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Cephalometric radiography

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- Cephalometric radiography is a specialized radiographic technique concerned with imaging the craniofacial region in a standardized and reproducible manner. A cephalometric analysis identifies defined anatomical landmarks on the film and measures the angular and linear relationships between them. This numerical assessment can provide detailed information on the relationship of skeletal, dental and soft tissue elements within the craniofacial region.

USES OF CEPHALOMETRICS

1. Study of craniofacial growth

Serial cephalogram studies have helped in providing information regarding

- The various growth patterns.
- The formation of standards, against which other cephalograms can be compared.
- Prediction of future growth.
- Predicting the consequences of a particular treatment plan.

2. Diagnosis of craniofacial deformity

Cephalograms help in identifying, locating and quantifying the nature of the problem, the most important result being a differentiation between skeletal and dental malrelationships

3. Treatment planning

By helping in diagnosis and prediction of craniofacial morphology and future growth, cephalometrics help in developing a clear treatment plan. Even prior to starting orthodontic treatment an orthodontist can predict the final position of each tooth within a given patient's craniofacial skeleton to achieve aesthetic and more stable results. It helps in distinguishing cases which can be treated with growth modification appliances or which may require orthognathic surgery in future.

4. Evaluation of treated cases

Serial cephalograms permit the orthodontist to evaluate and assess the progress of treatment and also helps in guiding any desired change.

5. Study of relapse in orthodontics

Cephalometrics also helps in identifying causes of orthodontic relapse and stability of treated malocclusions.

By convention, the distance from the X-ray source to the subjects' midsagittal plane is kept at five feet. The distance from the midsagittal plane to the cassette can vary in different machines, but must be the same for each patient everytime.

Tracing a lateral skull cephalometric radiograph

- A lateral skull radiograph should be hand-traced in a darkened room with suitable back illumination using a hard pencil and high-quality tracing paper attached to the radiograph. The peripheral regions of the radiograph should be masked to highlight the cranial base and facial complex. Bilateral structures should be traced independently and then averaged. Alternatively, the landmarks and tracing can be digitized directly into a computer using specialized software, which will instantly produce an analysis.

STEPWISE TRACING TECHNIQUE

Step 1 Draw at least two plus shaped crosses on the top right and left corners of the radiograph. These are drawn away from any landmarks and are used to orient the tracing over the radiograph.

Step 2 Trace the soft tissue profile, external cranium, and the cervical vertebrae.

Step 3 These are followed by the tracing of the cranial base, internal border of cranium, frontal sinus, and ear rods (Moorrees recommends abandoning porion and instead using the superior border of the head of condyle to define FH).

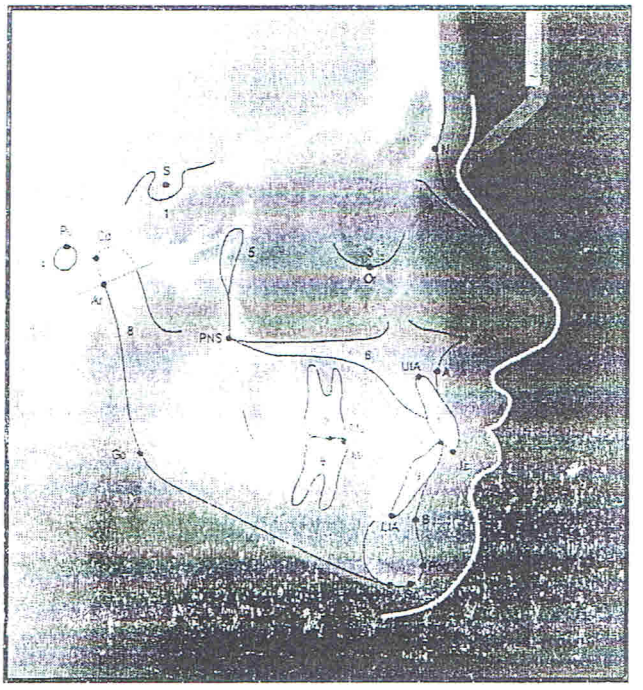
Facial Height

Step 4 Maxilla and related structures including the key ridges (which represent the zygomatic processes of the maxillary bone) and pterygomaxillary fissures are then traced. The nasal floor is also traced along with the anterior and posterior nasal spines. The first molar and the most anteriorly placed maxillary incisor (including its root) are also traced.

Step 5 Finally the mandible, including the symphysis, the lower border of the mandible, the condyles and the coronoid processes is traced. The first molars and the most anteriorly placed incisor tooth including its root are to be traced. The mandibular canal may be traced and is at times used for superpositioning serial radiographs.

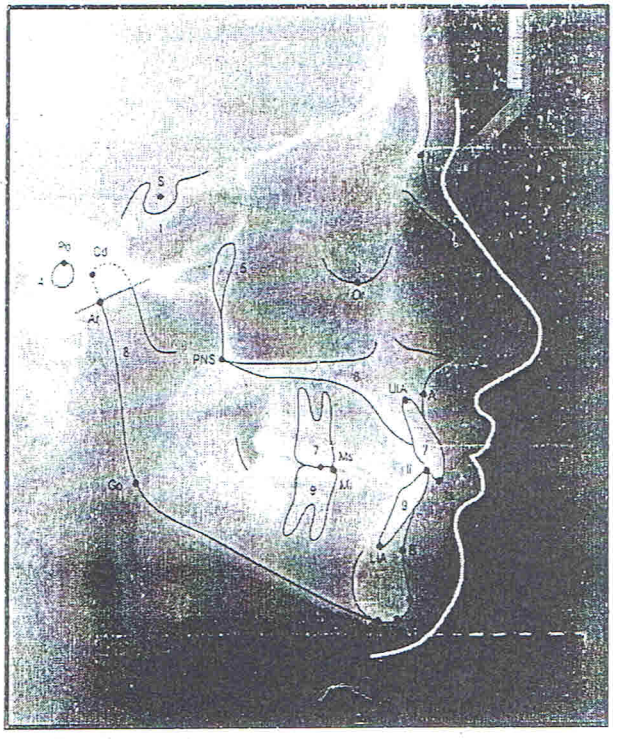
Commonly used cephalometric points in lateral view

- A point (A): this is the point of deepest concavity on the anterior profile of the maxilla. It is also called subspinale. This point is taken to represent the anterior limit of the maxilla and is often tricky to locate accurately. However, tracing the outline of the root of the upper central incisor first and shielding all extraneous light often aids identification. A point is located on alveolar bone and is liable to changes in position with tooth movement and growth.
- Anterior nasal spine(ANS): this is the tip of the anterior process of the maxilla and is situated at the lower margin of the nasal aperture.
- B point (B): the point of deepest concavity on the anterior surface of the mandibular symphysis. B point is also sited on alveolar bone and can alter with tooth movement and growth.



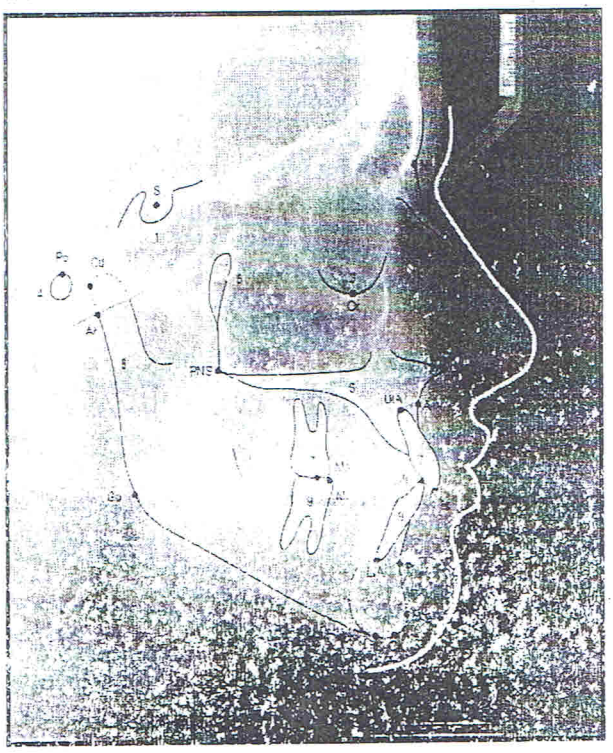
Commonly used cephalometric points in Lateral view

- Gonion (Go): the most posterior inferior point on the angle of the mandible. This point can be 'guesstimated', or determined more accurately by bisecting the angle formed by the tangents from the posterior border of the ramus and the inferior border of the mandible.
- Menton (Me): the lowest point on the mandibular symphysis.
- Nasion (N): the most anterior point on the frontonasal suture.
- Sella (S): the midpoint of the sella turcica.



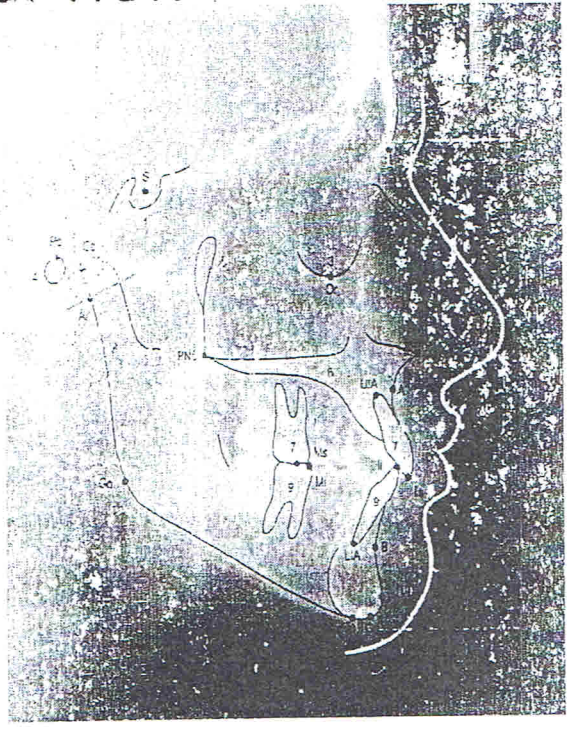
Commonly used cephalometric points in Lateral view

- Orbitale (Or): Orbitale is the lowest point in the inferior margin of the orbit, midpoint between right and left images.
- Pogonion (Pog): the most anterior point on the mandibular symphysis.



Commonly used cephalometric points in Lateral view

- Porion (Po): Porion is the most superior point of the external auditory meatus . This landmark can be obscured by the ear posts of the cephalostat, and some advocate tracing these instead. However, this is not recommended as they do not approximate to the position of the external auditory meatus. The uppermost surface of the condylar head is at the same level, and this can be used as a guide where diffi culty is experienced in determining porion.
- Posterior nasal spine (PNS): this is the tip of the posterior nasal spine of the maxilla. This point is often obscured by the developing third molars, but lies directly below the pterygomaxillary fissure.



Commonly used cephalometric reference planes

- SN line: this line, connecting the midpoint of sella turcica with nasion, is taken to represent the cranial base.
- Frankfort plane: this is the line joining porion and orbitale. This plane is difficult to define accurately because of the problems inherent in determining orbitale and porion.
- Mandibular plane: The line joining gonion and menton.

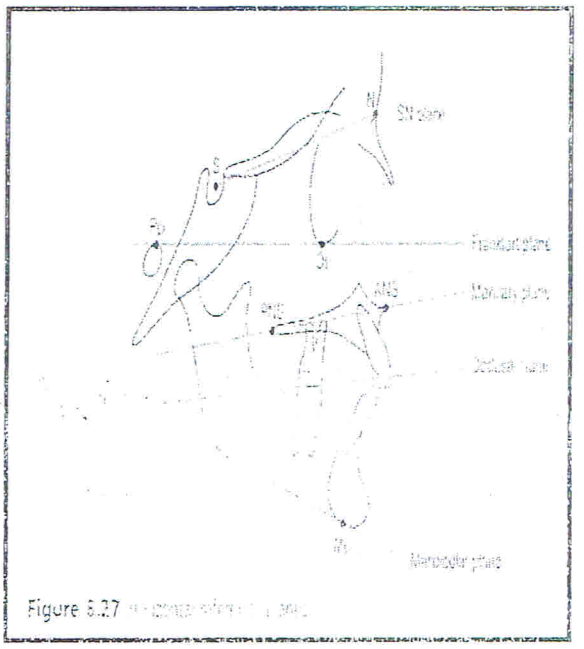


Figure 6.27

Commonly used cephalometric reference lines and planes

- Maxillary plane (palatal plane): the line joining anterior nasal spine with posterior nasal spine.
- Functional occlusal plane: a line drawn between the cusp tips of the permanent molars and premolars (or deciduous molars in mixed dentition).

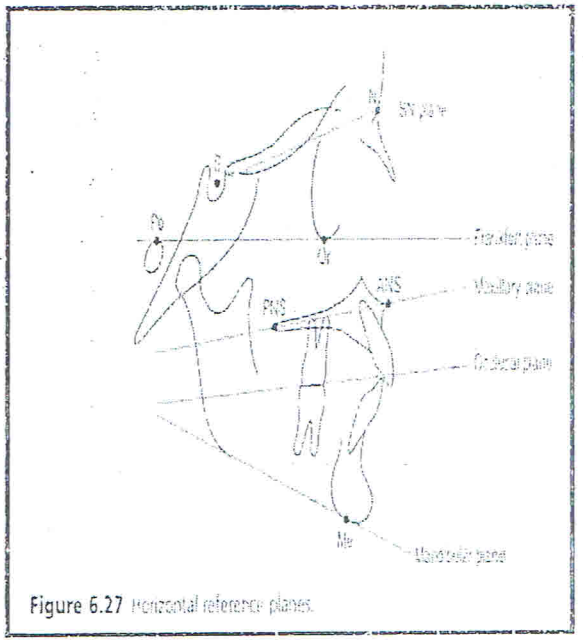


Figure 6.27 Horizontal reference planes.

SKELETAL PARAMETERS

Assessing the anteroposterior skeletal relationship:

- The ANB angle

  This method was first described as part of a cephalometric analysis proposed by Richard Riedel and relates the maxilla and mandible to the anterior cranial base (Riedel, 1952). The SN plane represents the anterior cranial base, whilst points A and B represent the anterior surfaces of the maxillary and mandibular apical bases, respectively (Fig. 6.30):

- The anteroposterior position of the maxilla is calculated by measuring the angle SN to point A (SNA) (81° ± 3°); and

- The anteroposterior position of the mandible is calculated by measuring the angle SN to point B (SNB) (78° ± 3°); I The relative difference in the anteroposterior relationship of the maxilla and mandible is measured by the difference between the SNA and SNB angles, or ANB angle

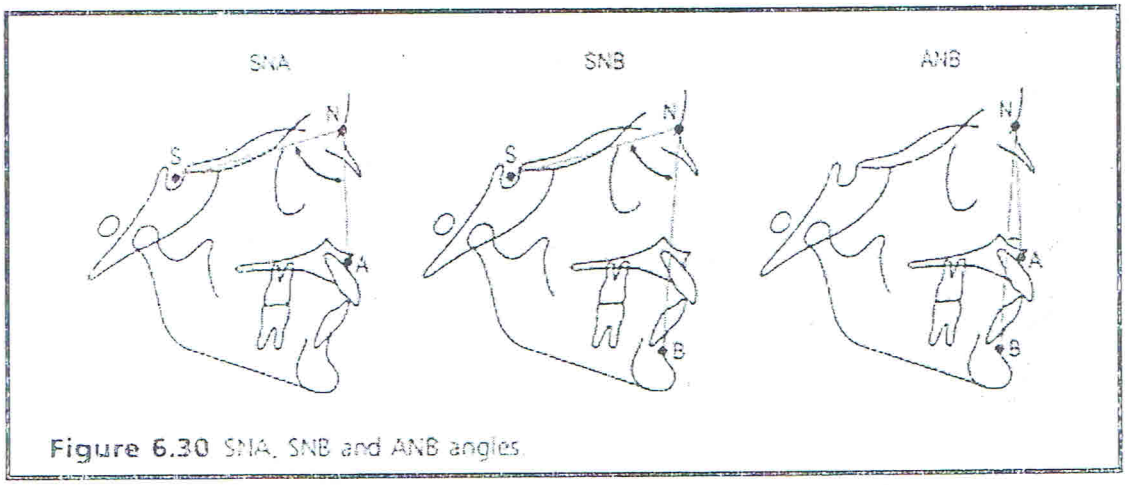


Figure 6.30 SNA, SNB and ANB angles.

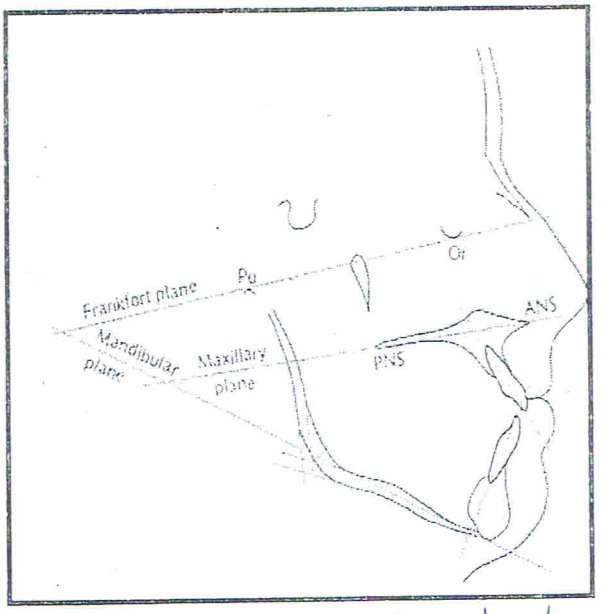
Table 6.3 Classification of anteroposterior skeletal pattern using the ANB angle

Skeletal class	ANB angle
Class I	2–4°
Class II	> 4°
Class III	< 2°

Assessing the vertical skeletal relationship:

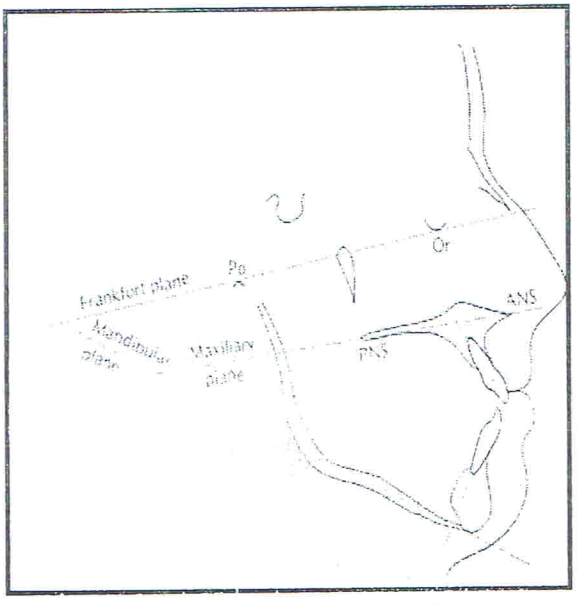
- Maxillary–mandibular plane angle (MMPA)

  The MMPA is a common method for evaluating the vertical jaw relationship, with horizontal reference planes that are easily located. The mean value is 27° ± 5°.

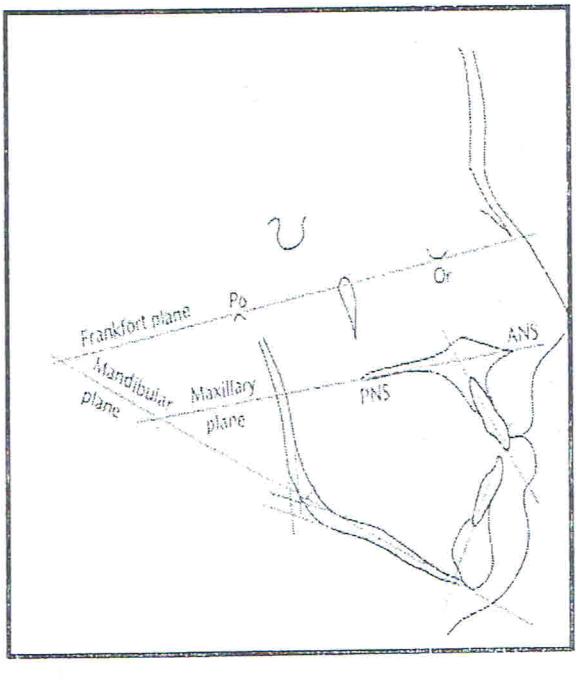


increased vertical growth
decreased " = Deep bite

- Frankfort–mandibular plane angle (FMPA) The FMPA uses the Frankfort plane as a horizontal reference to the mandibular plane. This method ignores the maxillary plane, which if affected by a significant cant can give a misleading value to the vertical jaw relationship.



- High mandibular plane angles occur in both retrusive and protrusive faces and are suggestive of unfavorable hyperdivergent facial patterns or 'long face cases'. The range extends from a minimum of 17° to a maximum of 28° with a mean of 21.9°.



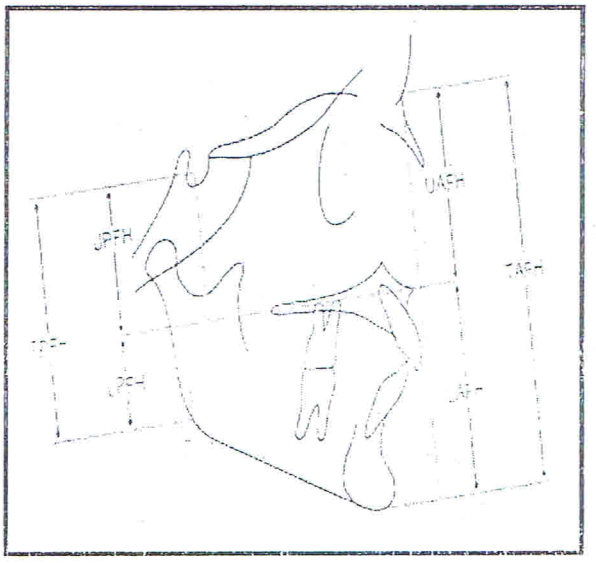
- **Anterior facial heights**

Anterior and posterior face heights are also used as a measure of vertical facial relationships (Fig. 6.35):

- Total anterior face height (TAFH) extends from nasion to menton, with both lines constructed perpendicular to the maxillary plane (mean 119-mm in an adult male).

TAFH is further subdivided into:

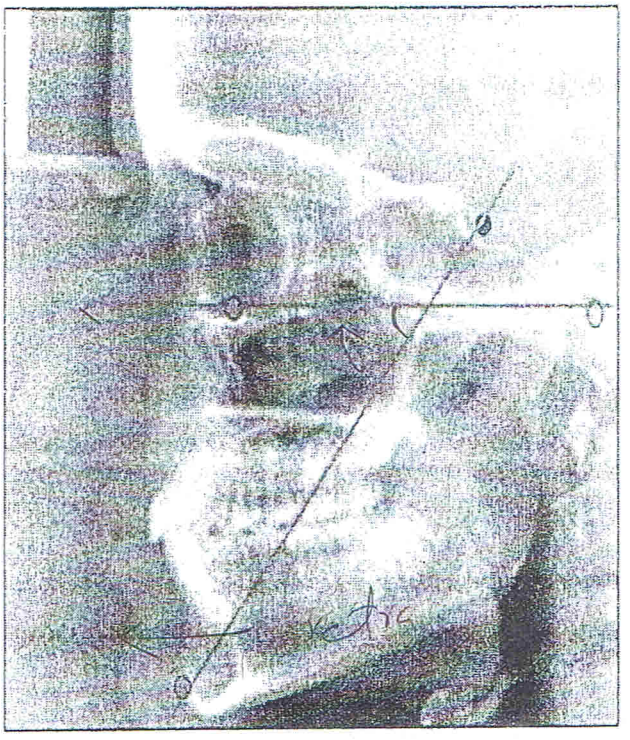
- Upper anterior face height (UAFH); nasion to maxillary plane (mean 54-mm);
- Lower anterior face height (LAFH); maxillary plane to menton (mean 65-mm); and I The LAFH should be approximately 55% of the TAFH.



Y-(Growth) Axis

The growth axis is measured as an acute angle formed by the intersection of a line from sella turcica to Gnathion with the Frankfort horizontal plane (Fig.9.32E).

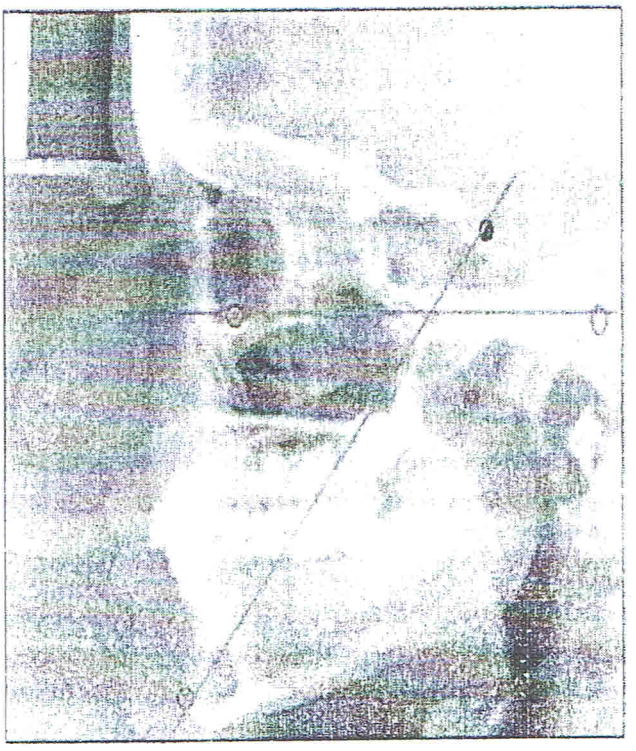
- This angle is larger in Class II facial patterns than in those with Class III tendencies. It indicates the degree of downward, rear ward or forward position of the chin in relation to the upper face.
- A decrease of the Y-axis in serial radiographs may be interpreted as a greater horizontal than vertical growth of the face or a deepening of the bite in orthodontic cases.



- Y-(Growth) Axis

- An increase in the Y-axis is suggestive of vertical growth exceeding horizontal growth of the mandible or an opening of the bite during orthodontic treatment.
- The Y-axis reading also increases with the extrusion of the molars (this is generally desirable when correcting malocclusions in horizontal growers.

  The range extends from a minimum of 53° to a maximum of 66° with a mean reading of 59.4°.



DENTAL PARAMETERS

- Assessing the dental relationship Several methods of assessment are available for positioning the maxillary and mandibular dentition in relation to the jaws and face.
- **Maxillary incisor relationship**

  The inclination of the most prominent maxillary incisor is constructed using a line through UI and measured in relation to the maxillary plane (Fig. 6.36). The mean value is 109° ± 6°.

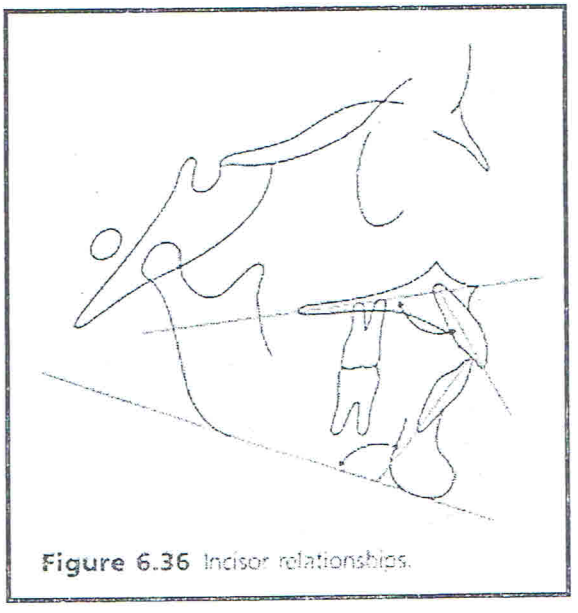


Figure 6.36 Incisor relationships.

- **Mandibular incisor relationship**

The inclination of the most prominent mandibular incisor is constructed using a line through LI and measured in relation to the mandibular plane (Fig. 6.36). The mean value is 93° ± 6°;

incisor proclination 100°

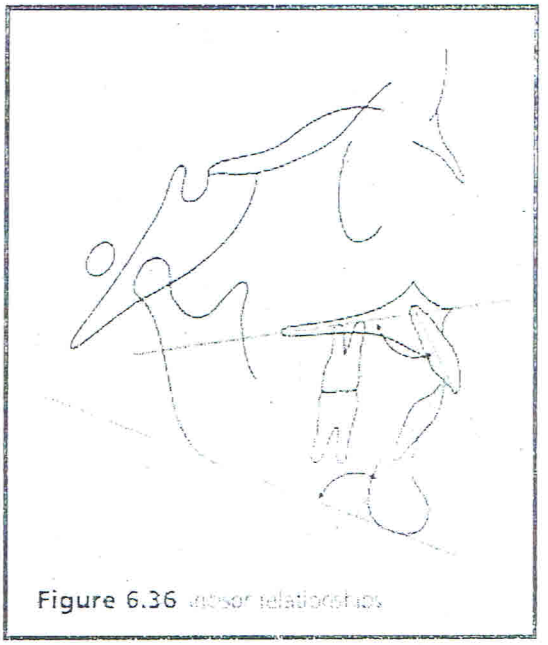


Figure 6.36 Incisor relationships

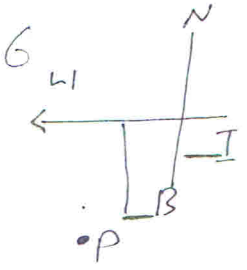
- **Interincisal angle**

The angle formed between the most prominent maxillary and mandibular incisors. The inter-incisal angle is established by passing a line through the incisal edge and the apex of the root of the maxillary and mandibular central incisors The mean value is 135° ± 10°.

bimaxillary proclination 100°

- **Lower Incisor to Chin**

The chin forms one of the most important landmarks on the profile. According to studies conducted by Holdaway, the distance between the labial surface of the lower incisor to the N-B line and the distance from Pogonion to the N-B line should be equal (i.e., 4 mm) (Fig. 9.33I). A 2 mm discrepancy between these measurements is acceptable; a 3 mm is less desirable, but tolerable. If the difference between these dimensions exceeds 4 mm, however, corrective measures are generally indicated.

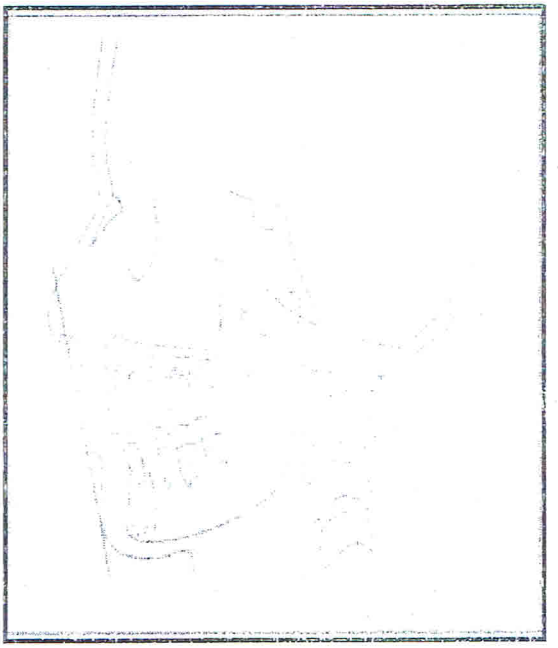


THE SOFT TISSUE ANALYSIS

- The analysis laid emphasis on the soft tissue profile as well as the underlying skeletal structure. The profile was mainly affected by the chin, nose and the lips. The shape and posture of the lips is partially governed by the underlying dentition and thus can be modified orthodontically. The thickness of the tissue over the symphysis and the nasal structure also contributes to the prominence of the lower face and attention should be paid to the same when as it may camouflage the underlying malocclusion.

Steiner's S-line

- According to Steiner, the lips in well balanced faces, should touch a line extending from the soft tissue contour of the chin to the middle of an "S" formed by the lower border of the nose. This line is referred to as the "S-line" (Fig.9.33J). Lips located beyond this line tend to be protrusive in which case the teeth and/or the jaws usually require orthodontic treatment to reduce their prominence. If the lips are positioned behind this line, it is generally interpreted that the patient possesses a "concave" profile. Orthodontic correction usually entails advancing the teeth in the dental arches to protrude the lips to approximate the S-line.



Ricketts' E-line

- Ricketts' E-line is a line drawn from tip of the nose to soft tissue pogonion. The upper lip should be 4-mm and the lower lip 2-mm behind this line. This line is age-related, as the lips tend to become more retrusive with age.