone Projections 1-8 will be described using the Film Centred approach
2. The "Baseline" used is the **Orbital Meatal Line (OML)**
3. Angles will be described as Cranial or Caudal
4. Angles will be quoted in reference to the "Baseline" **not** the film plane.
5. All projections will be described for the Erect technique

I. **Isocentric positions 1-8** will be described using the object centred approach.
II. The "Baseline" used is the Anthropological baseline (APB)
III. Angles will be described as Cranial or Caudal
IV. Angles will be quoted in reference to the "Start Zero" **position**
V. All projections will be described for the Supine technique

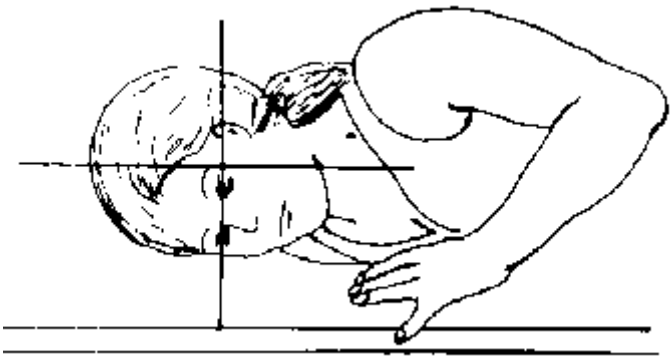
Respiration.

In order to help minimise movement unsharpness exposure should be made on suspended respiration where possible.

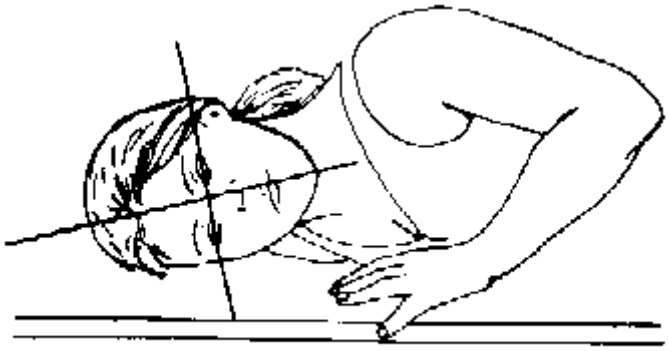
Common Positioning Errors

Rotation and tilt are two of the most common positioning errors.

A. Rotation occurs when the median Sagittal plane is not parallel to the film.



B. Tilt occurs when the interpupillary line is not at 90° to the film.



Causes of Positioning Errors

When positioning a patient's head, it is necessary to look at various facial features and palpate various anatomical landmarks in order to place certain planes precisely in relation to the film plane. Although the human body is supposed to be symmetrical this is not always true.

The ears nose and jaw being the notable exceptions. Bony parts such as the mastoid tips and the orbital margins are usually more accurate landmarks, for example whilst positioning it is often more accurate to use the eyes rather than the nose as positioning aids.

Equipment choice

Generator and Tube

A medium / high powered medium frequency generator matched to the tube rating is the optimum choice for minimum exposure times coupled with the use of a tube with a focus of 0.3mm.

Equipment Choice

In order of decreasing suitability for maximum image quality.
Dedicated Isocentric skull radiography is the equipment of choice.
Dedicated 'Lysholm' skull unit,
General purpose generator and erect bucky
General purpose generator and grid cassettes.

Film Centred Radiography

The Lysholm Skull Apparatus.

Film Plane Centred Radiography

The original Elma - Schöenander Skull table was first made in 1934 and continued to be made and sold up until the late 1970's when it generally became superseded by Isometric equipment and the introduction of clinical Computer Tomography around 1974 which spelt the end procedures like air encephalography. However many units are still in place and in use, these units are still able to provide high quality images of the cranium and it's associated structures, in use the techniques used are very similar to the techniques using a normal X-Ray tube and bucky arrangement.

The unit consists of a small object table made of clear perspex, which includes a removable cassette tray and grid mechanism, the largest cassette size practicable is a 24cm x 30cm though a 35cm x 35cm cassette will fit in the mechanism the narrow focal spot angle will not permit full coverage.

The grid is able to be rotated through 360 degrees to ensure that the central ray is parallel to the slat direction in all possible tube / table positions.

The object table is mounted on a vertical column on which is free to travel up and down (100 cm).

The object table is also able to rotate round a central boss from being flat at 90 degrees to the column to upright parallel to the column.

The X-Ray tube is mounted on a counterbalanced arc centred to the same central boss as the table, with a focus table distance of 90cm. The tube arc is also moveable in an arc across the table top the tube moving towards (max. 30) and away from the tube column (max. 80), also centred around the central boss.

It is also possible to make small angular adjustments at the tube port position.

The use of a central boss to all the rotations ensures that the central ray of the X-Ray beam is always directed to the centre of the object table, as though the X-Ray tube is on the surface of a sphere which has the centre of the object table at the centre of the sphere.

There is a system of mirrors and cross lights to enable accurate positioning as there is no light beam diaphragm arrangement, beam collimation being achieved using a series of cones and plates.

The object table is able to fit a range of accessories including a fixation band to limit movement, rails for angiographic film changers etc.

The Lysholm equipment is used in a similar manner to a normal tube / Bucky arrangement with the object to be imaged placed at the centre of any tube angulation as close to the film as possible.

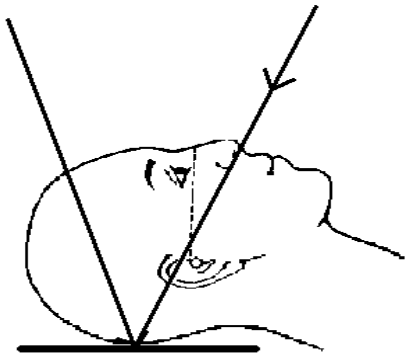
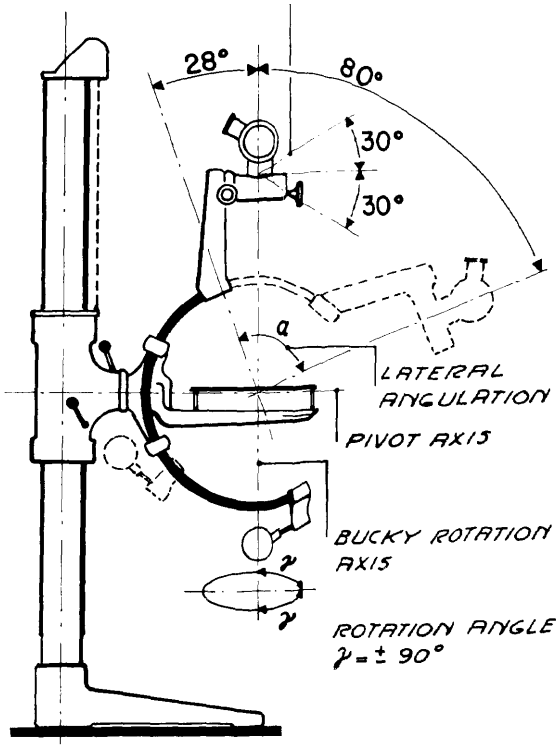
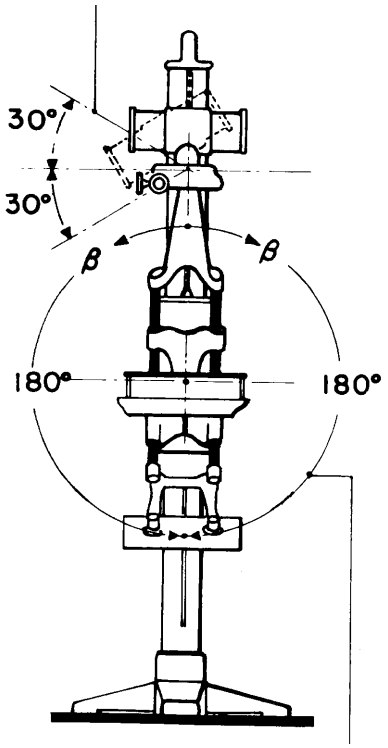


Diagram to Illustrate,
Lysholm equipment principles.

The Lysholm Skull Apparatus.





Appendices

Basic Positioning Skull and facial bones.

Film Centred Technique

Skull:

Occipital Frontal
Occipital Frontal 20°
Fronto Occipital 30°
Lateral
SMV

Facial bones and Sinuses

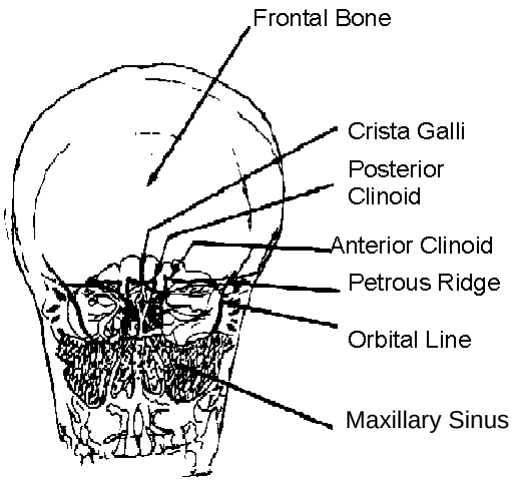
Occipital mental
Occipital mental 30°
Lateral

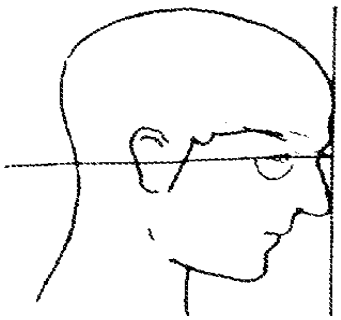
Patient Centred Technique

The Isocentric equivalents of the above techniques Basic Skull Projections

Basic Skull Projections

Fronto Occipital 0°





Anatomy Demonstrated

Frontal bone, crista galli, internal auditory canals, frontal and ethmoid sinuses, petrous ridges, greater and lesser wings of sphenoid.

Patient Position

Patient sits erect facing the erect bucky.
Rest patient's noise and forehead against the bucky.
Align midsagittal plane perpendicular to and in line with the midline of bucky and central ray.
Tuck chin in to bring the OML 90° to film.
Centre bucky to Glabella

Central Ray

Centre the horizontal central ray to exit through the Glabella.

Exposure / Projection Details (Typical)

Projection	Kv	mAS	Focus F/B	Grid Y/N	Size cm	FFD cm.	CR ⇑°	CR ⇓°	OMBL ⇑°	OMBL ⇓°
Fronto Occipital	80		Fine	Y	24x30	100	0	0	0	0

Image Evaluation Criteria,

Petrous pyramids fill the orbits. (Central Ray to R.B.L. angle)

Distance from orbital line to the lateral margin of the skull equal on both sides. (Rotation)

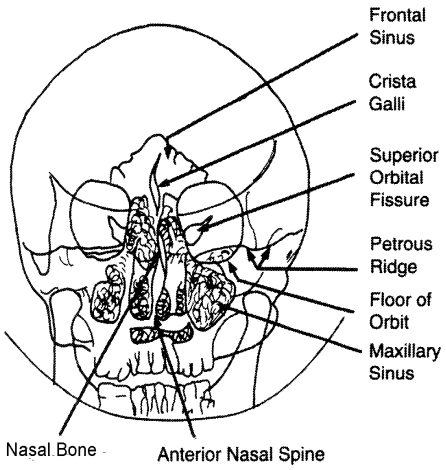
Dorsum sella and anterior clinoids are visualised superior to the ethmoid sinuses. (Central Ray to R.B.L. angle)

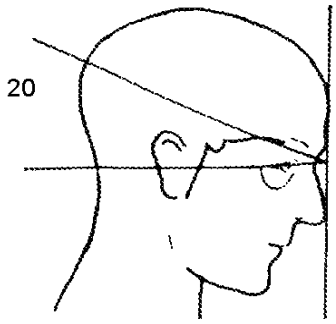
Interpupillary line parallel to film edge. (Tilt)

Sufficient penetration and exposure to visualise frontal bone and petrous pyramids.

Basic Skull Projections

20° Fronto Occipital





Anatomy Demonstrated

Frontal bone, crista galli, Orbital margin, frontal and ethmoid sinuses, petrous ridges, greater and lesser wings of sphenoid.

Patient Position

Patient sits erect facing the erect bucky.
Rest patient's noise and forehead against the bucky.
Align midsagittal plane perpendicular to and in line with the midline of bucky and central ray.
Tuck chin in to bring the OML 90° to film.
Centre bucky to Nasion

Central Ray

20° Caudal angled central ray to exit through the Nasion

Exposure / Projection Details (Typical)

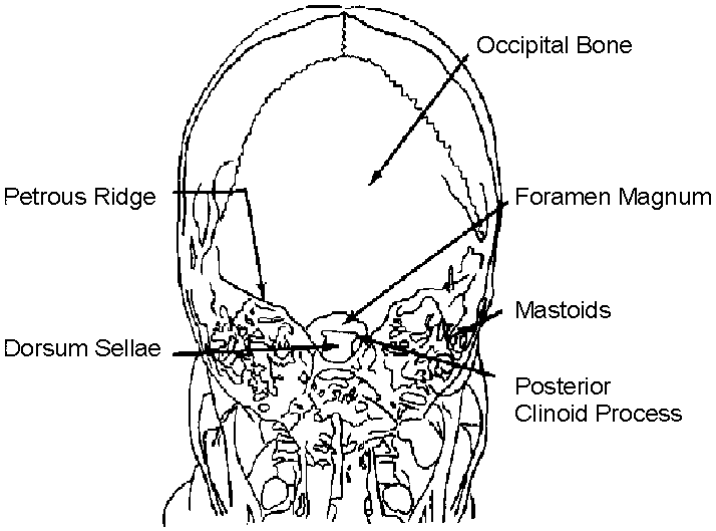
Projection	Kv	mAS	Focus F/B	Grid Y/N	Size cm	FFD cm.	CR ⇑°	CR ⇓°	OMBL ⇑°	OMBL ⇓°
Fronto Occipital 20°	80		Fine	Y	24x30	100		20	0	0

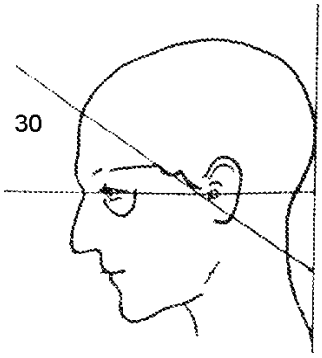
Image Evaluation Criteria, Positioning.

Petrous pyramids projected into lower 1/3 of the orbits. (Central Ray to R.B.L. angle)
Distance from orbital line to the lateral margin of the skull equal on both sides. (Rotation)
Superior orbital margin projected free of other structures.
Interpupillary line parallel to film edge. (Tilt)
Sufficient penetration and exposure to visualise frontal bone and petrous pyramids.

Basic Skull Projections

30° Fronto Occipital





Anatomy Demonstrated

Occipital bone, petrous pyramids, foramen magnum, dorsum sellae and posterior clinoids.

Patient Position

Patient sits erect A.P. against the erect bucky

Align midsagittal plane perpendicular to and in line with the midline of bucky and central ray.

Tuck chin in to bring the OML 90° to film.

Central Ray

30° Caudad angled central ray to a point 6cm above the Nasion in the midline.

Exposure / Projection Details (Typical)

Projection	Kv	mAS	Focus F/B	Grid Y/N	Size cm	FFD cm.	CR ⇑°	CR ⇓°	OMBL ⇑°	OMBL ⇓°
Fronto Occipital 30° (Townes)	85		Fine	Y	24x30	100		30	0	0

Image Evaluation Criteria, Positioning.

Equal distance from foramen magnum to lateral margin of skull on each side. (Rotation)

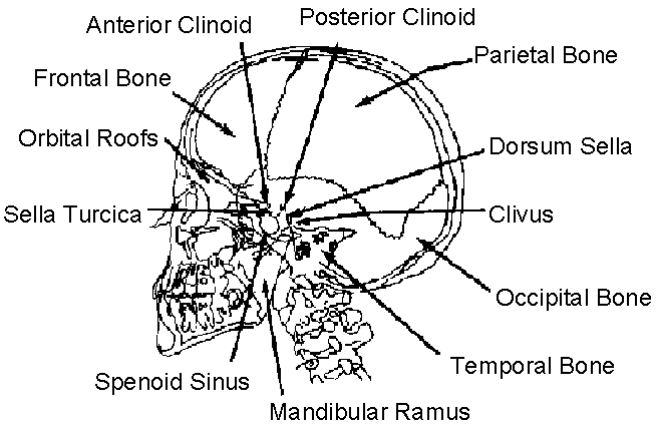
Dorsum sella and posterior clinoids are projected into the foramen magnum. (Central Ray to R.B.L. angle)

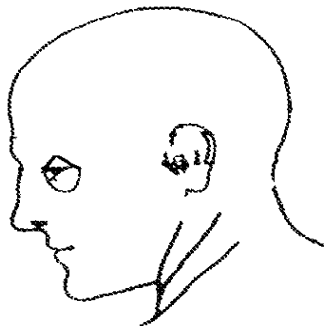
Petrous ridges are symmetrical (Rotation) and superior to the mastoids. (Central Ray to R.B.L. angle)

Tips of petrous ridges parallel to film edge. (Tilt)

Basic Skull Projections

Lateral





Anatomy Demonstrated

Lateral aspect of cranium nearest to the film, dorsum sella, anterior and posterior clinoids, greater and lesser wings of sphenoid bone.

Patient Position

Patient sits erect facing the bucky, the head is then rotated to the side in question, to bring the median Saggital plane parallel to the film.

The angle of the OMB is adjusted for maximum patient comfort.
The Interpupillary line should be parallel to the floor.

Central Ray

The horizontal central ray is centred to a point 5cm superior to the EAM.

Alternative, midway between the Glabella and EOP

Exposure Details (Typical)

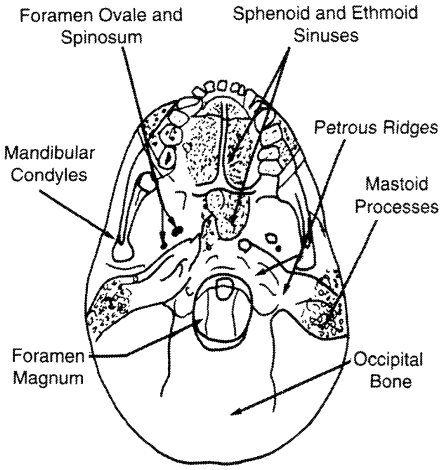
Projection	Kv	mAS	Focus F/B	Grid Y/N	Size cm	FFD cm.	CR ⇑°	CR ⇓°	OMBL ⇑°	OMBL ⇓°
Lateral Skull	75		Fine	Y	24x30	100	0	0	0	0

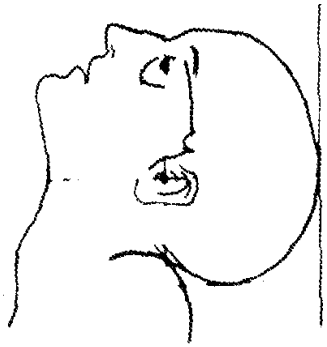
Image Evaluation Criteria, Positioning

Mandibular rami, orbital roofs, E.A.M.s and wings of sphenoid bone superimposed.
Mis alignment one above the other = Tilt, M.S.P. not parallel to film plane
Mis alignment one anterior to the other = Rotation.
Sella turcica seen in profile.

Basic Skull Projections

Sub Mento Vertical (SMV)





Anatomy Demonstrated

Foramen magnum, foramen ovale and spinosum, mandible, sphenoid and ethmoid sinuses, petrous ridge, hard palate and occipital bone.

Patient Position

Care must be taken during positioning as the patient may feint with the neck in hyper extension so practice and speed are essential, it may be safer to use the supine positioning technique particularly in the elderly.

Patient sits erect with the dorsal aspect against the bucky, the shoulders may need supporting on a pad for comfort. The patient's neck is hyper extended until the OMB is parallel to the film plane.

With the CRT4 skull unit this may be enabled by angling the film plane so the lower border is moved backwards away from the patient. The interpupillary line should be parallel to the floor.

Central Ray

The horizontal central ray (or at 90° to OMB) is directed in the midline to a point midway between the mandibular angles.

Exposure Details (Typical)

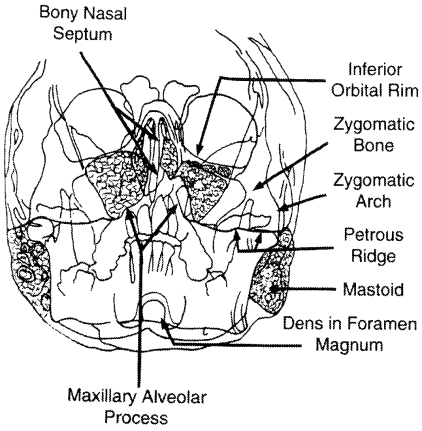
Projection	Kv	mAS	Focus F/B	Grid Y/N	Size cm	FFD cm.	CR ⇑°	CR ⇓°	OMBL ⇑°	OMBL ⇓°
SMV	90		Fine	Y	24x30	100	0	0	90	0

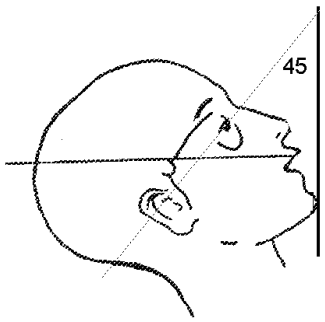
Image Evaluation Criteria, Positioning

Entire facial skeleton visualised, symmetrical with no rotation.
Mandibular symphysis superimposed on anterior frontal bone.
Symmetrical structures projected evenly either side of the mid Saggital plane.
Mandibular condydles projected evenly anterior to petrous bones.
Visualisation of foramen spinosum and ovale.

Basic Facial Bones Projections

Occipito-Mental





Anatomy Demonstrated

Maxillary sinuses, frontal sinuses, inferior orbital rim, maxillae, zygomatic arches, zygoma bones, nasal septum, anterior nasal spine and floors of orbits.

Patient Position

The patient sits erect facing (PA) the erect bucky midsagittal plane in line with the centre of the bucky.

The chin is raised so that the orbital meatal line is 45° to the film plane.

If it is required to visualise the sphenoid sinuses the exposure is made with the mouth open.

Central Ray

The horizontal central ray is centred in the midline to exit at the level of the lower orbital margins.

Exposure Details (Typical)

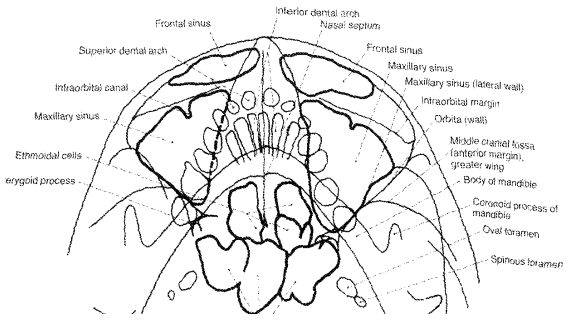
Projection	Kv	mAS	Focus F/B	Grid Y/N	Size cm	FFD cm.	CR ⇑°	CR ⇓°	OMBL ⇑°	OMBL ⇓°
Occipito mental	80		Fine	Y	24x30	100	0	0	45	

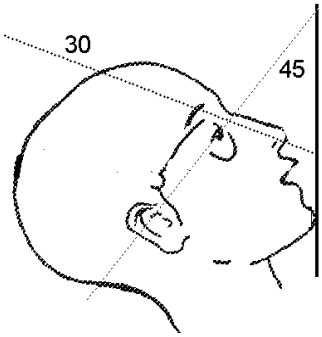
Image Evaluation Criteria, Positioning

The entire facial skeleton must be visualised.
The petrous bone must be projected below the lower borders of the maxillary sinuses.
Structures must be projected equally either side of the midline.
Interpupillary line horizontal unless tilt is deliberately applied to examine fluid levels in the maxillary sinuses.

Basic Facial Bones Projections

Occipito-Mental 30°





Anatomy Demonstrated

Inferior orbital margins and floors of orbits.

Patient Position

The patient sits erect facing (PA) the erect bucky midsagittal plane in line with the centre of the bucky.

The chin is raised so that the orbital meatal line is 45° to the film plane.

If it is required to visualise the sphenoid sinuses the exposure is made with the mouth open.

Central Ray

The central ray is angled 30° caudal to make an angle of 105° to the orbital meatal line in the midline to exit at the level of the inferior orbital margins.

Exposure Details (Typical)

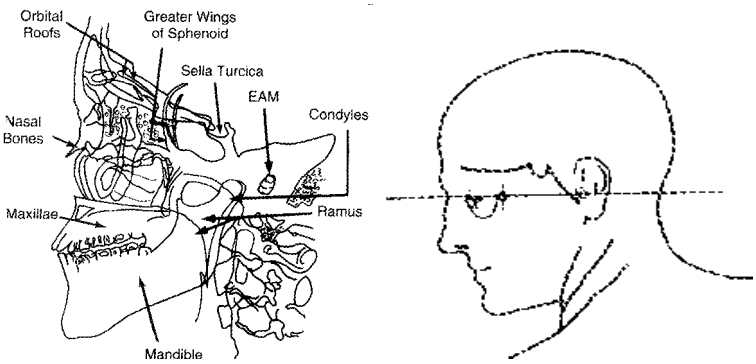
Projection	Kv	mAS	Focus F/B	Grid Y/N	Size cm	FFD cm.	CR ⇑°	CR ⇓°	OMBL ⇑°	OMBL ⇓°
Occipito mental	80		Fine	Y	24x30	100	0	30	45	

Image Evaluation Criteria, Positioning

The entire facial skeleton must be visualised.
The inferior orbital margins must be projected in outline.
Structures must be projected equally either side of the midline.
Interpupillary line horizontal unless tilt is deliberately applied to examine fluid levels in the maxillary sinuses.

Basic Facial Bones Projections

Lateral



Anatomy Demonstrated

Superimposed facial bones, greater wings of sphenoid, orbital roofs, sella turcica, zygoma, mandible and the facial air sinuses.

Patient Position

Patient sits erect facing the bucky, the head is then rotated to the side in question, to bring the median Saggital plane paralel to the film.

The angle of the OMB is adjusted for maximum patient comfort.
The interpupillary line should be parallel to the floor.

Central Ray

The horizontal central ray is centred to a point half way between the outer canthus of the eye and the EAM

Exposure Details (Typical)

Projection	Kv	mAS	Focus F/B	Grid Y/N	Size cm	FFD cm.	CR ⇑°	CR ⇓°	OMBL ⇑°	OMBL ⇓°
Lateral Facial	65		Fine	Y	24x30	100	0	0	0	0

Image Evaluation Criteria, Positioning

The zygomatic bones are superimposed vertically (Tilt) and are in anterior / posterior alignment (Rotation).

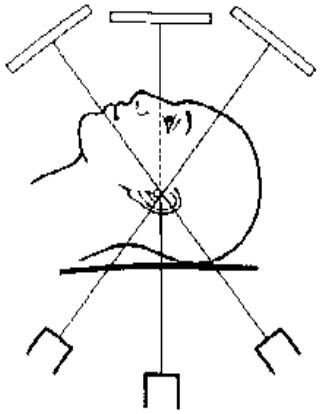
Isocentred Radiography or Object Centred Radiography

The Orbix(Siemens), Satella X, Pendo Diagstat ((Phillips).

The Isocentric technique produces similar images to the Lysholm technique with the benefit of all projections may be taken in the P.A. positions reducing radiation dose to the eyes, and with the central ray at 90 degrees to the film reducing geometric distortion.

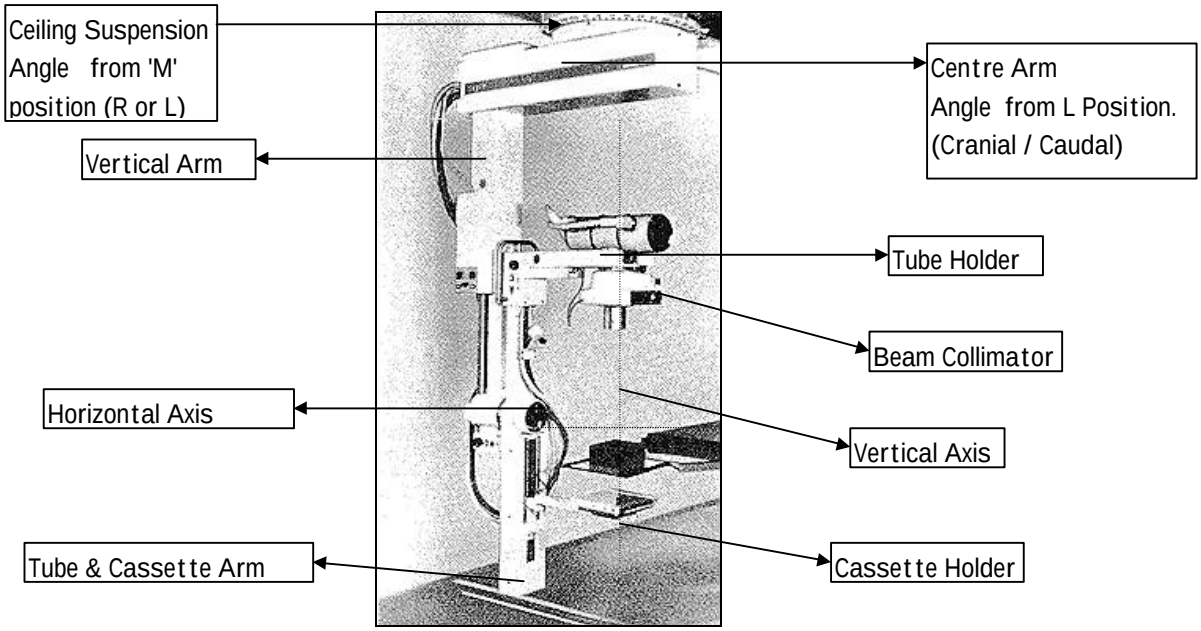
The principal of Isocentric Skull Imaging equipment is to simplify patient positioning making it more easily reproducible, accurate and simple to carry out. First described in 1956 by a man named Dulac it was not until 1971 when the first commercial equipment was produced and marketed.

Whereas using the Lysholm technique the X-Ray tube is rotated around the centre of the film the Isocentric technique relies on the part of the skull to be imaged lying at the centre of the sphere over which the opposed tube and cassette travel around. Hence the Isocentre of the rotation is the object and the central ray remains at 90 degrees to the film at all times.



Diagrams to Illustrate,

Isocentric equipment principles. (L Position)



Isocentric Equipment & Principals

There are currently three models of Isocentric skull units in the region, they are the Satella X, Pendo Diagstat and the Orbix. Of these the Pendo Diagstat may be considered the "odd one out" as one of the rotations is produced by rotating the patient table round the central axis rather than the tube / cassette support. However all three models rely on the Isocentric principal, this handbook will describe detailed projections using the Orbix as this is the most frequently used Isocentric skull unit

The Orbix is a ceiling mounted device with a central pivot point enabling 360 degree rotation round the vertical axis, (A 360 degree rotation when seen in plan view).

The X-Ray tube and cassette holder are mounted on vertical arm with a central pivot enabling 360 degree rotation round the horizontal axis arm. (A 360 degree rotation when seen from the side) The central ray is kept at 90 degrees to the cassette at all times. The column has motorised vertical movements, and the focus film distance can be varied between 70 and 130cm.

The equipment is normally equipped with a fixed height patient table which enables the head to be positioned over the cassette holder, using horizontal and crosswise floatation. All or some of the movements may motorised and are calibrated in degrees or millimetres depending on whether the movement is rotational or linear.

The X-Ray tube is equipped with a standard light beam collimator with accessory rails for a selection of beam limiting "cones".

As well as the light beam collimator accurate positioning is aided by three cross lights positioned to align the equipment in each of the three planes which movements is moved, one cross light indicates the vertical height of the Isocentre, the second the horizontal position and a third the crosswise position.

Immobilisation of the patient's head is achieved using Velcro straps round the head and the chin.

The X-Ray tube generally is a bifocal tube with a 0.3mm and a 0.6mm focus, the equipment may be connected to a variety of generators and with modern fast film screen combinations a 40 kW medium frequency generator will be adequate in most situations.

Summary of the basic Features of the Isocentric technique

1.,The patient is always supine.

2. The position of the patient's head is always the same except for the SMV projection.
3. The spatial co-ordinates are determined in three constant skull planes.

A) the auricular plane.
B) The median sagittal plane.
C) The Infraorbital plane.

4. All measurements of distance are in millimetres mm.
5. There are three manipulations required to position the patient
6. The position of the tube is defined by the two angles around two rotation axis of the tube stand.
7. There is no geometric positional distortion
8. Most projections are in the P.A. position with the tube below the patient and film above.

The M and L Start positions

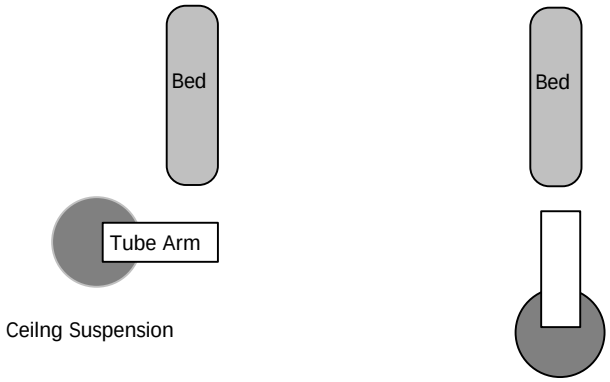
Lateral position of the tube column L

The tube column is positioned lateral to the patients head, (using the ceiling suspension angle adjustment) so that angulation the central ray can be cranial or caudal

Medial position of the Tube column M.

The tube column is positioned adjacent to the vertex of the head (using the ceiling suspension angle adjustment) so that tube angulation causes the central ray to be directed to either side of the head.

Plan View of Orbix in a) L position b) M Position



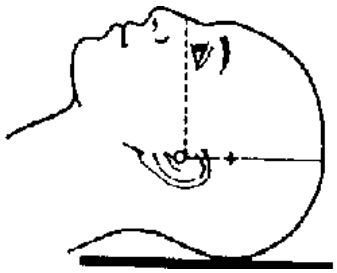
Note:

When describing the table movements moving the table in the direction of the feet causes the Isocentre to move in the Cranial direction.

When describing tube angulation the angles will be described as caudal when the central ray is directed towards the feet.

This description of the tube angulation is in contrast to the instruction book supplied with the Orbix but follows Normal radiographic convention.

Base Reference Position for Isocentric Positioning

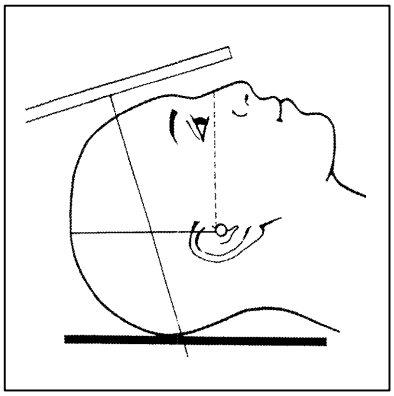


Note: The Orbital Auricular line is vertical.

The patient is positioned supine with the head resting on a small pad for support and comfort. The median sagittal plane is vertical, The anthropological plane is vertical. The auricular plane is horizontal.

The cranio caudal and the cross wise table position is such that the centre lights cross midway between and at the level of the external auditory meati.

Basic Skull Projections
Occipito Frontal (Pineal projection)



Tube Column

The Lateral (L) position with the tube positioned beneath the patient's head is used.

Patient Position

The patient is moved 40mm caudal from the start position.

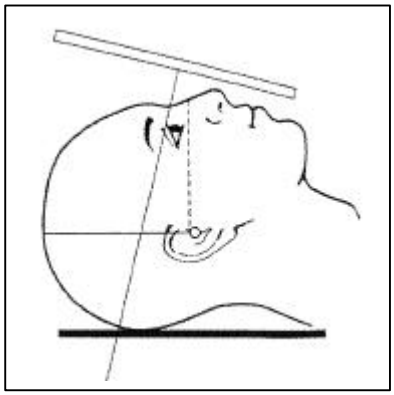
Central Ray

The central ray is angled 15° cranial so that it enters the head 2cm above the external occipital protuberance and exits 4cm above the glabella.

Summary

Position	Start Position M/L	Anthropological plane Basic or ⇑°	Tube Arm Rotation° Cranial / Caudal Right or Left mm.	Table Displacement Cranial. Or Caudal mm.
OF	L	Basic	15° Cranial	40 mm Caudal

Basic Skull Projections
Occipito Frontal 10°



Tube Column

The Lateral (L) position with the tube positioned beneath the patient's head is used.

Patient Position

The patient is moved 40mm caudal from the start position.

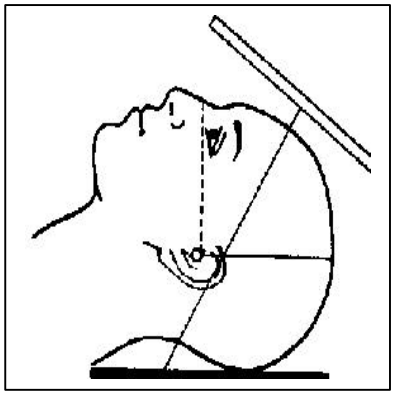
Central Ray

The central ray is angled 10° caudal and enters in the midline between the parietal bones and exits through the nasion.

Summary

Position	Start Position M/L	Anthropological plane Basic or ⇑°	Tube Arm Rotation° Cranial / Caudal Right or Left mm.	Table Displacement Cranial. Or Caudal mm.
OF 10	L	Basic	10 Caudal	40 mm Caudal

Basic Skull Projections
Occipito Frontal 40° (Towne's)



Tube Column

The Lateral (L) position with the tube positioned beneath the patient's head is used.

Patient Position

The patient is moved 40mm caudal from the start position.

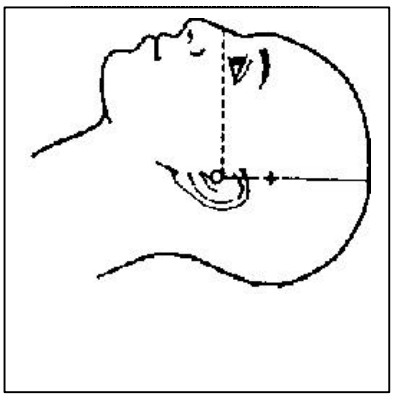
Central Ray

The central ray is angled 40° cranial and enters in the midline through the foramen magnum and exits 6cm above the glabella

Summary

Position	Start Position M/L	Anthropological plane Basic or ⇑°	Tube Arm Rotation° Cranial / Caudal Right or Left mm.	Table Displacement Cranial. Or Caudal mm.
OF 40	L	Basic	40° Cranial	50mm Caudal

Basic Skull Projections
Lateral



Side View

Tube Column

The Medial (M) position with the tube positioned to the side of head is used.

Patient Position

The patient is moved 40mm caudal from the start position.

Central Ray

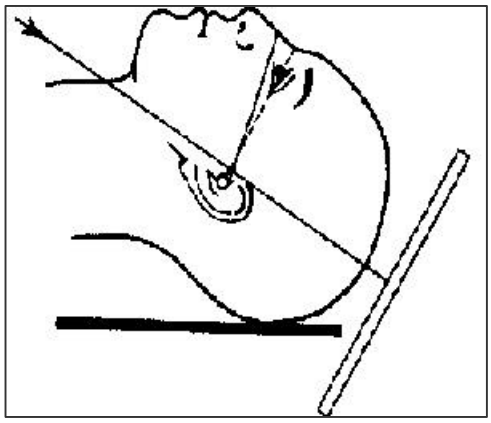
The horizontal central ray enters the head at a point 40mm superior to the upper border of the EAM.

Summary

Position	Start Position M/L	Anthropological plane Basic or ⇑°	Tube Arm Rotation° Cranial / Caudal Right or Left mm.	Table Displacement Cranial. Or Caudal mm.
Lateral	M	Basic	90 Left / Right	40mm

Basic Skull Projections

Sub-Mento Vertical (Full Axial) SMV



Tube Column

The Lateral (L) position with the tube positioned beneath the patient's head is used, and the tube positioned A.P.

Patient Position

The patient's head is adjusted chin up to bring the Anthropological line 40° up from the basic start position.

Central Ray

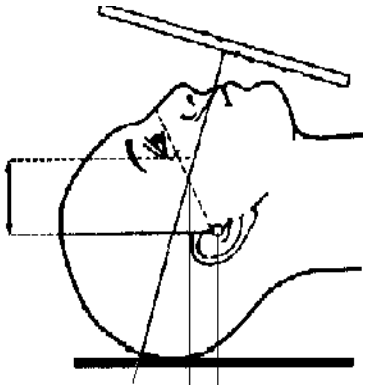
The central ray is angled 55° cranialy, to enter midway between the angles of the mandible and exit through the vertex of the skull.

Summary

Position	Start Position M/L	Anthropological plane Basic or ⇑°	Tube Arm Rotation° Cranial / Caudal Right or Left mm.	Table Displacement Cranial. Or Caudal mm.
SMV	L	45°⇑	55° Cranial	0-5mm Caudal

Basic Facial Bone Projections

Occipto Mental



Tube Column

The Lateral (L) position with the tube positioned beneath the patient's head is used, and the tube positioned PA.

Patient Position

The chin is raised to bring the anthropological baseline 35° up from the basic start position.

Central Ray

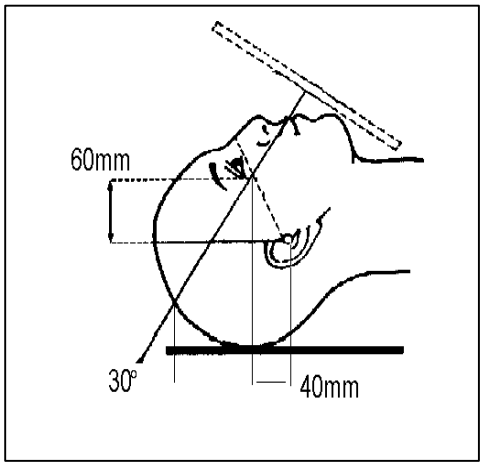
The tube arm is raised 60mm and the table moved 40mm caudal, the central ray angled 15° caudal enters through the occiput in the midline and exits in the midline through the upper central incisors.

Summary

Position	Start Position M/L	Anthropological plane Basic or ⇑°	Tube Arm Rotation° / Raised/ Lowered Cranial / Caudal Right or Left mm.	Table Displacement Cranial. Or Caudal mm.
OM Facial Bones	L	35°⇑	15° 60mm(	40mm Caudad

Basic Facial Bone Projections

Occipto Mental 30°



Tube Column

The Lateral (L) position with the tube positioned beneath the patient's head is used, and the tube positioned PA.

Patient Position

The chin is raised to bring the anthropological baseline 35° up from the basic start position.

Central Ray

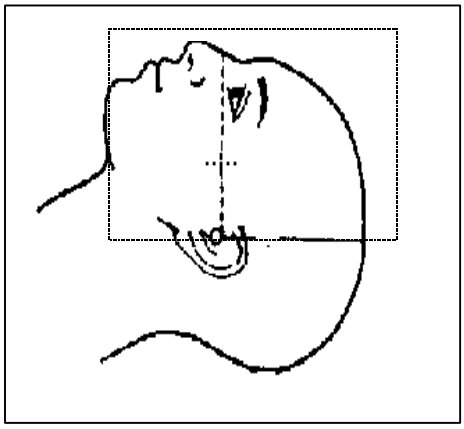
The tube arm is raised 60mm and the table moved 40mm caudal, the central ray angled 30° caudal enters through the occiput in the midline and exits in the midline through the upper central incisors.

Summary

Position	Start Position M/L	Anthropological plane Basic or ⇑°	Tube Arm Rotation° / Raised/ Lowered Cranial / Caudal Right or Left mm.	Table Displacement Cranial. Or Caudal mm.
OM 30° Facial Bones	L	35°⇑	30° 60mm⇑	40mm Caudad

Basic Facial Bone Projections

Lateral



Tube Column

The Medial (M) position with the tube positioned to the Left or Right the patient's head is used.

Patient Position

The Patient is in the basic start position

Central Ray

The tube arm is raised 50mm, the horizontal central ray enters and exits through opposite points on the temporal bone.

Summary

Position	Start Position M/L	Anthropological plane Basic or ⇑°	Tube Arm Rotation° Cranial / Caudal Right or Left mm.	Table Displacement Cranial. Or Caudal mm.
Lateral facial	M	Basic	R / L 90°	50mm Cranial