X-Ray Diagnosis

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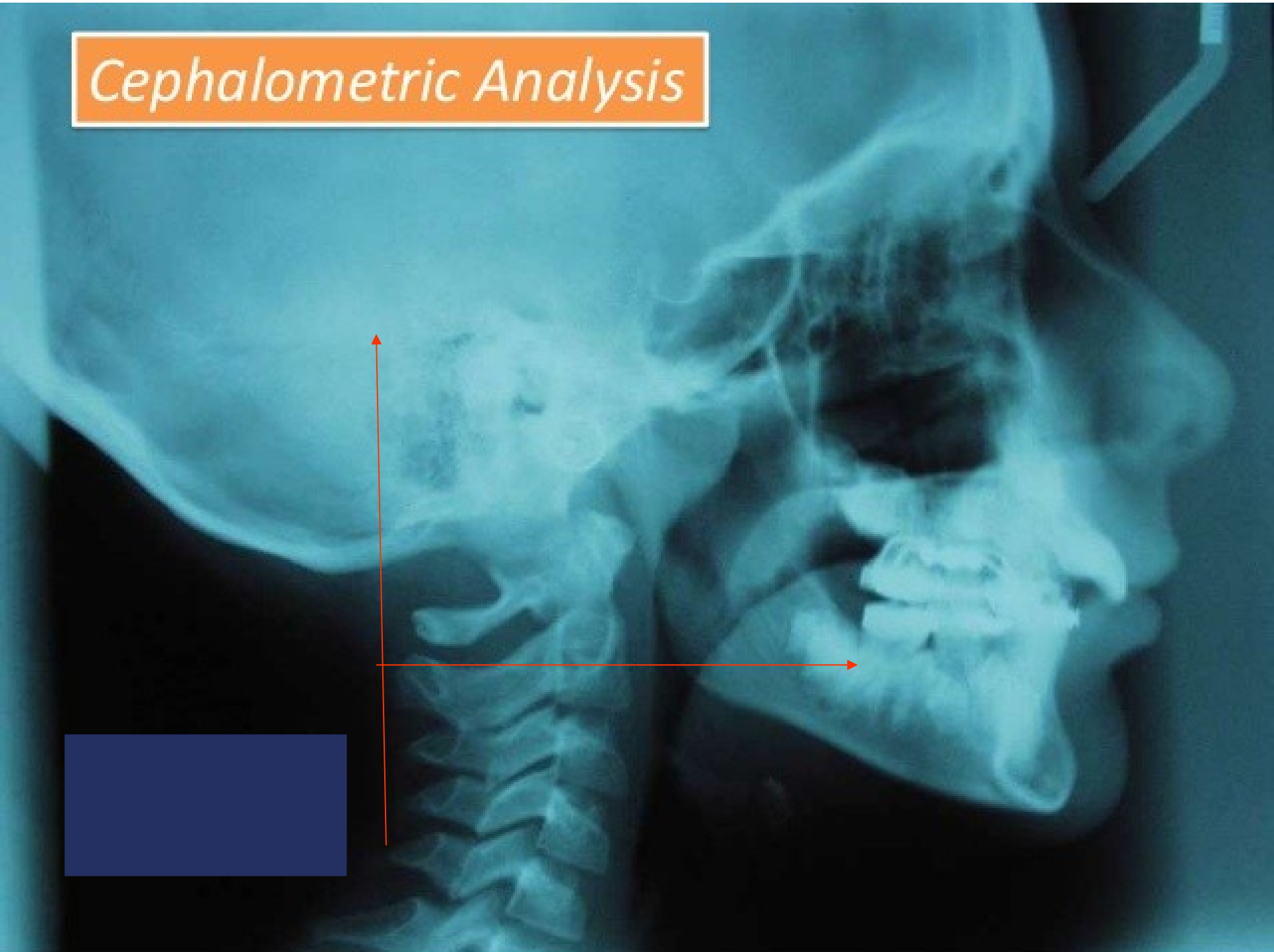
Cephalometric Analysis



X-RAYS USED IN ORTHODONTICS

- Extraoral x-rays
  - Orthopanthomogram
  - Lateral cephalogram
  - (Antero-posterior cephalogram)
  - TMJ (if necessary)
- Intraoral x-rays
  - Periapical x-rays (if necessary)
  - Bitewing x-rays (if necessary to locate the impacted, retained teeth)

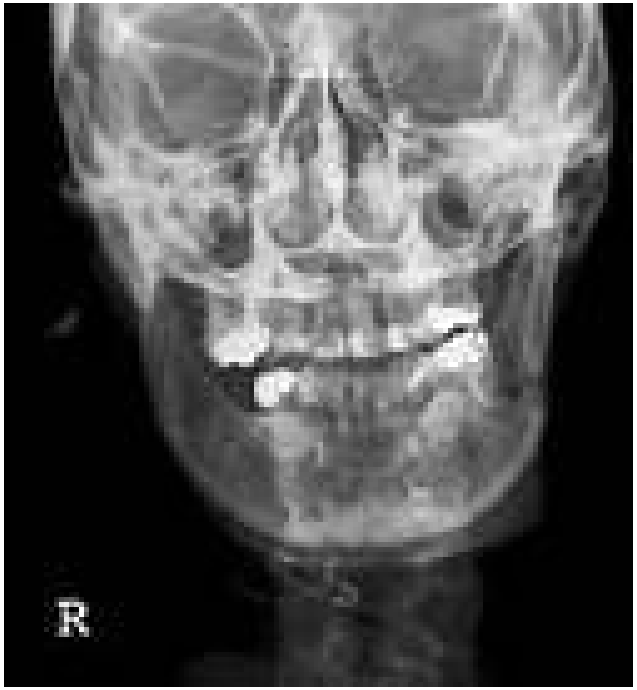
Orthopanthomogram

- To identify general and dental pathology: caries and periodontal deseases
- To localize unerupted teeth (impaction, retention)
- To asses numerical anomalies (aplasia, supernumerary teeth)
- To assess dental development
- To compare the denture before the treatment and after the end of treatment

Limitation: anterior maxillary region is not clearly visible upper anterior occlusal vie

Antero-posterior x-rays

- Rarely used in orthodontics, mostly to examine asymmetry
- Fractures, tumors may also be seen



Rules of taking (lateral) cephalommetric X-rays 1.

- The distance between the head's median-sagittal plane and the focus of the x-ray is 1.5m
- The main beam is perpendicular to the head's median-sagittal plane
- The main beam pass through the two auditory meatus
- The film is parallel to the head's median sagittal plane /15-18 cm/
- Because of the paralell beams the picture is proportional
- The denture is in central occlusion

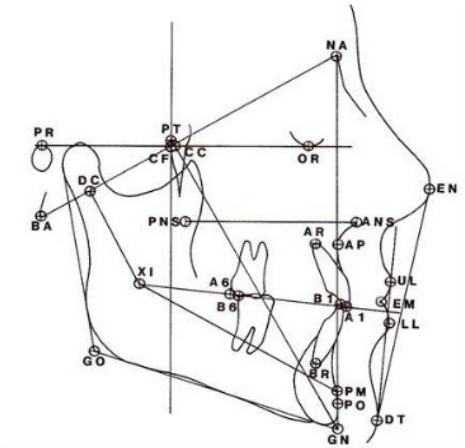
Use of lateral cephalometric

- Diagnosis and treatment planning
- To identify the reason of the anomaly: wether it is a sceletal or dentoalveolar anomaly
- Which part of the craniofacial complex is responsible for the anomaly (which jaw) ?
- Growth forecast
- Estimation of skeletal age by assessing the development of the cervical vertebra
- Monitoring treatment changes (before, during and after treatment)
- Soft tissue analysis
- Audit, documentation, research and teaching

The sequence of the examination

- Visual control of the whole X-ray
- • Superimposing the important landmarks
- • Signs of the anatomical points and lines
- • Measurement of the angles
- • Linear measurements

CC Point (Centre of cranium) :
formed at the intersection of the Ba-N & Pt-Gn(facial axis) lines.



Goal Of Cephalometric Analysis

To evaluate the relationships, both sagittally & vertically, of the five major components of face:

1. the cranium & cranial base
2. the skeletal maxillae
3. the skeletal mandible

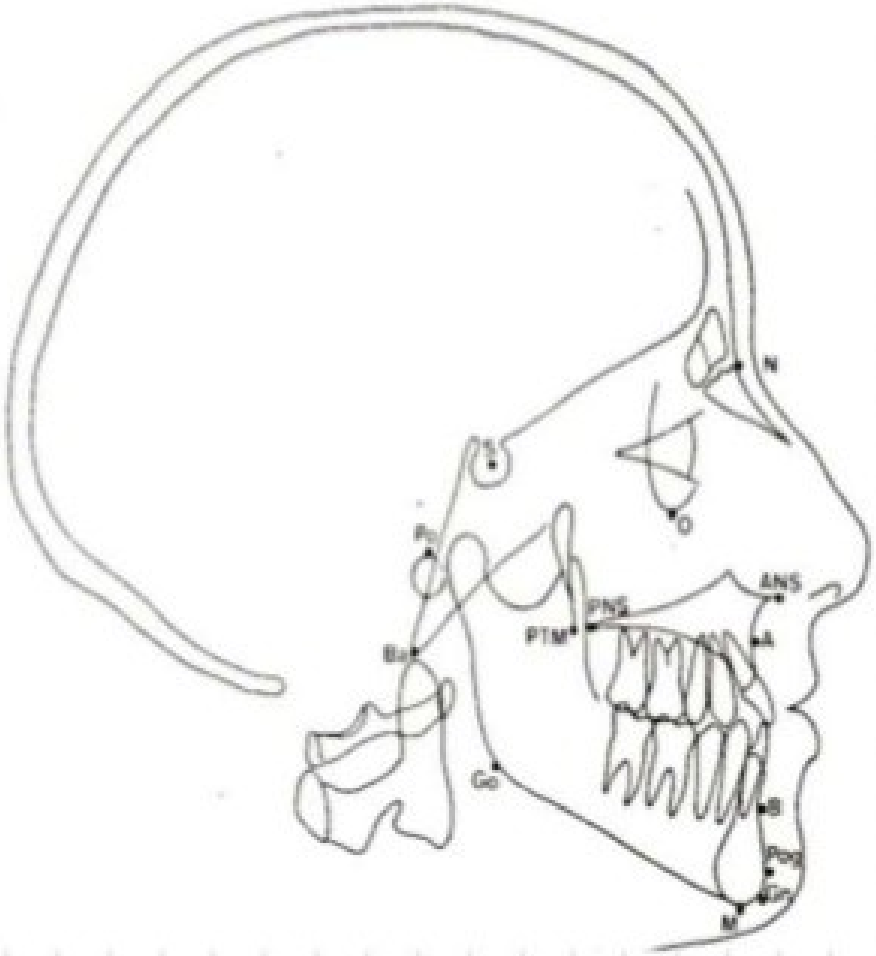
} related to the basis of the skull and to each-other, in the vertical and sagittal dimension

4. the maxillary dentition and alveolar process
5. the mandibular dentition and alveolar process
6. Soft tissue analysis – face harmony
7. Growth analysis

i.e to estimate the relationships, sagittally & horizontally, of the jaws to the cranial base & to each other & the relationship of the teeth to their surrounding bone.

A Quick Revision

Hasund, Steiner – Hasund based on Steiner analysis



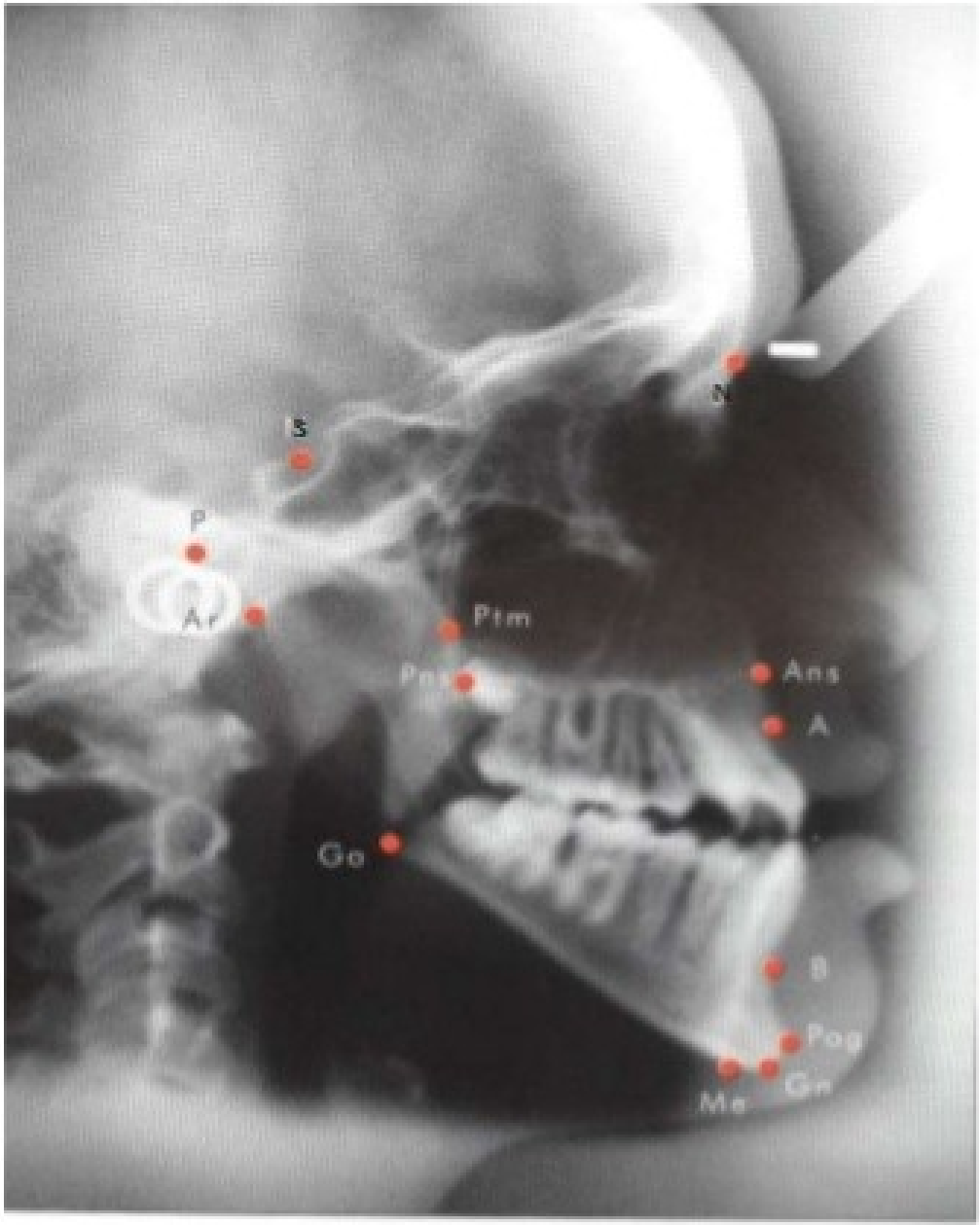


Fig 3 (A) Important lateral cephalometric landmarks identified on the lateral cephalogram

Hasund, Steiner

Basion (Ba)-The most inferior posterior point in the sagital plane on the anterior rim of the foramen magnum

Posterior nasal spine (PNS)-The most posterior point on the bony hard palate in the sagital plane

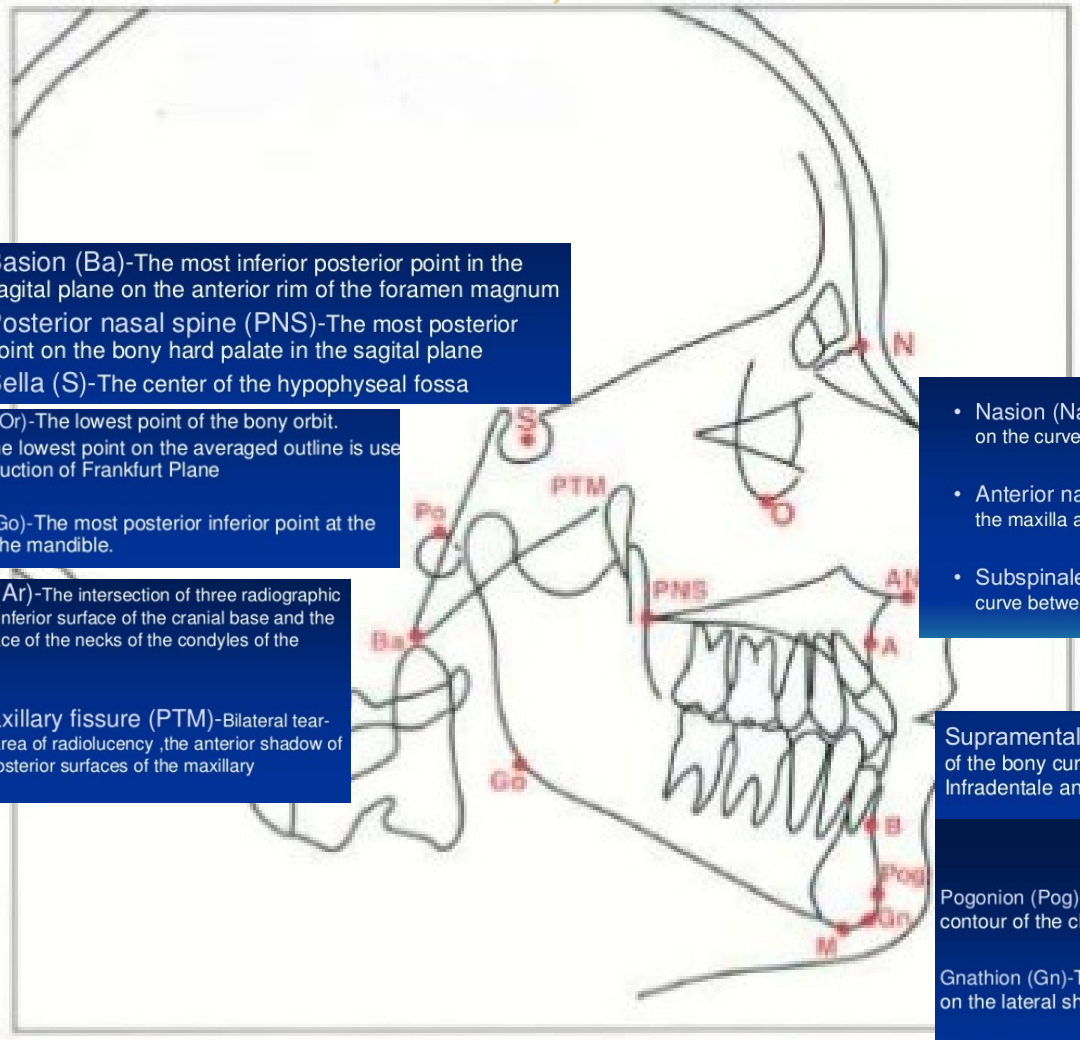
Sella (S)-The center of the hypophyseal fossa

Orbitale (Or)-The lowest point of the bony orbit. Usually the lowest point on the averaged outline is use for construction of Frankfurt Plane

Gonion (Go)-The most posterior inferior point at the angle of the mandible.

Articulare (Ar)-The intersection of three radiographic shadows :the inferior surface of the cranial base and the posterior surface of the necks of the condyles of the mandible

Pterygomaxillary fissure (PTM)-Bilateral tear-drop shaped area of radiolucency ,the anterior shadow of which is the posterior surfaces of the maxillary tuberosities



- Nasion (Na)- frontonasal suture at its most superior point on the curve at the bridge of nose
- Anterior nasal spine (ANS)-the most anterior point on the maxilla at the level of the palate
- Subspinale("A" point)-the most posterior point on the curve between ANS and superior Prosthion

Supramentale ("B" point)-The most posterior point of the bony curvature of the mandible below Infradentale and above Pogonion .

Pogonion (Pog)-the most anterior point on the contour of the chin

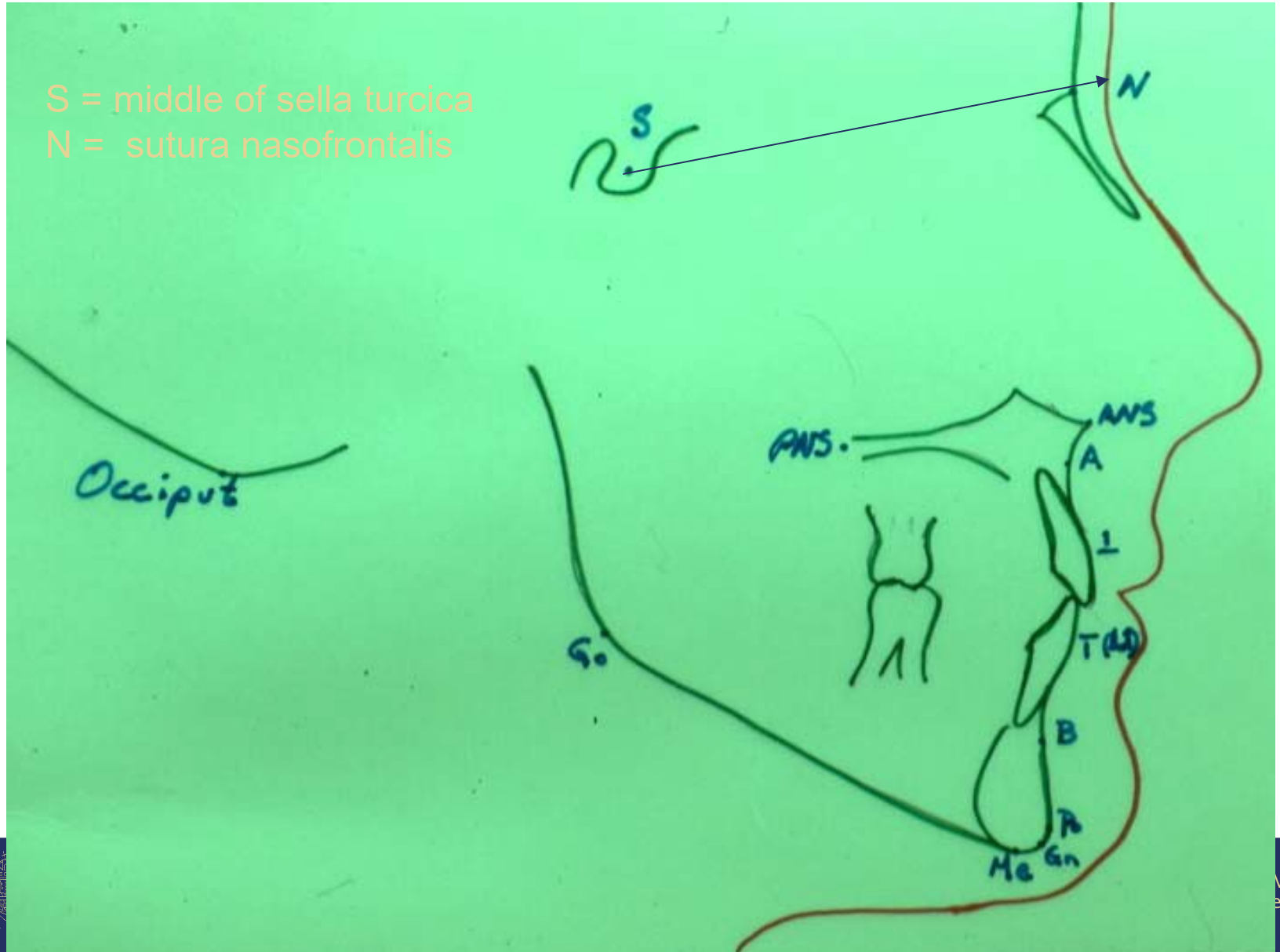
Gnathion (Gn)-The most anterior inferior point on the lateral shadow of the chin

Menton (Me)-The lowest point on the symphyseal outline of the chin

Fig 6–1 Traditional lateral cephalometric headfil… marks used with Steiner analysis.

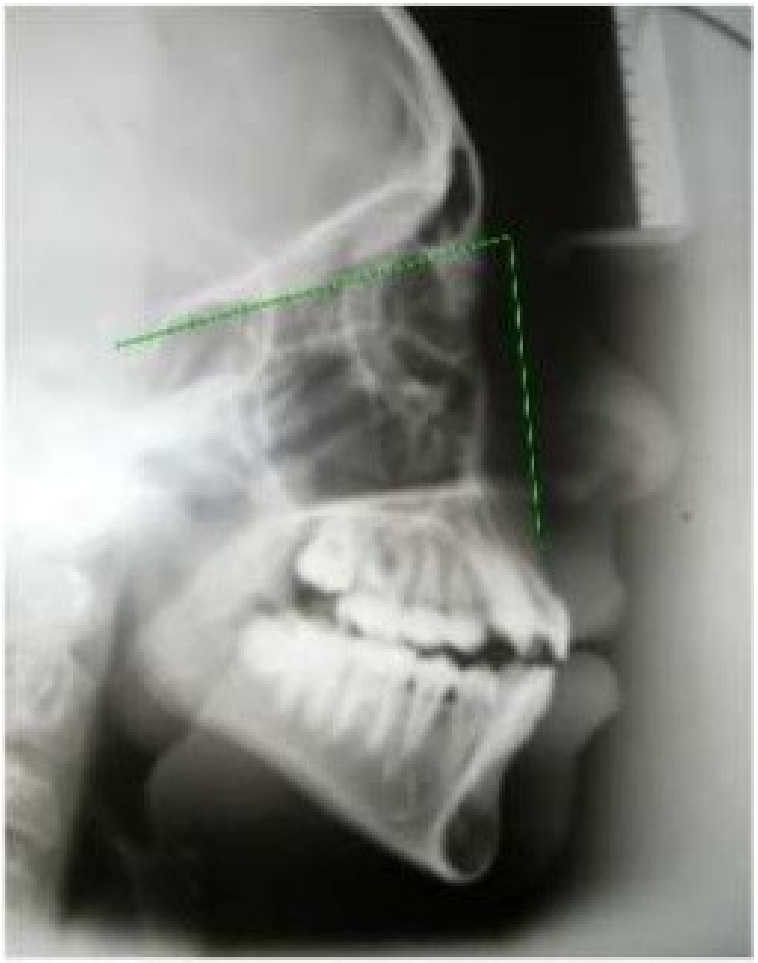
SN line is the anterior cranial base

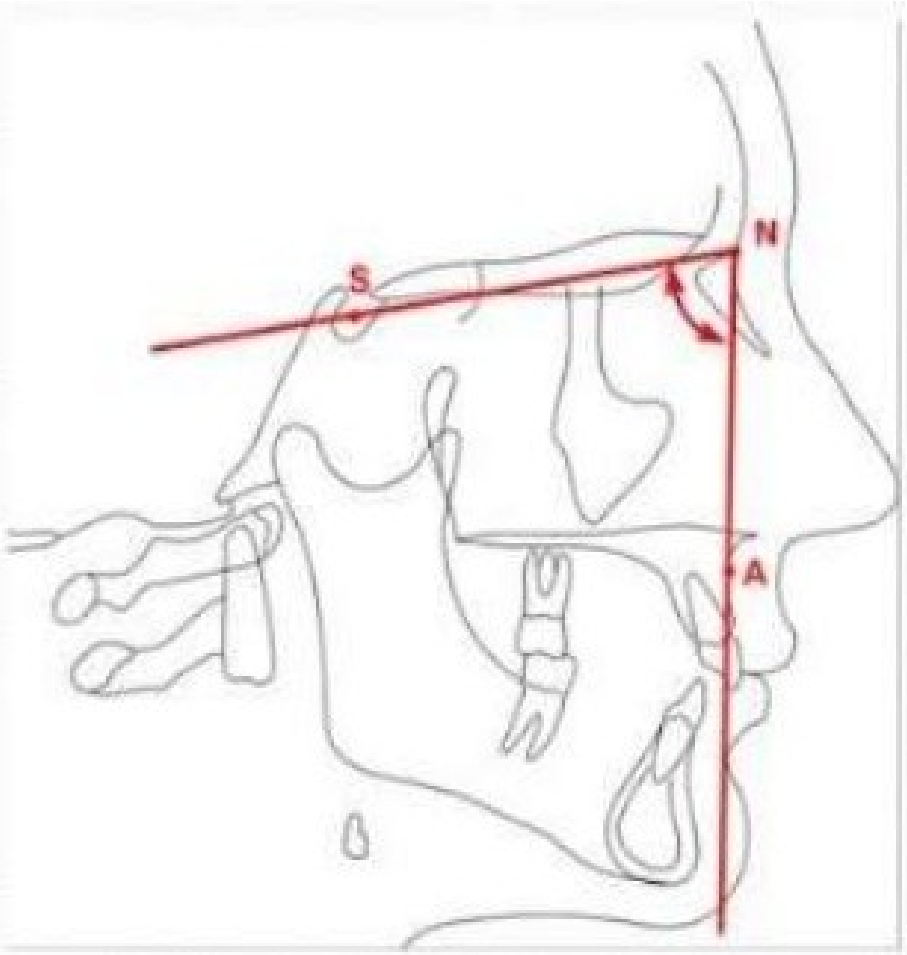
(used as reference line) Hasund, Steiner



Skeletal: SNA angle

Hasund, Steiner

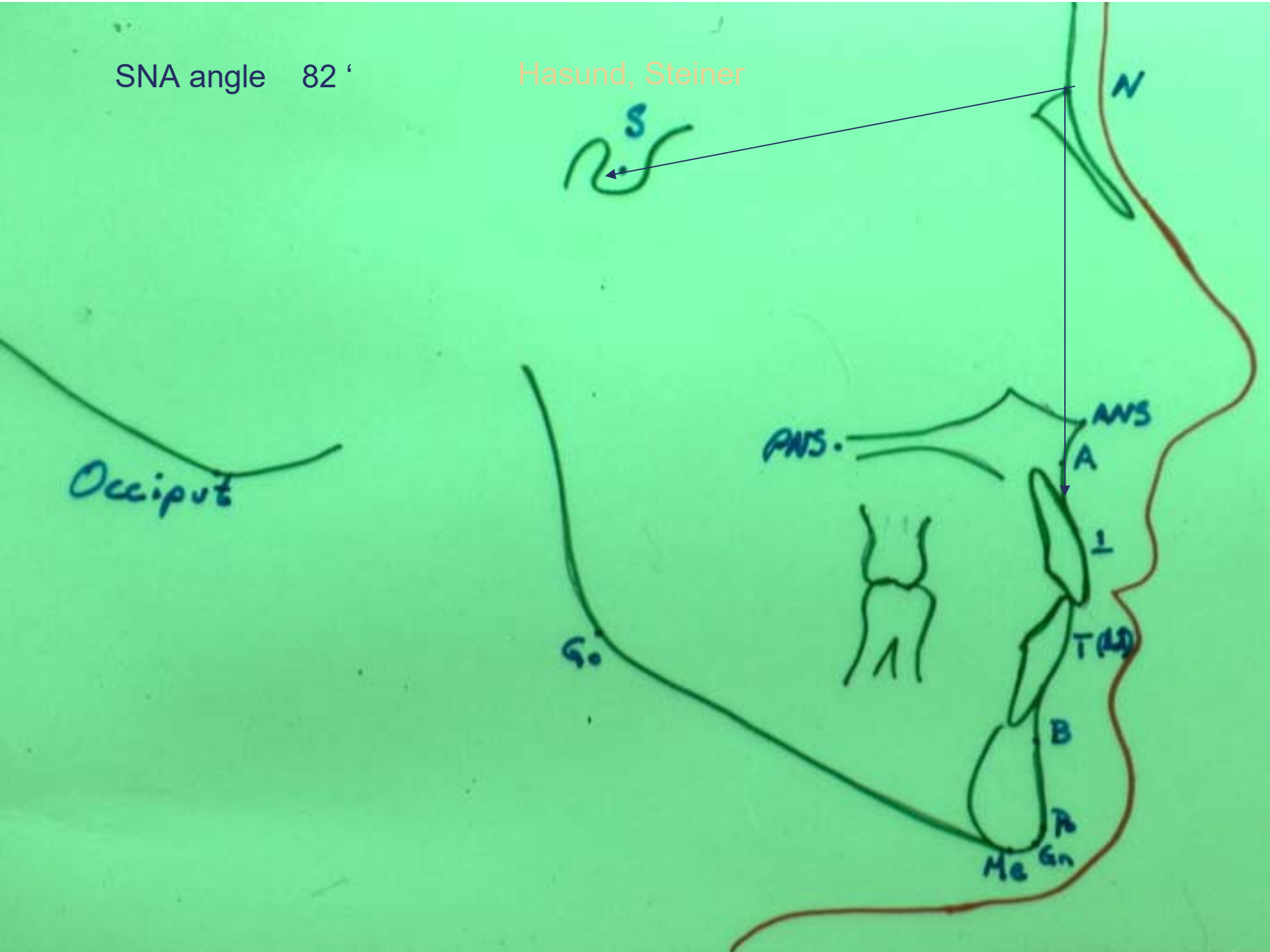




SNA is used to assess the anteroposterior position of maxilla relative to anterior cranial base.

SNA angle 82 ‘

Hasund, Steiner



Skeletal: SNA angle

Hasund, Steiner

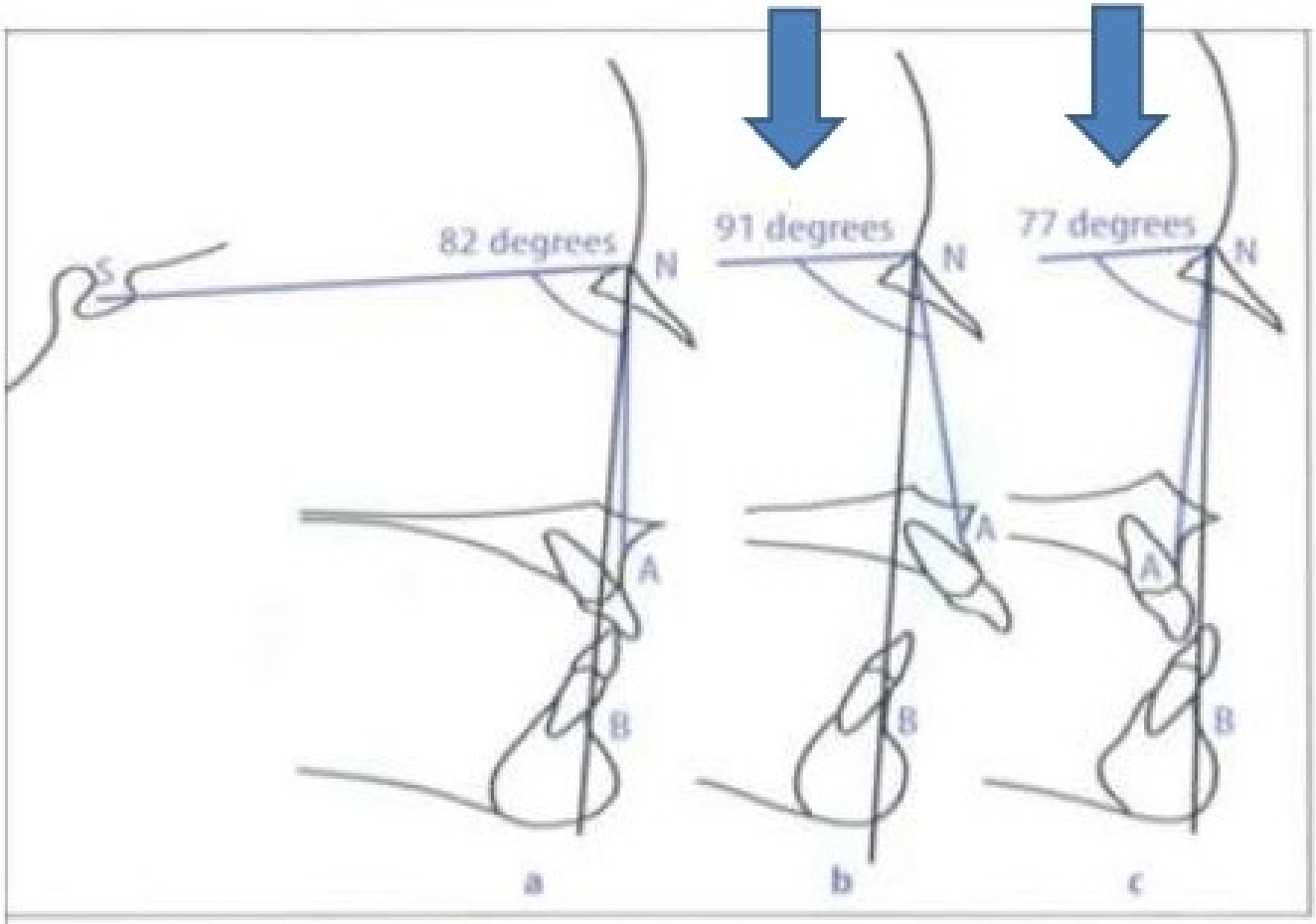
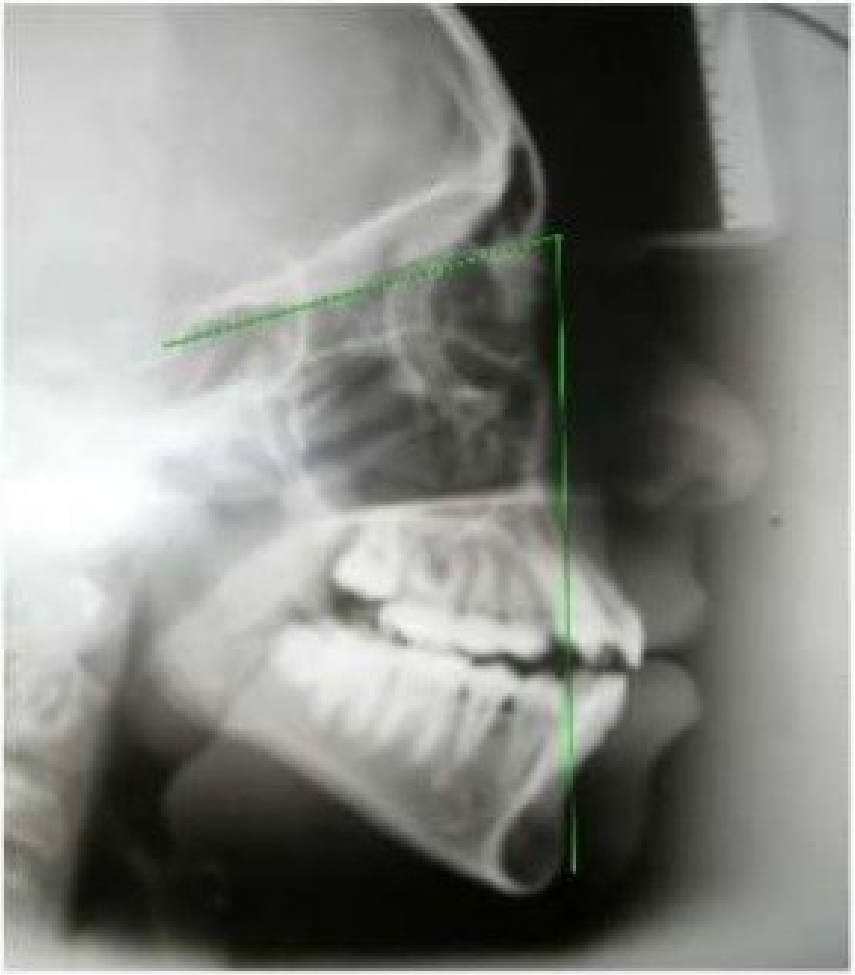
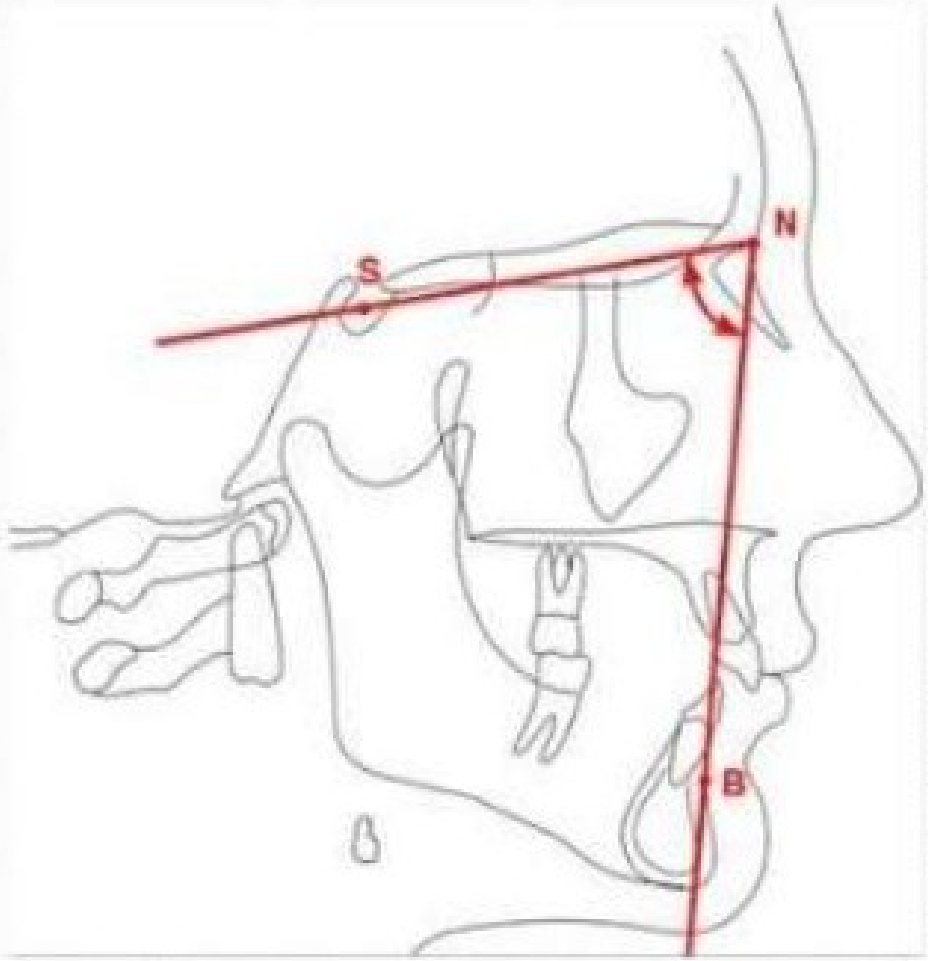


Fig 7-3 SNA angle. *(a)* The mean SNA reading is 82 degrees. *(b)* An SNA angle of 91 degrees suggests a protrusive maxilla. *(c)* An SNA angle of 77 degrees suggests a recessive maxilla.

Skeletal: SNB angle

Hasund, Steiner





SNB is used to assess the anteroposterior position of mandible relative to anterior cranial base.

Hasund, Steiner

Skeletal: SNB angle

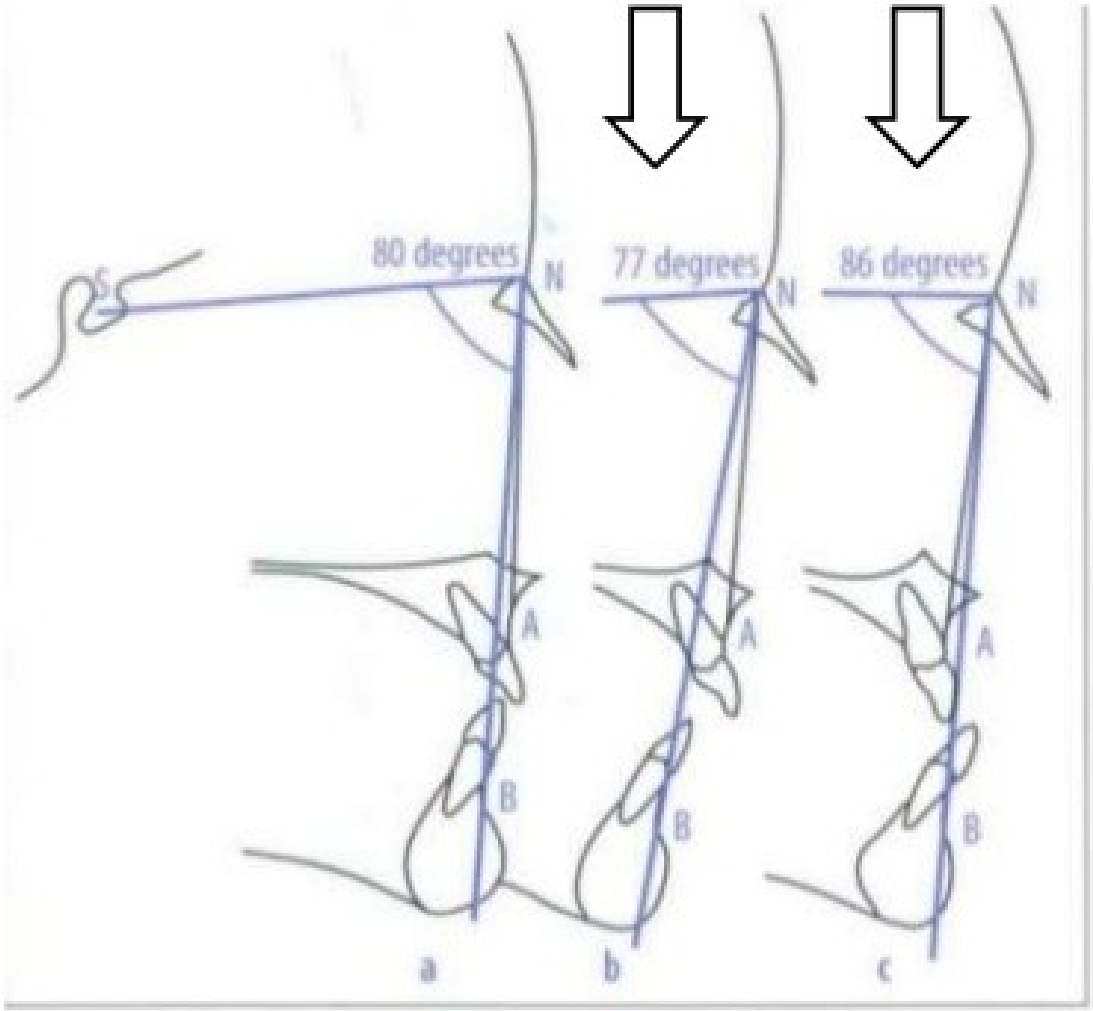
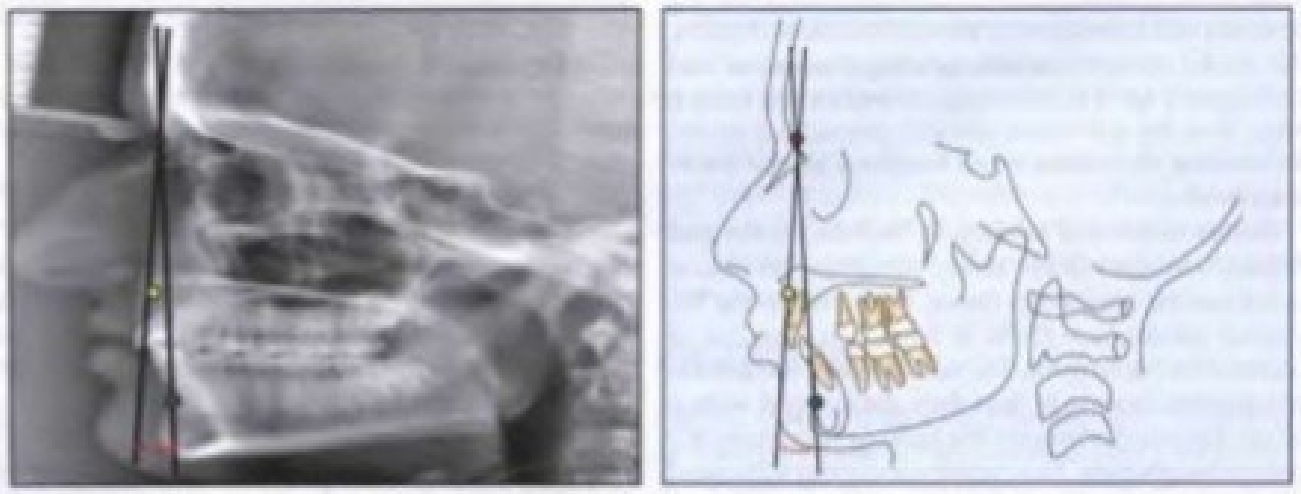


Fig 7-4 SNB angle. *(a)* The mean SNB reading is 80 degrees. *(b)* An SNB angle of 77 degrees suggests a recessive mandible. *(c)* An SNB angle of 86 degrees suggests a protrusive mandible.

Skeletal: ANB angle



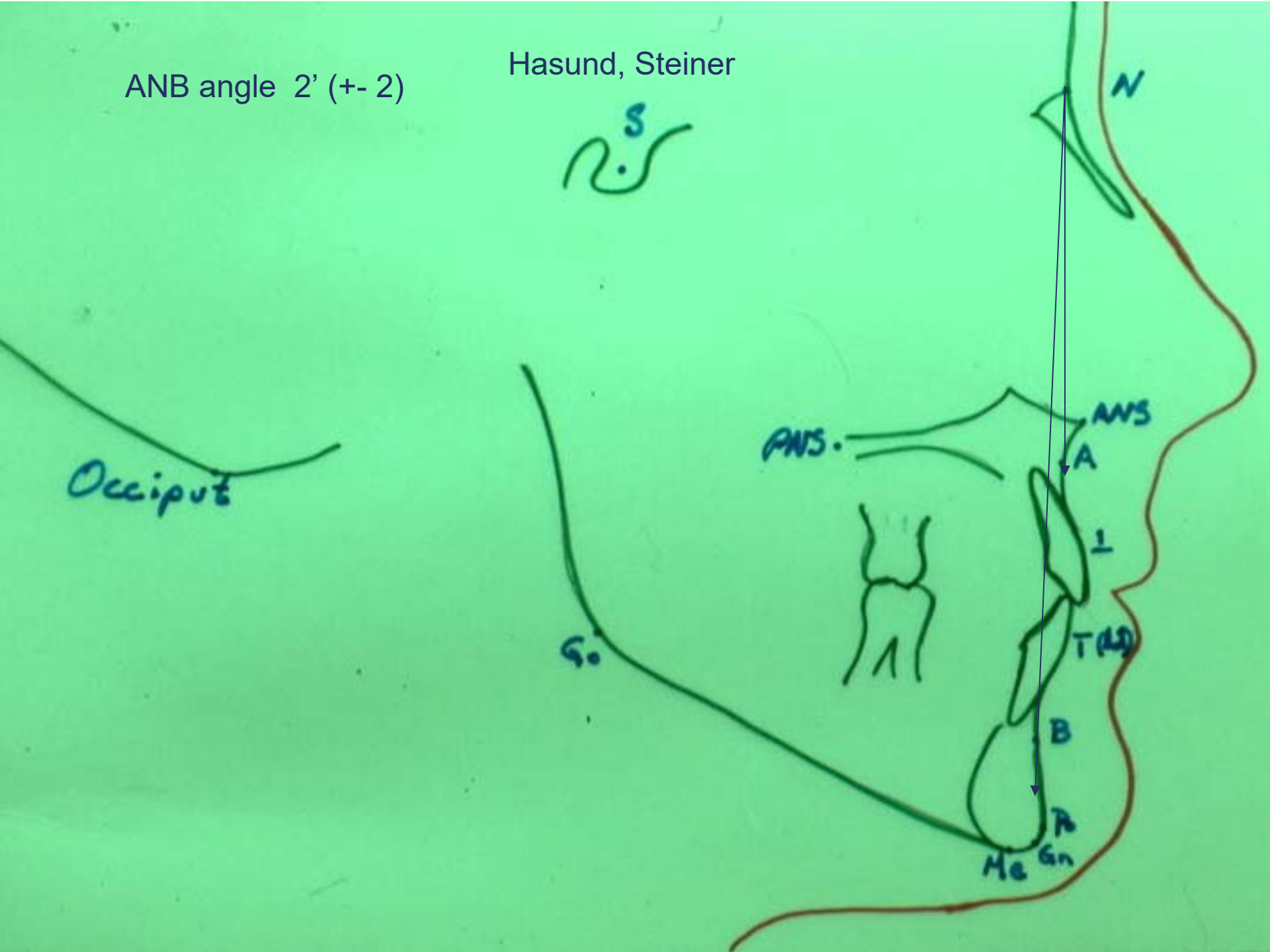
ANB angle indicates magnitude of the discrepancy between the maxilla and mandible.

Hasund, Steiner

- ANB angle tell us only about "magnitude of the discrepancy between the jaws (maxilla and mandible)" not the absolute discrepancy.
- If treatment is based on obtaining the ideal ANB angle of 2^{o} **it may not necessarily obtain the ideal position of either the maxilla or mandible.**

ANB angle 2’ (+- 2)

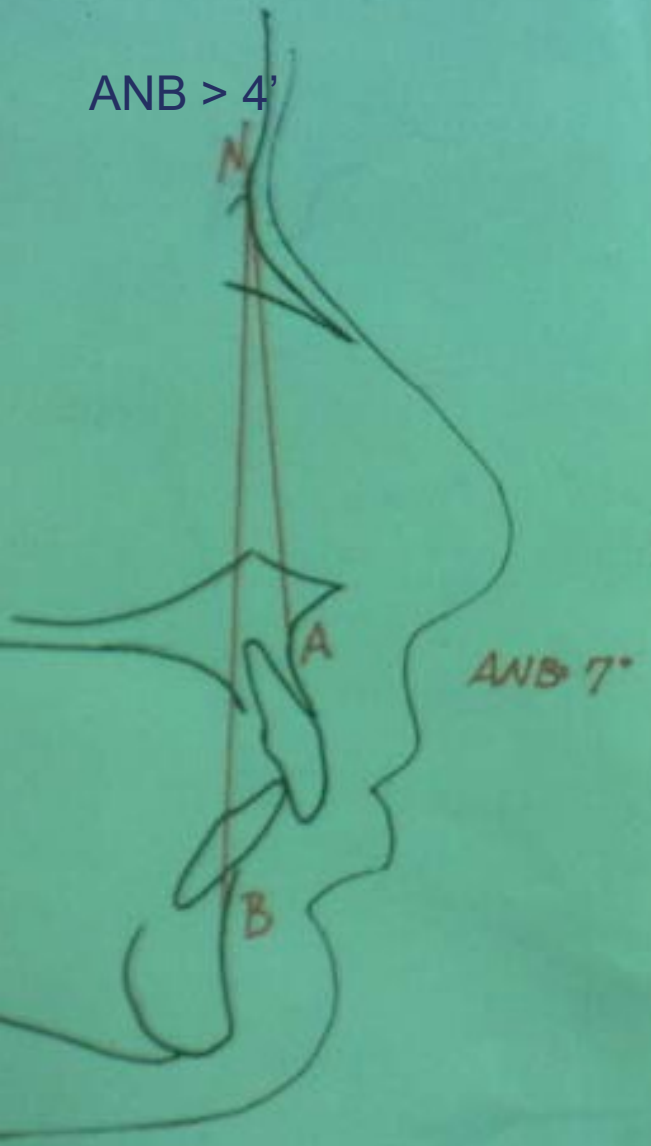
Hasund, Steiner



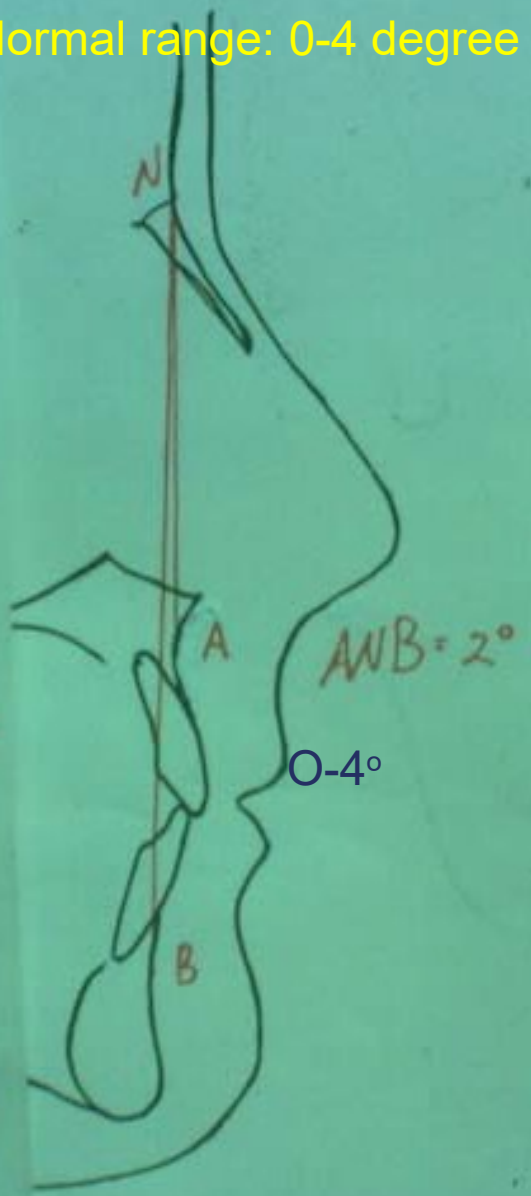
Hasund, Steiner

Distocclusion

ANB > 4’



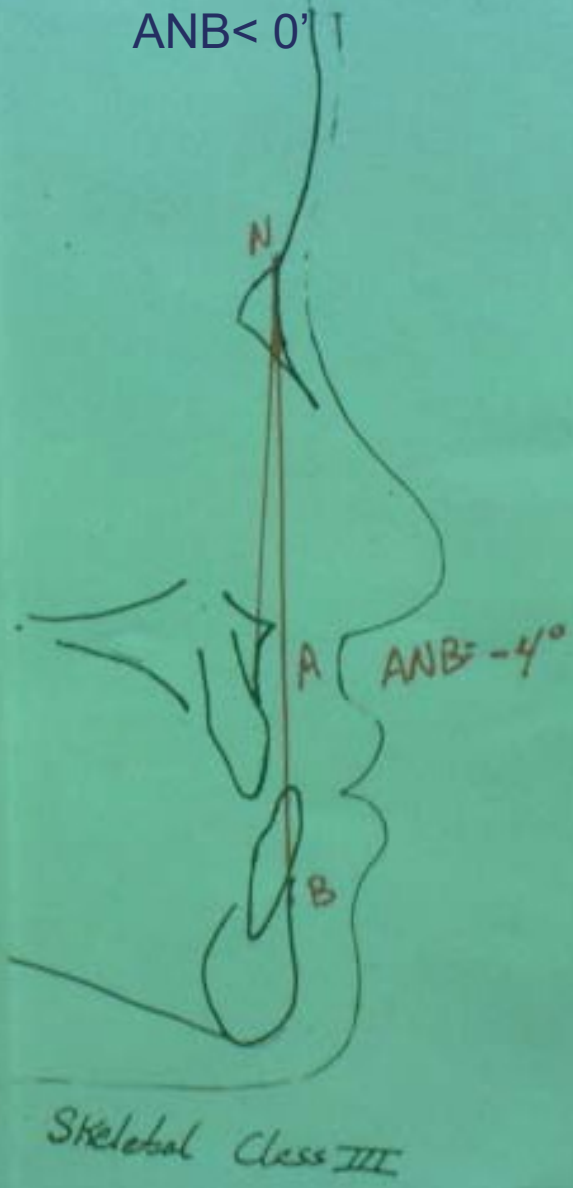
Normal range: 0-4 degree



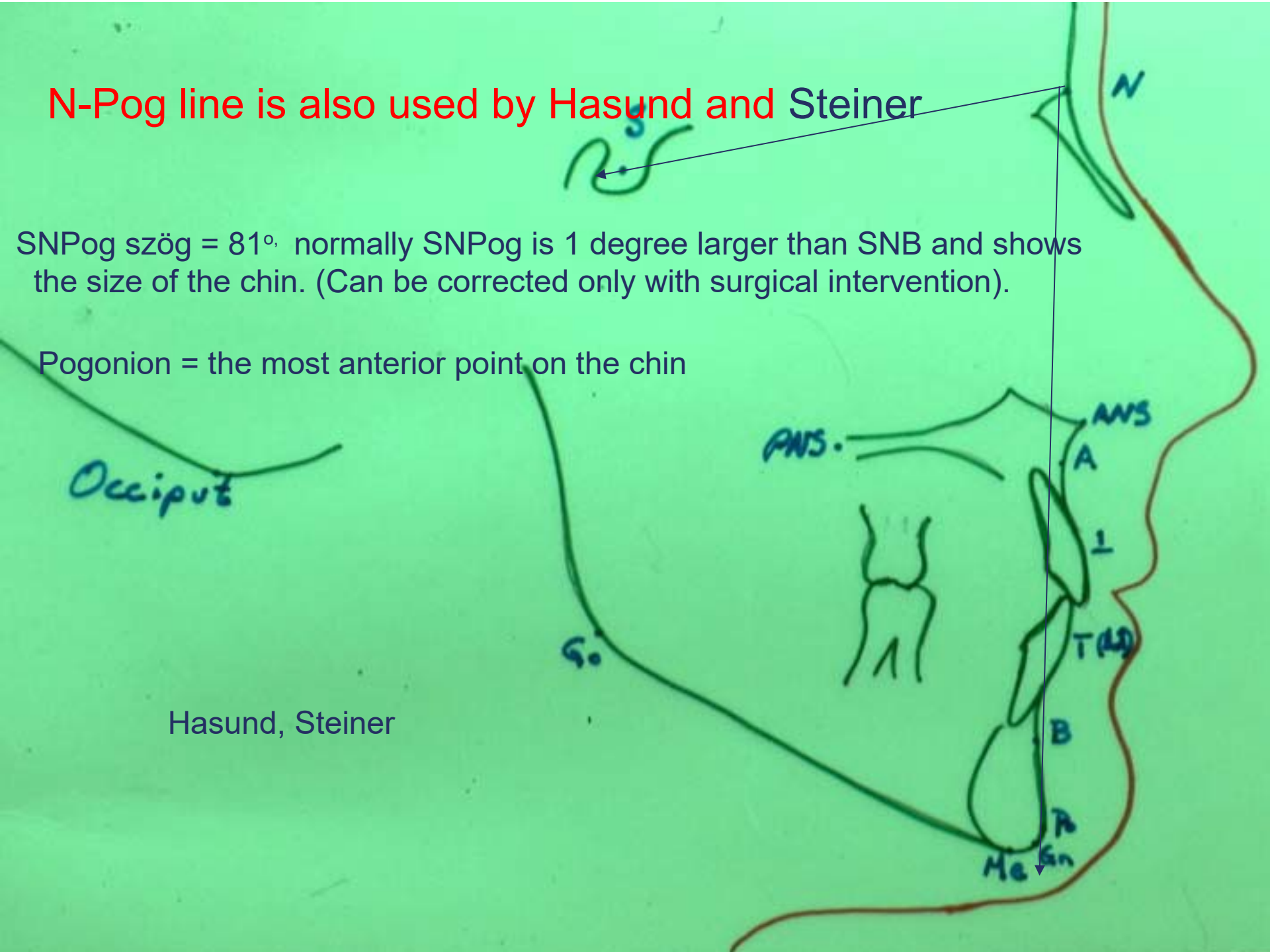
O-4°

Mesiocclusion

ANB< 0’



N-Pog line is also used by Hasund and Steiner



SNPog szög = 81°, normally SNPog is 1 degree larger than SNB and shows the size of the chin. (Can be corrected only with surgical intervention).

Pogonion = the most anterior point on the chin

Hasund, Steiner

Line of maxillary base – NL = nasal line (vertical !!)

1. Spina nasalis anterior – spina nasalis posterior
2. Spina nasalis anterior - pterygomaxillare

Hasund, Steiner

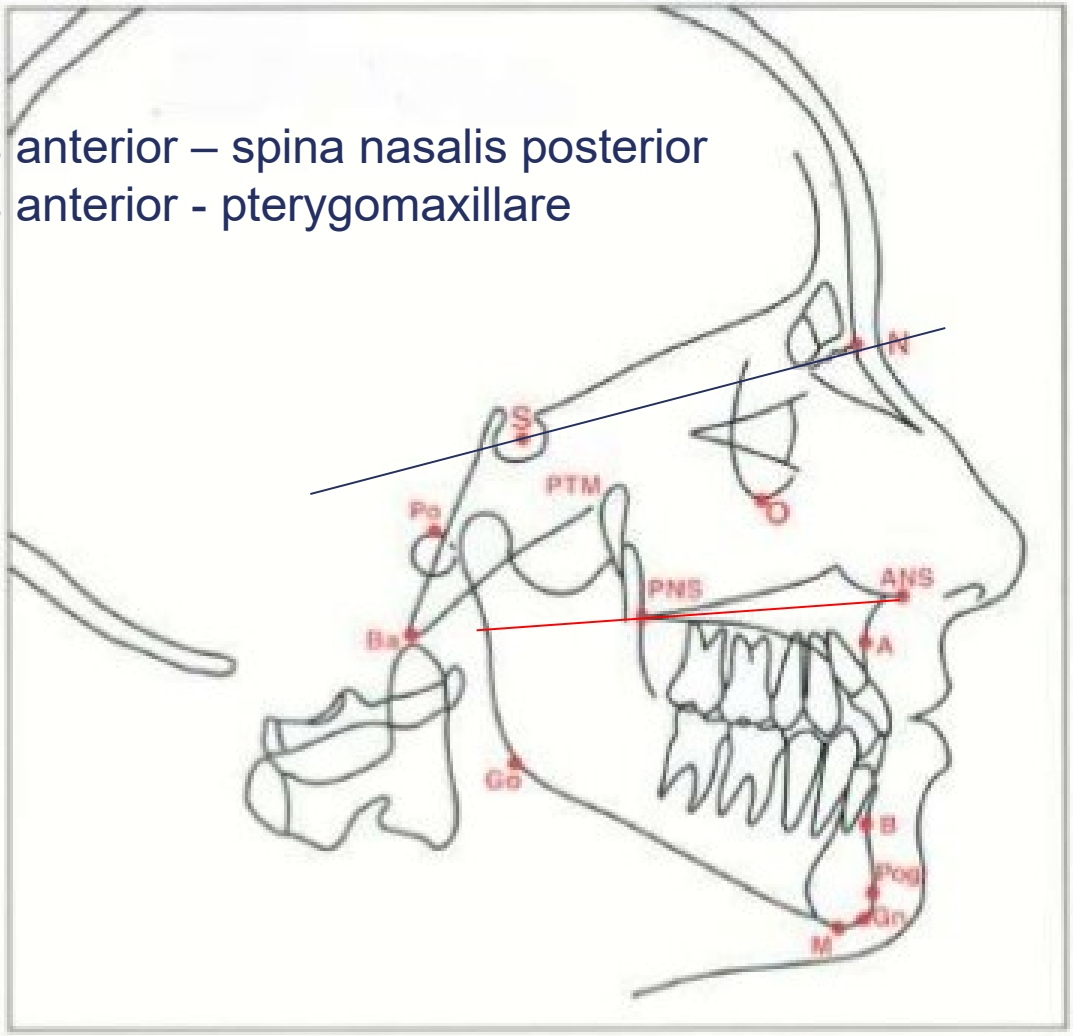
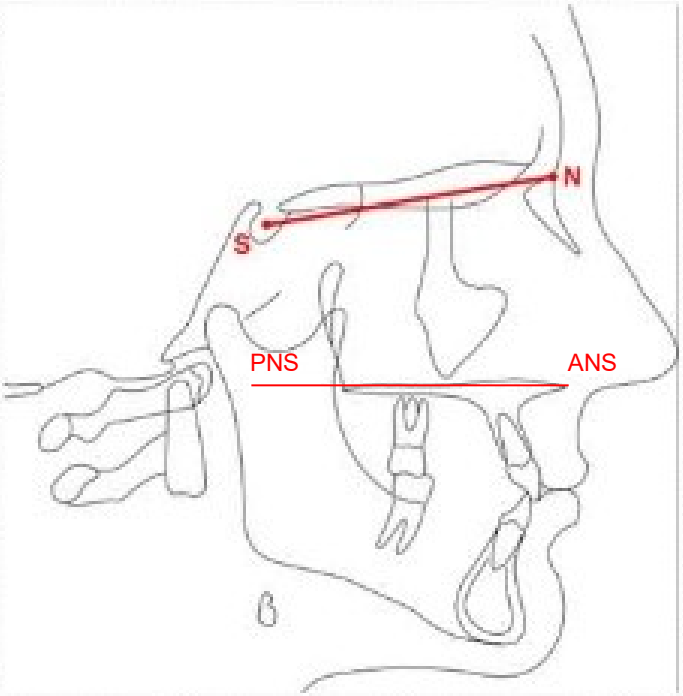


Fig 6–1 Traditional lateral cephalometric headfilm landmarks used with Steiner analysis.

The relationship between the skull and the maxilla in the vertical dimension (Hasund, Steiner)

Sella-Nasion line --- Maxillary base (NL)

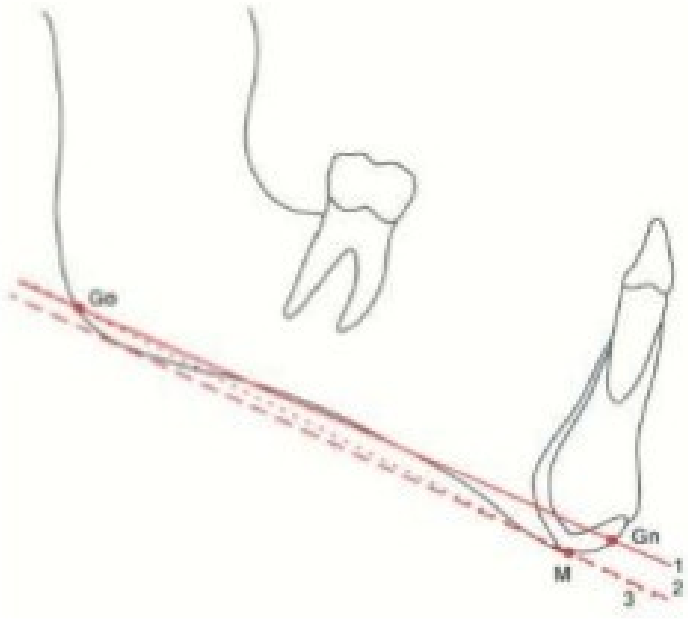
Normal 8-10 °



Hasund, Steiner

Skeletal: MP (mandibular plane) angle

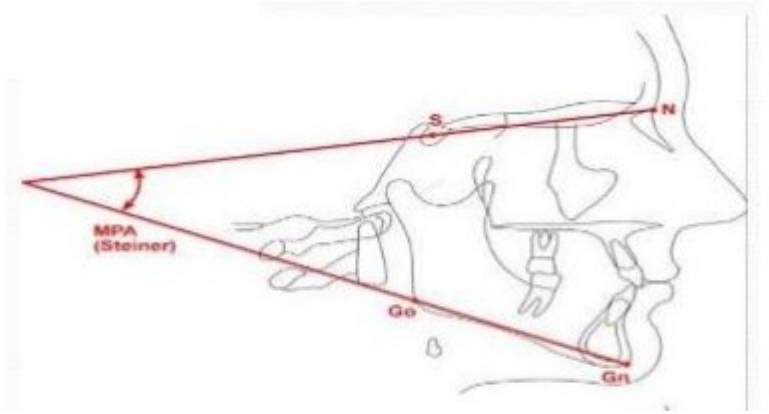
ML = base of the mandible



Hasund, Steiner

Fig 5–8 Various methods of constructing the mandibular plane: 1, as a plane joining gonion and gnathion; 2, as a plane joining gonion and menton; 3, as a tangent to the lower border of the mandible and menton (Downs). (Adapted from Graber TM. Reports on the first workshop in roentgenographic cephalometrics. In Saltzmann JA: Proceedings of the Second Research Workshop Conducted by the Special Committee of the American Association of Orthodontics. Philadelphia: J B Lippincott; 1961. Used with permission.)

Vertical position of maxilla
SN line – Go,Gn (base of mandible)



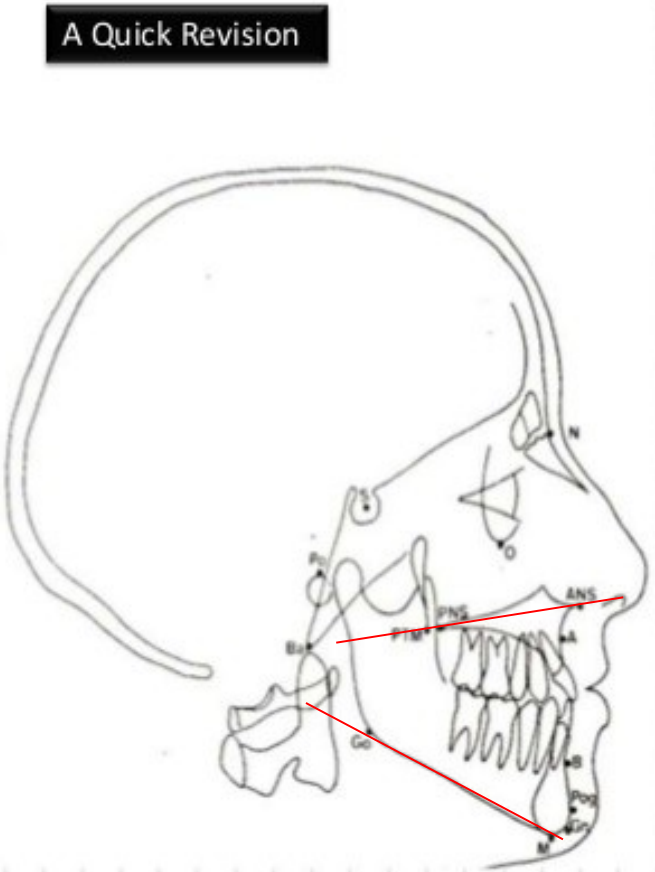
Hasund, Steiner

Normal value: 32°

The angle between the mandible and maxilla

24º

Hasund, Steiner



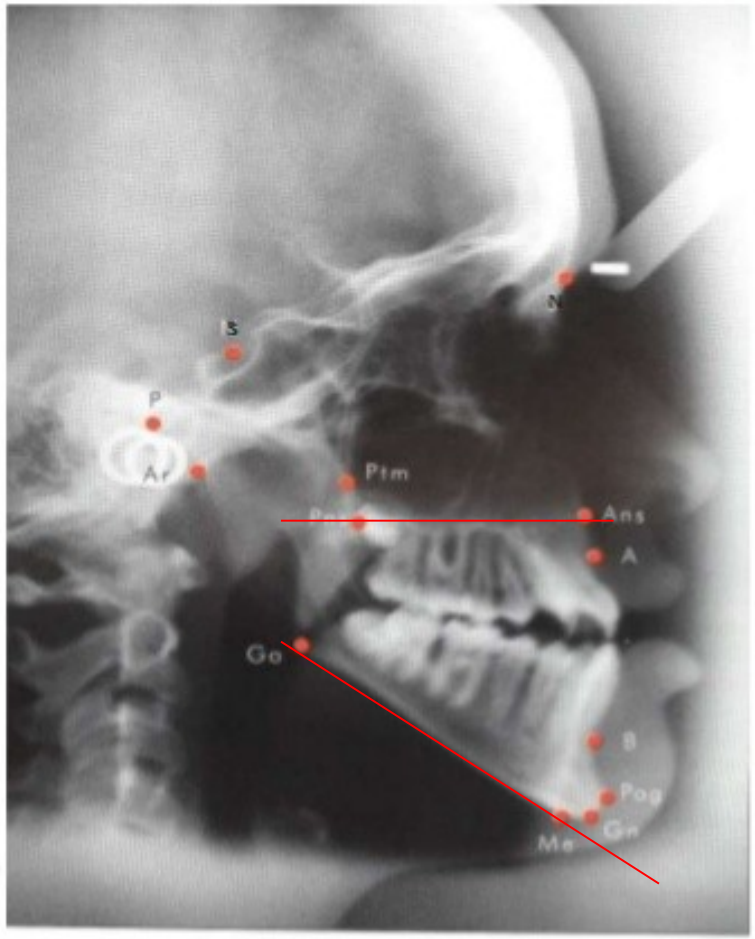
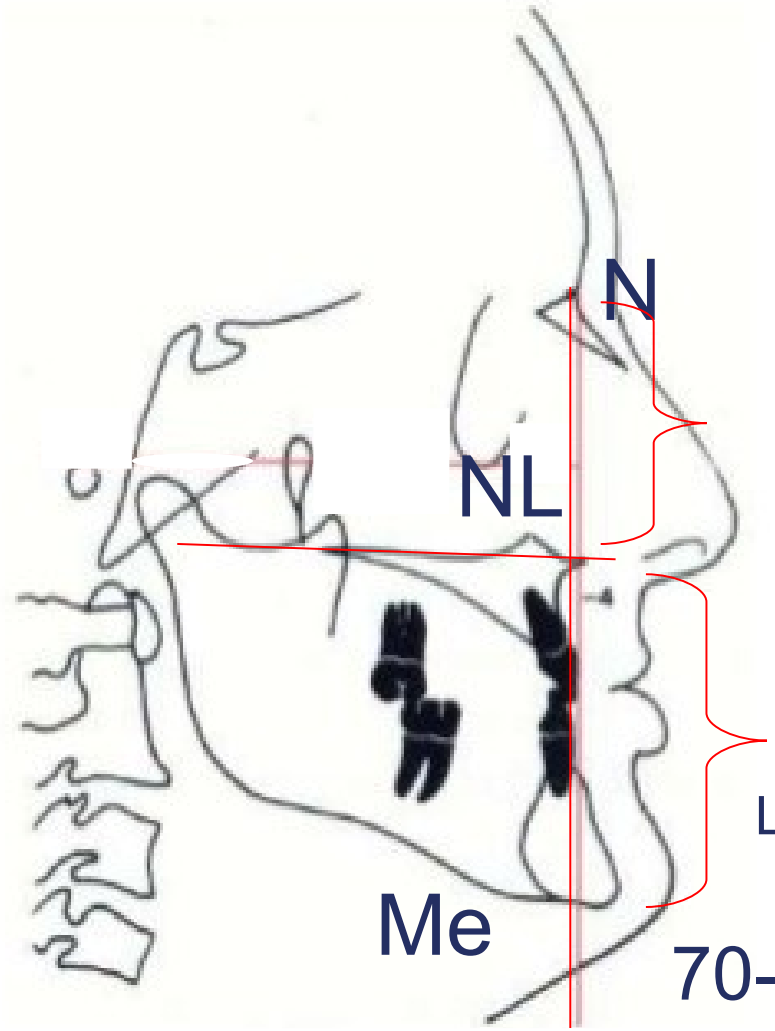


Fig 3 (A) Important lateral cephalometric landmarks identified on the lateral cephalogram

Dr. Kaán László Miklós,
Associate Professor

Face index



Midface

$$\frac{N,NL}{NL\ ,\_Me} \times 100$$

Lower part of the face

70-89 % - neutrális face

< 70 - O = open face character

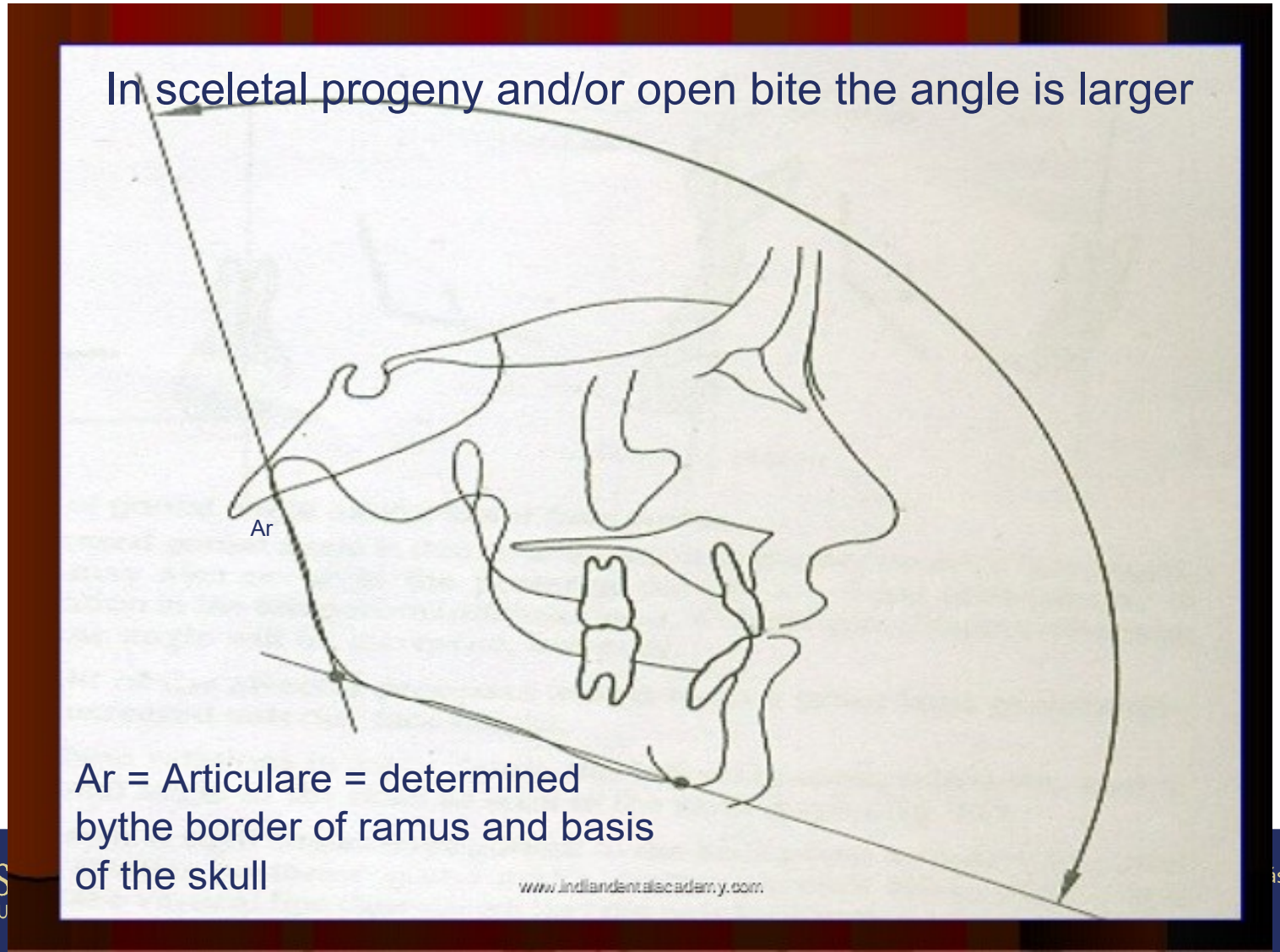
90< = T (tief) = deep face character

Gonion angle(Hasund, Steiner, Ricketts)

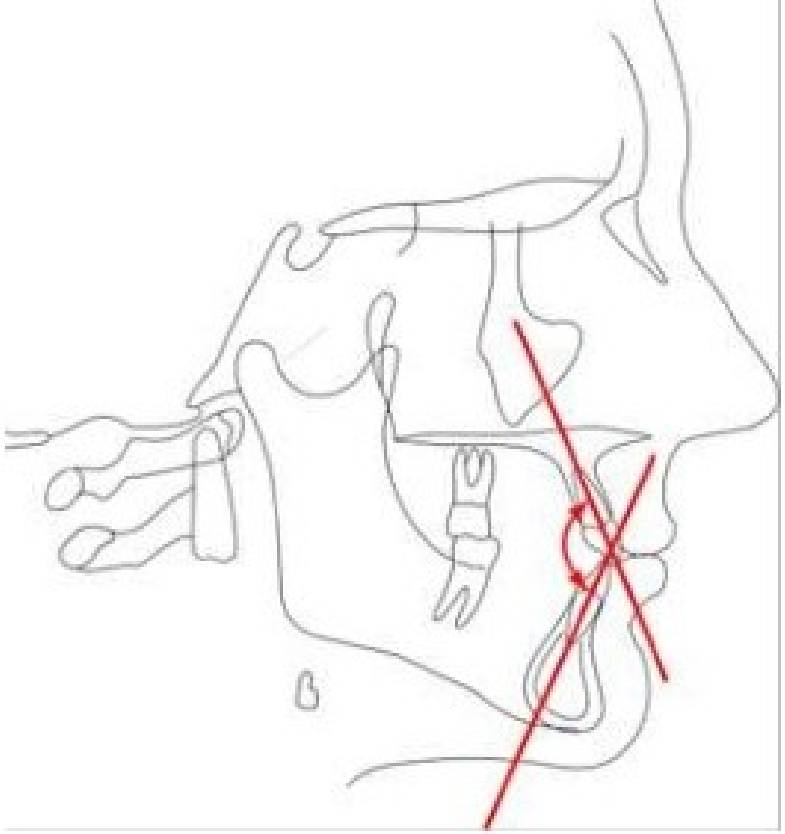
a the angle between corpus and ramus of the lower jaw

126°

Hasund, Steiner



Dental: Interincisal angle



Hasund, Steiner

131°

This angle is relatively small in individuals whose incisors are tipped forward.
A measurement of the degree of procumbency of the incisor teeth, introduced by W. B. Downs as the (posterior) angle formed by the intersection of the long axes of the maxillary and mandibular central incisors.

- Highly variable according to the positions of these teeth in different biotypes.
- Dolichofacial patients will have vertical upper incisors & high interincisal angles eg. Deep overbite
- Brachycephalic patients have more horizontal incisors and lower angles eg. The most biprotrusions are accompanied by a lower IIA.

Dental: UI-NA distance
Dental: UI-NA angle

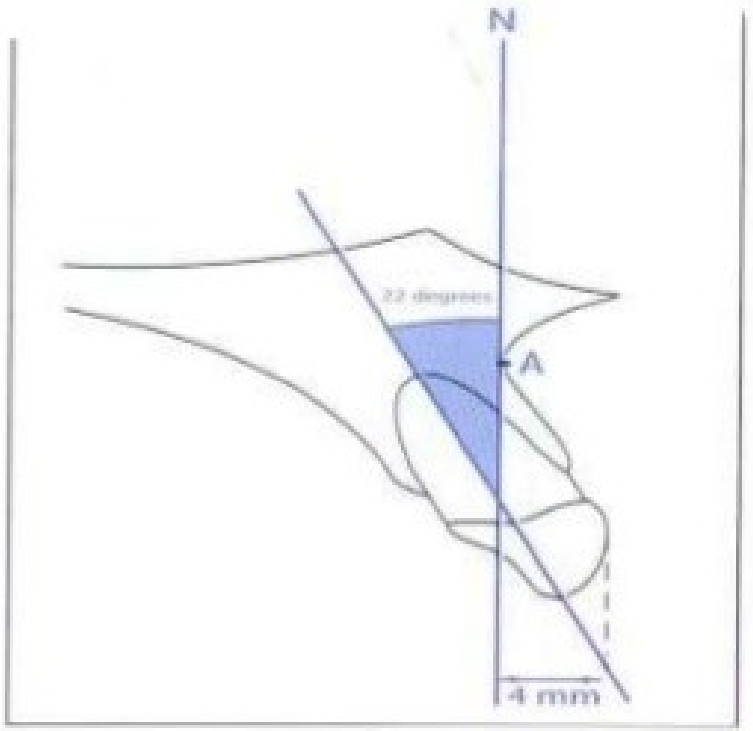


Fig 7-7 Maxillary incisor to NA line; 22 degrees and 4 mm is "ideal."

Hasund, Steiner

- **Maxillary Incisors Position:** The relative location and axial inclination of the upper incisors are determined by relating the teeth to N-A line.
- To precisely determine the relative anteroposterior position of the incisors, it is necessary to measure the distance of the most labial surface of the incisor to the NA line.

Dental: LI-NB distance
Dental: LI-NB angle

Hasund, Steiner

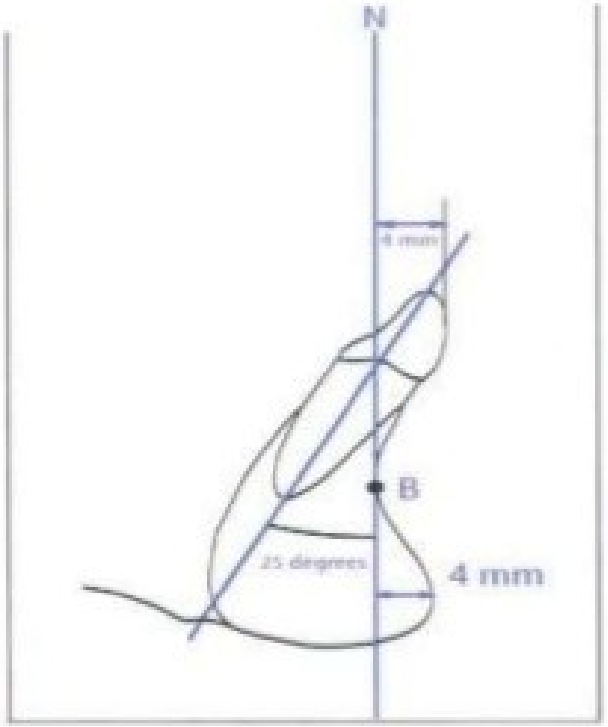


Fig 7-10 Relationship of mandibular incisor to NB line, 4 mm and 25 degrees.

- Angle greater than 25^0 may be seen in class II div 1.
- Angle less than 25^0 may be seen in class II div II OR class III.

Mandibular Incisors Position: The relative location and axial inclination of the lower incisors are determined by relating the teeth to N-B line.

- To precisely determine the relative anteroposterior position of the incisors, it is necessary to measure the distance of the most labial surface of the incisor to the N-B line.

Soft tissue: Steiner's S - Line

Hasund, Steiner

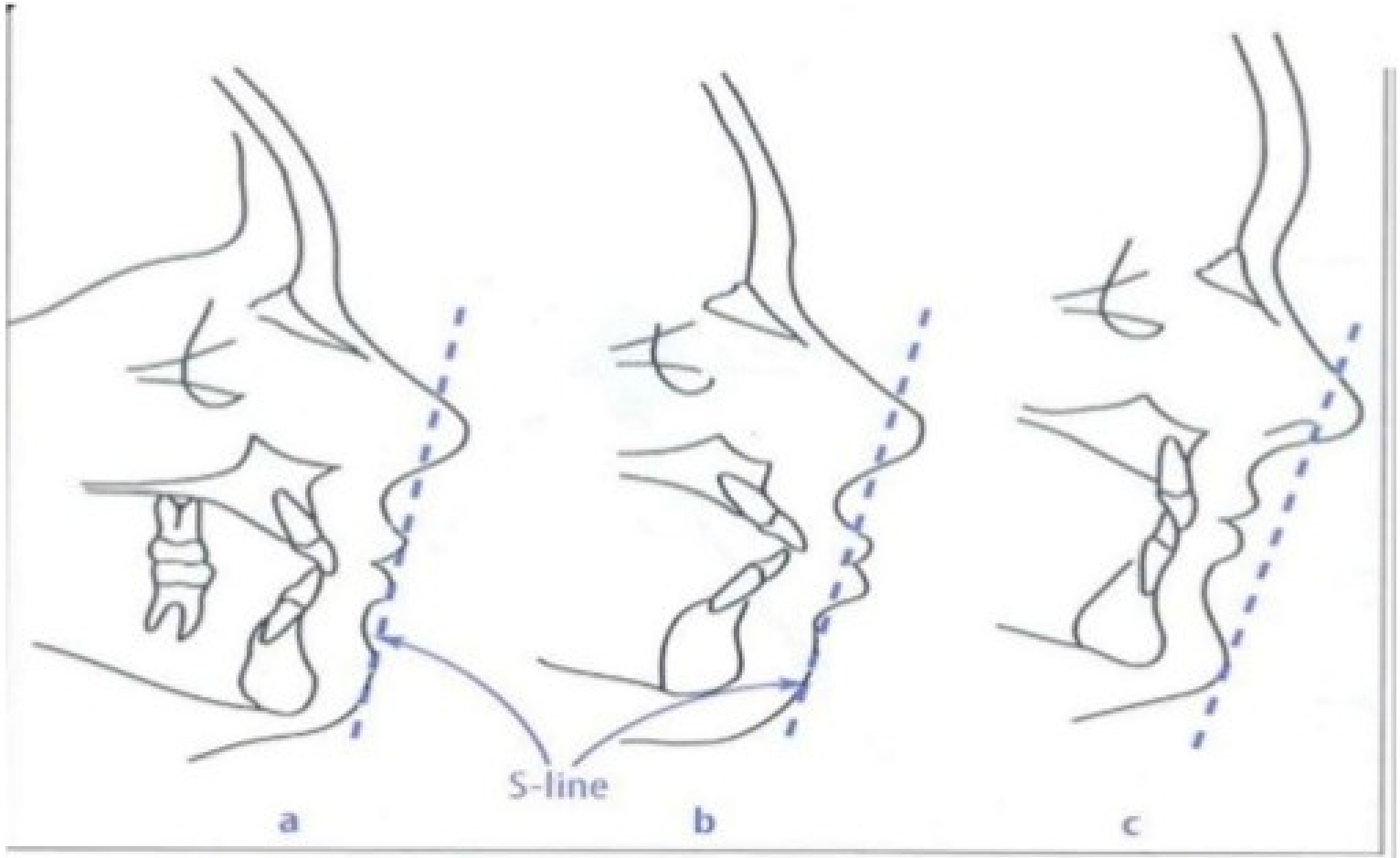


Fig 7-12 Steiner's S-line. *(a)* Lips in balance at rest; *(b)* lips too protrusive; *(c)* lips or lower facial profile too recessive.

Ricketts Measurements to determine the profile

11. Lower lip to E-plane:

The lower lip protrusion is evaluated by measuring the lower lip from an aesthetic line constructed by joining the tip of the nose and the tip of the chin.

Soft tissue analysis

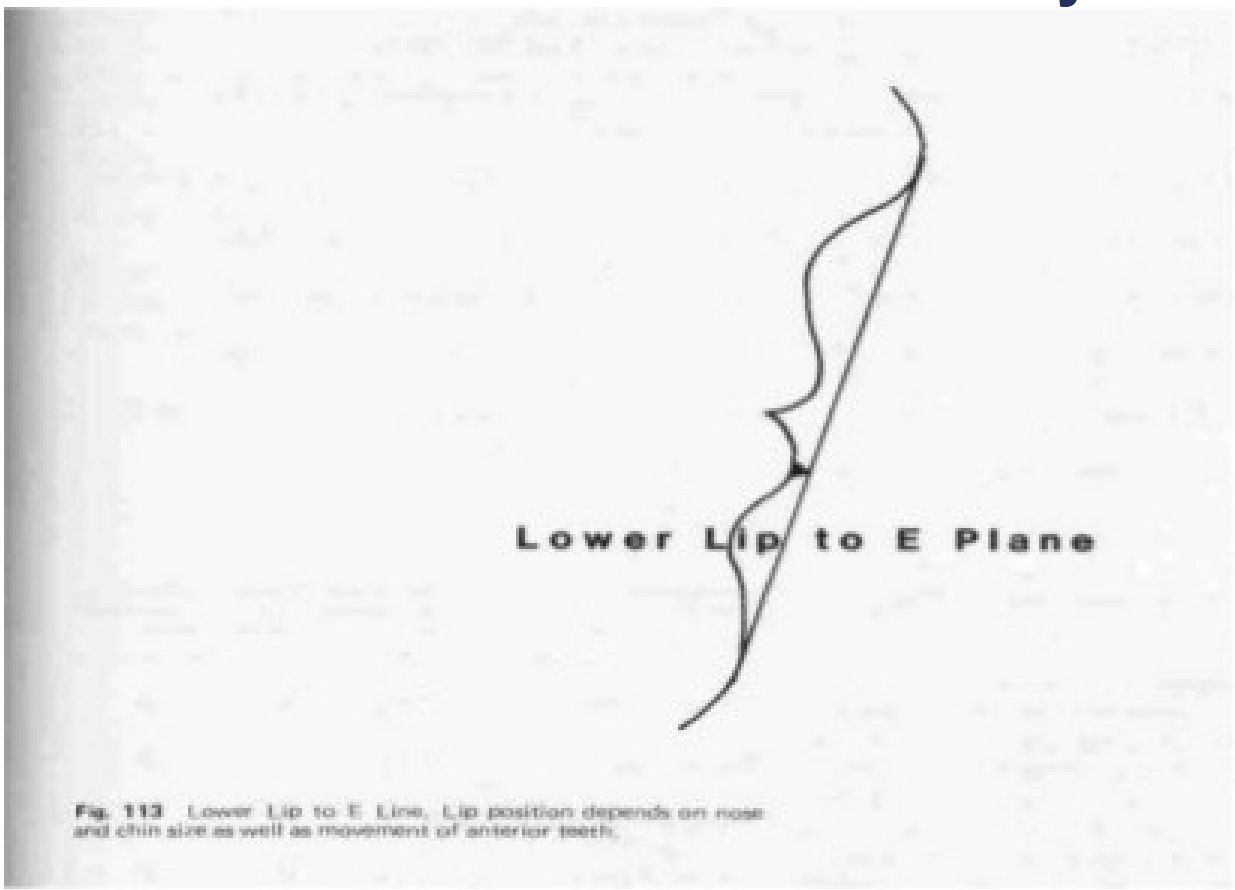


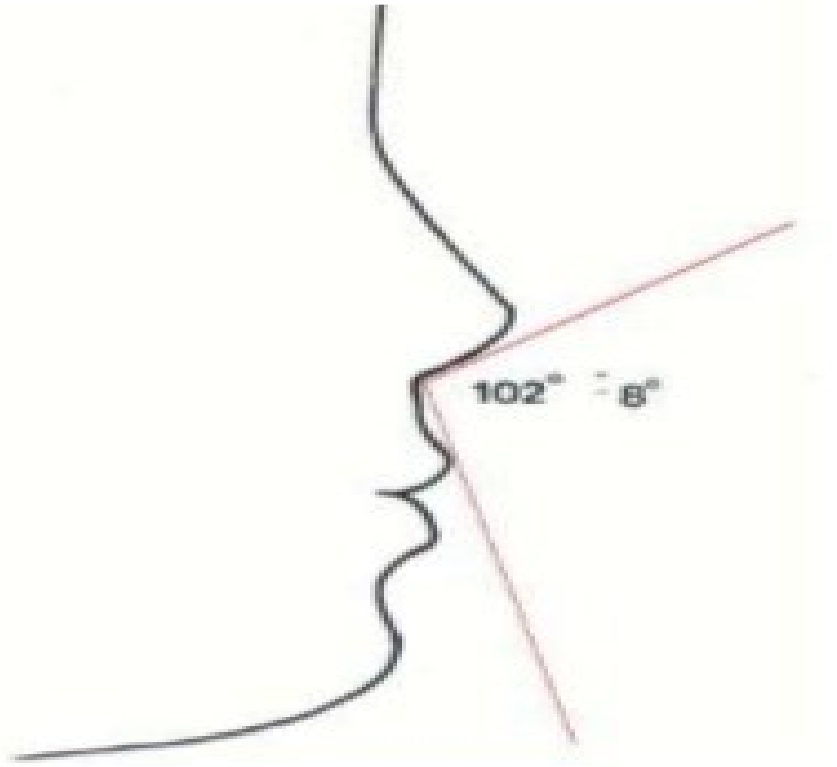
Fig. 113 Lower Lip to E Line. Lip position depends on nose and chin size as well as movement of anterior teeth.

Esthetic plane: tip of nose to tip of chin

Lower lip protrusion: lower lip to E-plane

Soft tissue evaluation by:

1. Nasolabial angle



Nasolabial angle

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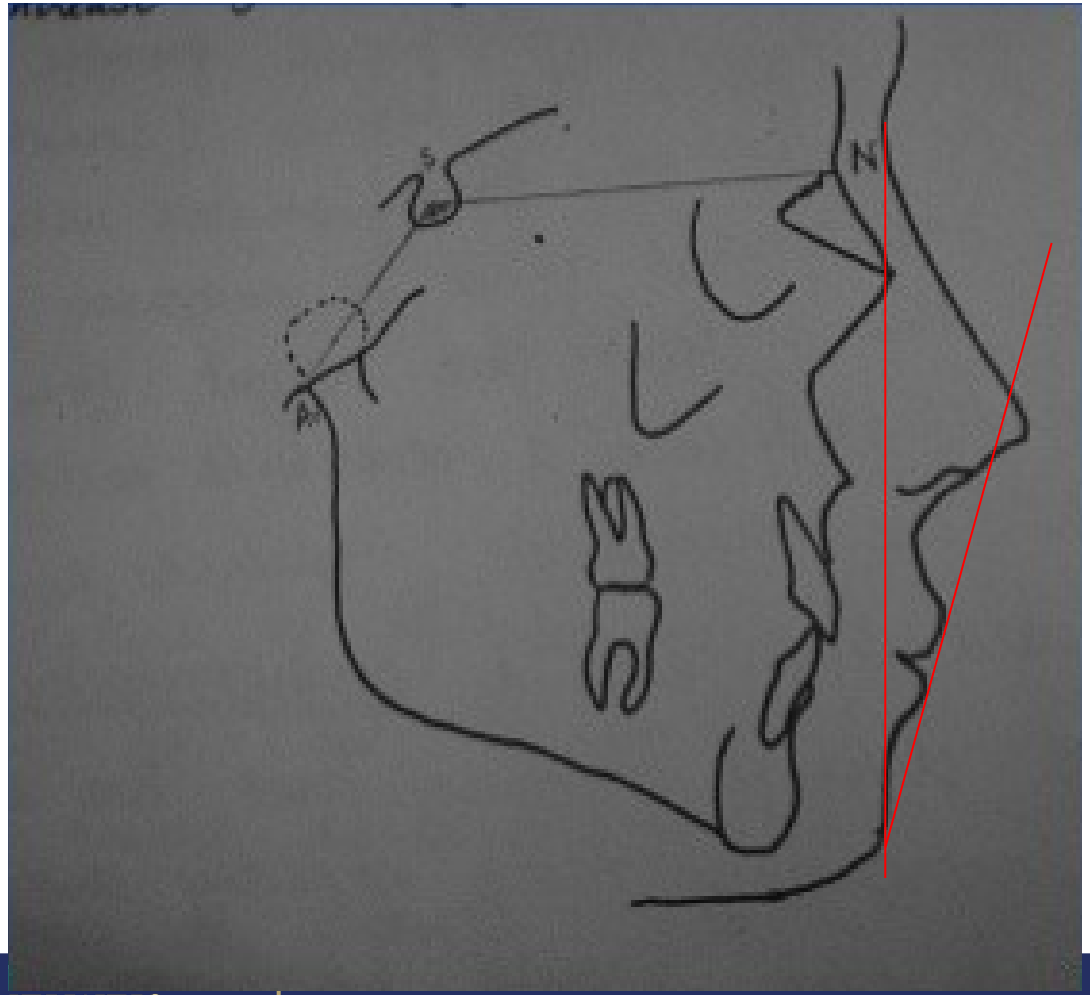
Associate Professor

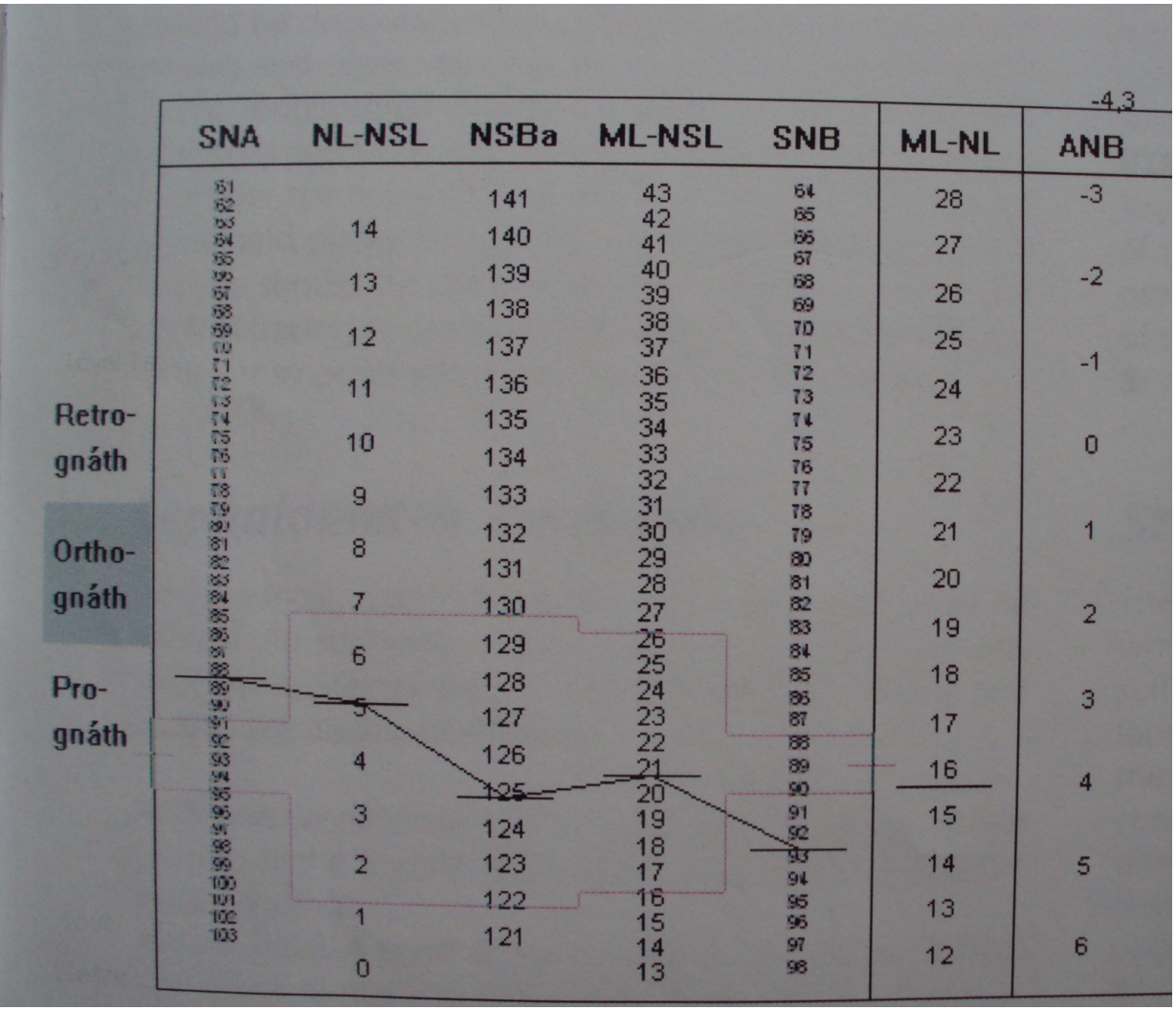
Soft tissue analysis - H angle

soft tissue N-Pog(signed N'-Pog') – Pog'Upper lip

Normal value: 8°



Harmony table and harmony box (moving) by Hasund



1. Most values has to be in the box
2. The position of the box determines the face type
3. Which value is outside the box !!!

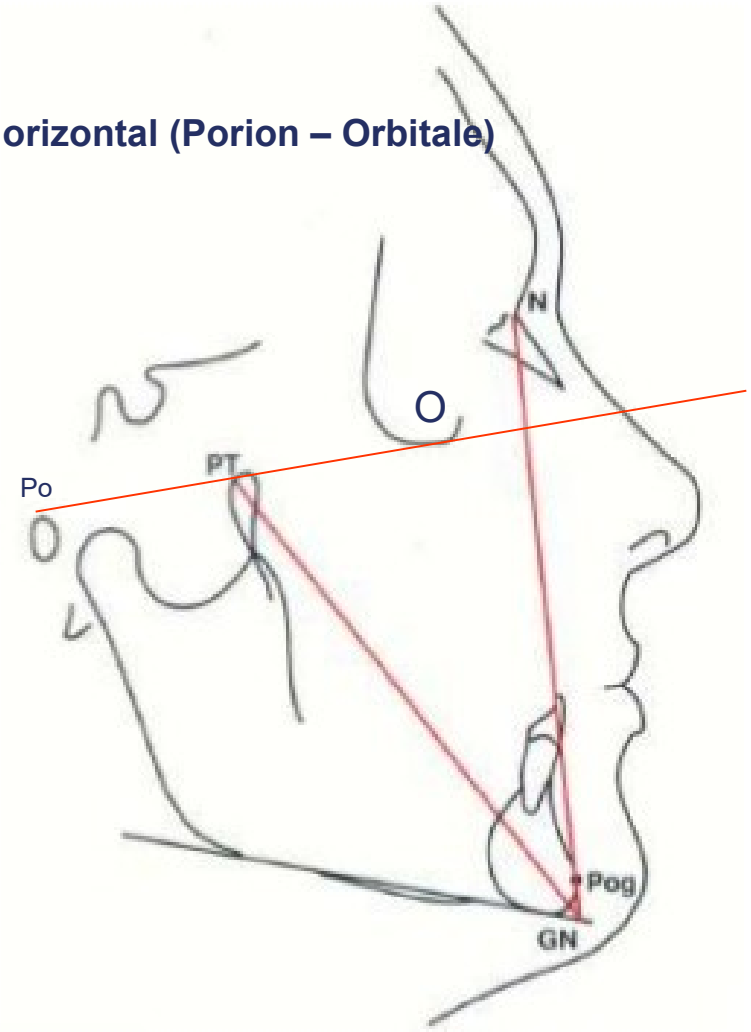
Don't Confuse facial axis with facial plane !!

Facial Axis is: Pt to Gn

Facial Plane is: N to Pog

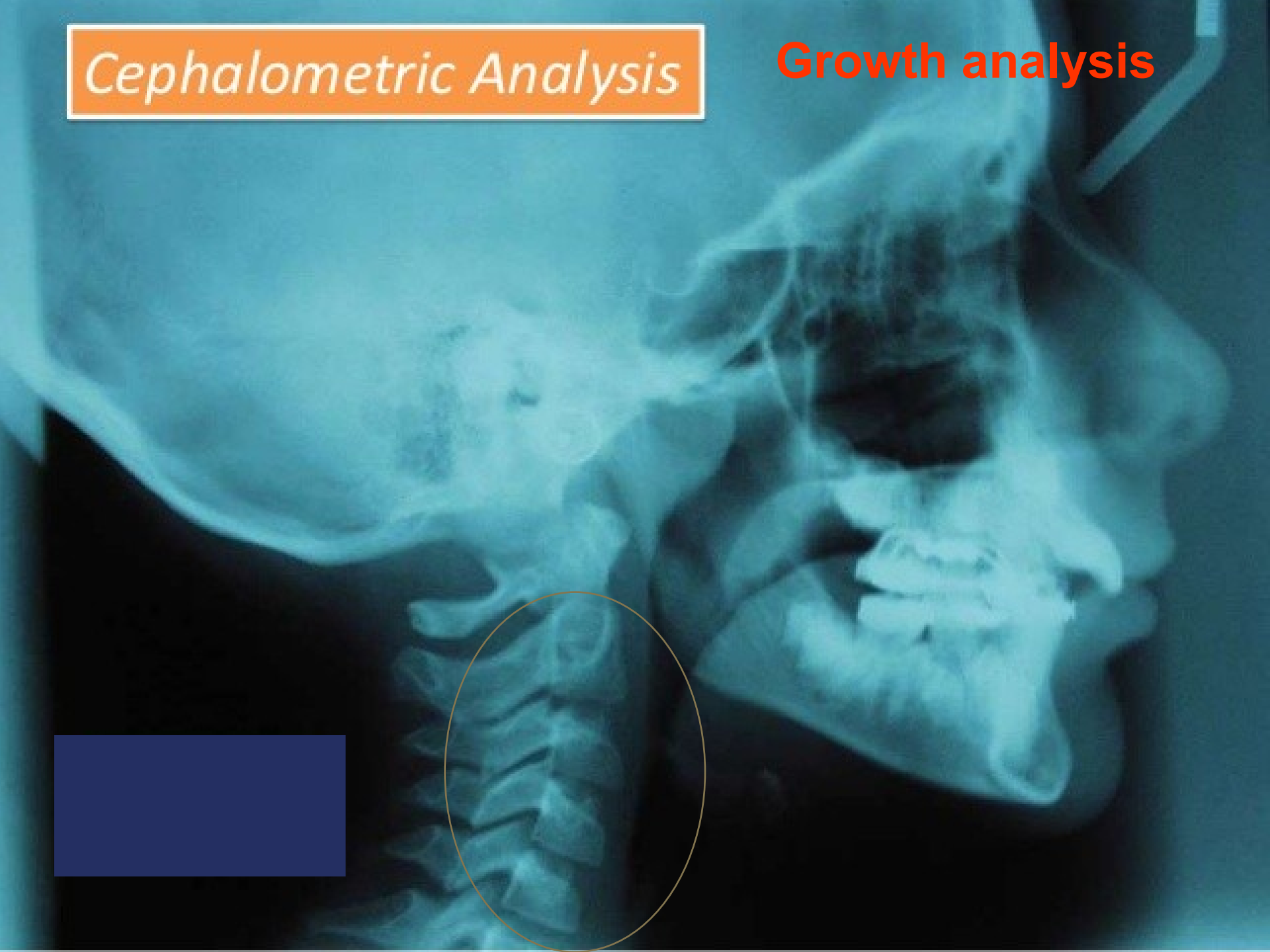
Ricketts uses other important planes

Reference line: Frankfurt horizontal (Porion – Orbitale)



Cephalometric Analysis

Growth analysis



Maxilla – mandible, when?

- In CVMS 1 é CVMS 2 phase worth expanding the upperjaw

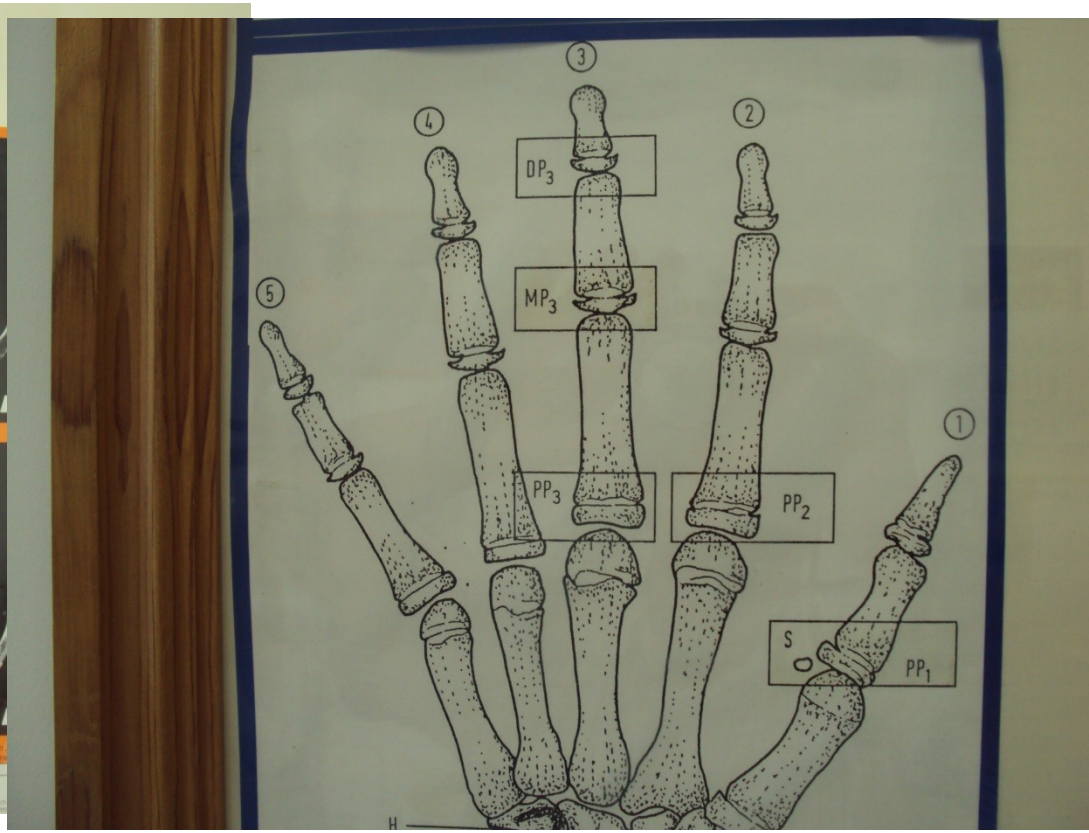
The application of the CVM method has revealed that:

1. Class II treatment is most effective when it includes the peak in mandibular growth; CS3 – CS 4 and Cl III ttt to restrict mandibular growth
2. Class III treatment with maxillary expansion and protraction is effective in the maxilla on when it is performed before the peak (CS1 or CS2).
3. Skeletal effects of rapid maxillary expansion for the correction of transverse maxillary deficiency are greater at prepubertal stages,(CS1-CS2) while pubertal or post pubertal us of the rapid maxillary expander entails more dentoalveolar effects
4. Deficiency of mandibular ramus height can be enhanced significantly in subjects with increased vertical facial dimension when orthopedic treatment is performed at the peak in mandibular growth (CS3).

To summarize, effects of therapies aimed to enhance/restrict mandibular growth appear tc be of greater magnitude at the circumpubertal period during which the growth spurt occurs in comparison to earlier intervention,
while effects of therapies aimed to alter the maxilla orthopedically (maxillary protraction/maxillary expansion) are greater at prepubertal stages

Hand-wrist radiographs

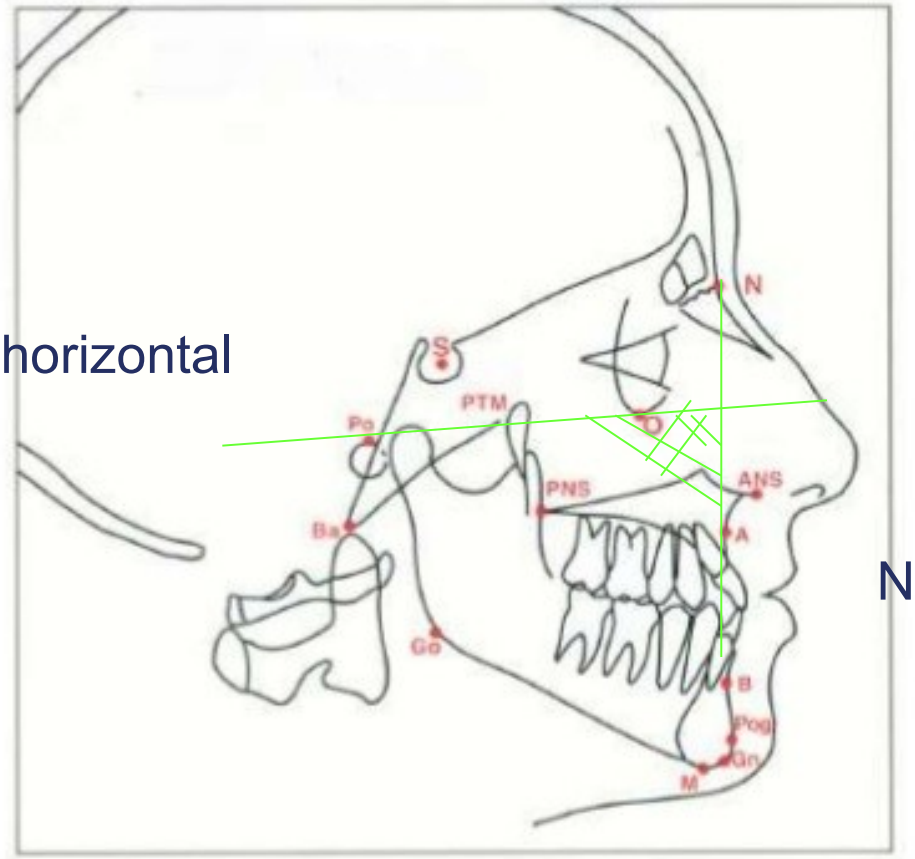
- To determine skeletal age by assessment of pattern of ossification of bones



Maxilla in the sagittalis dimension - Ricketts)

Normal value: 90°

Frankfurt horizontal



NA line

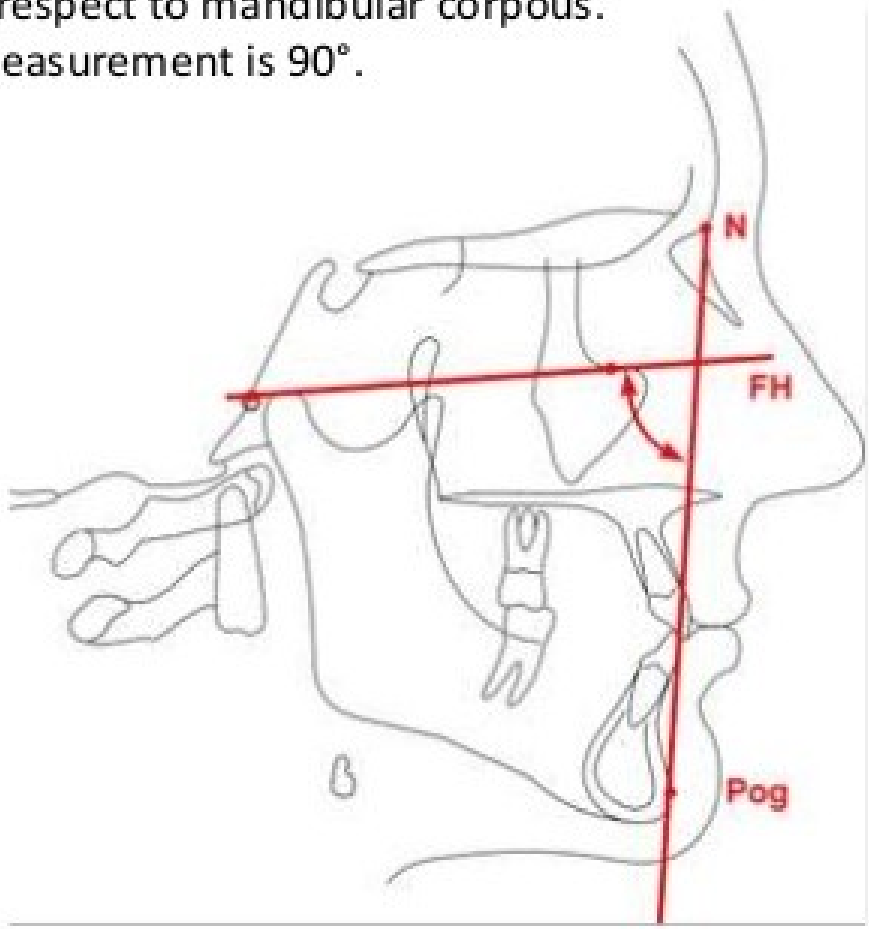
2. Facial depth angle: The sagittal position of the mandible Ricketts

The inferior posterior angle formed by the intersection of the Frankfort horizontal and the facial plane (N-Pog).

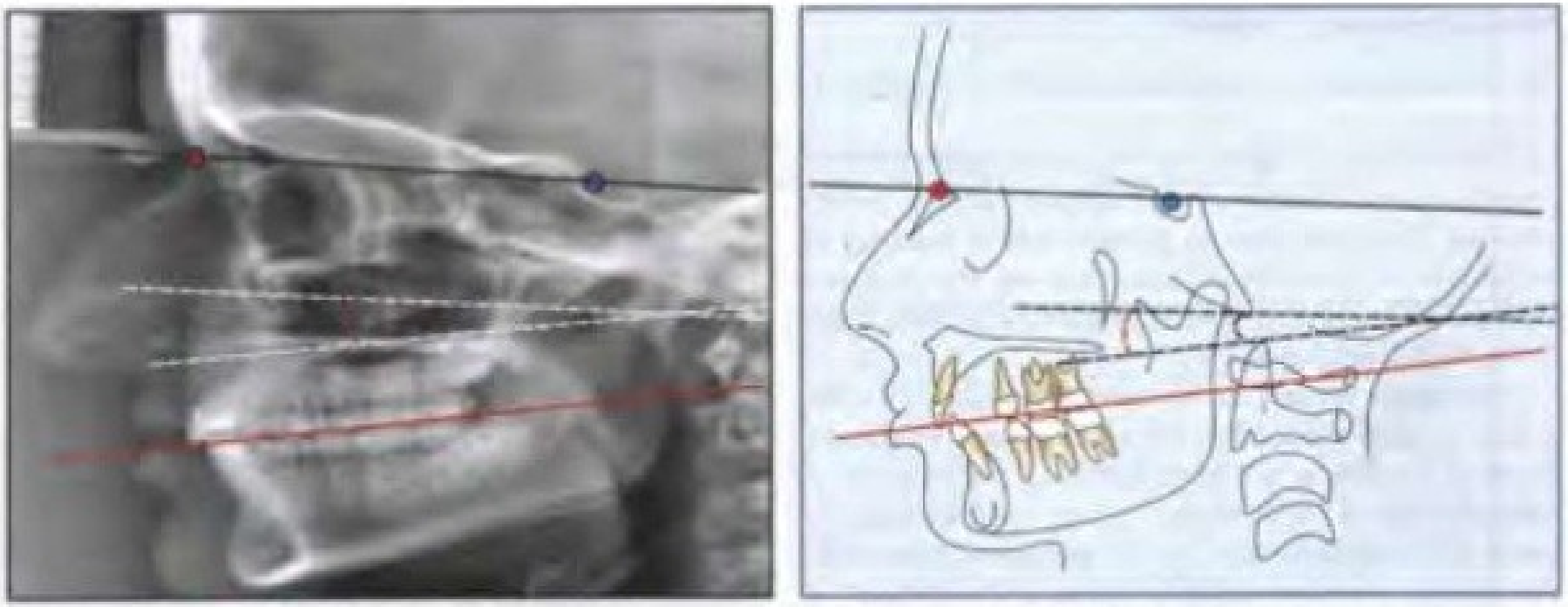
This angle gives the clinician an indication mandible (pogonion) in sagittal direction.

Increase in facial depth angle suggests a forward position of pog (brachyfacial type) while **decrease** implies a retrusion, as in dolichofacial patterns,

- This facial depth angle increases 1° every 3 years as the mandible grows forward and downward. This change with age is mainly due to a differential growth magnitude of the anterior cranial base with respect to mandibular corpous.
- In adulthood, the mean measurement is 90°.



Skeletal: occlusal plane angle (SN-Occlusal plane)



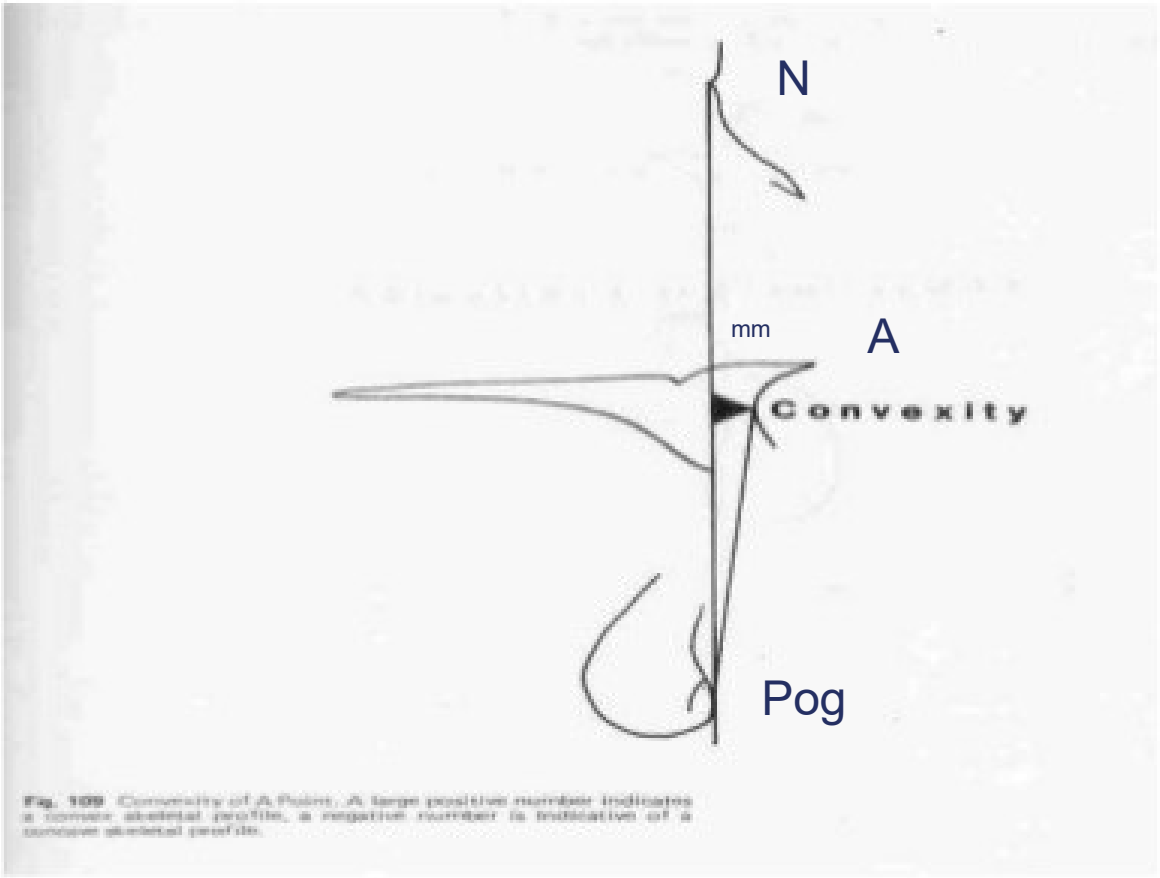
The mean reading for normal occlusions is 14°.
The angle is increased in long face or vertically growing individuals and also skeletal open bite cases.
It may be decreased in horizontally growing individuals or cases with a skeletal deep bite.

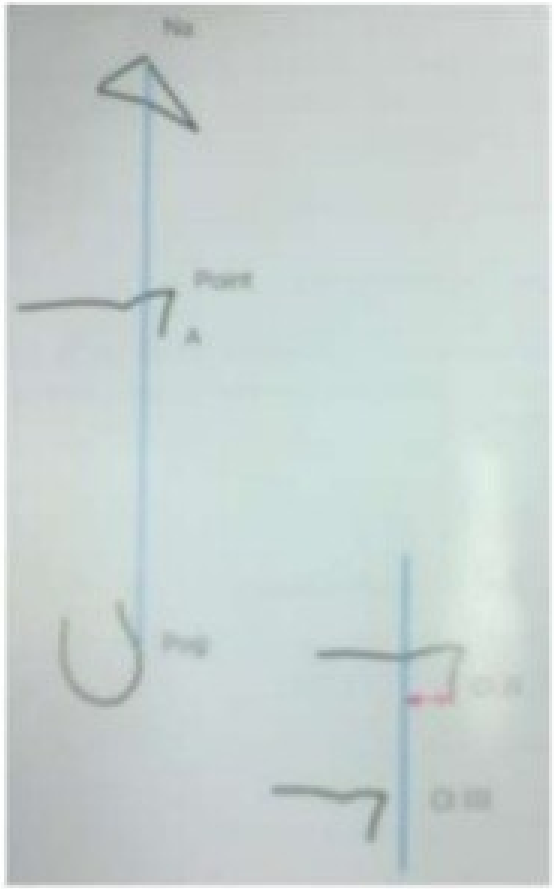
Ricketts Measurements to determine convexity

Ricketts

6. Convexity of point A :

Facial convexity is the distance in millimeters from A point to the facial plane, when measured perpendicular to that plane. The normal growth trend shows more anterior growth of the mandible than the maxilla. Thereby a decreases in its measurement with age. At maturity, the norm is 9 mm, indicating that A point lies along the facial plane. A **high convexity** indicates a Class II skeletal pattern; **negative convexity,** a skeletal Class III.

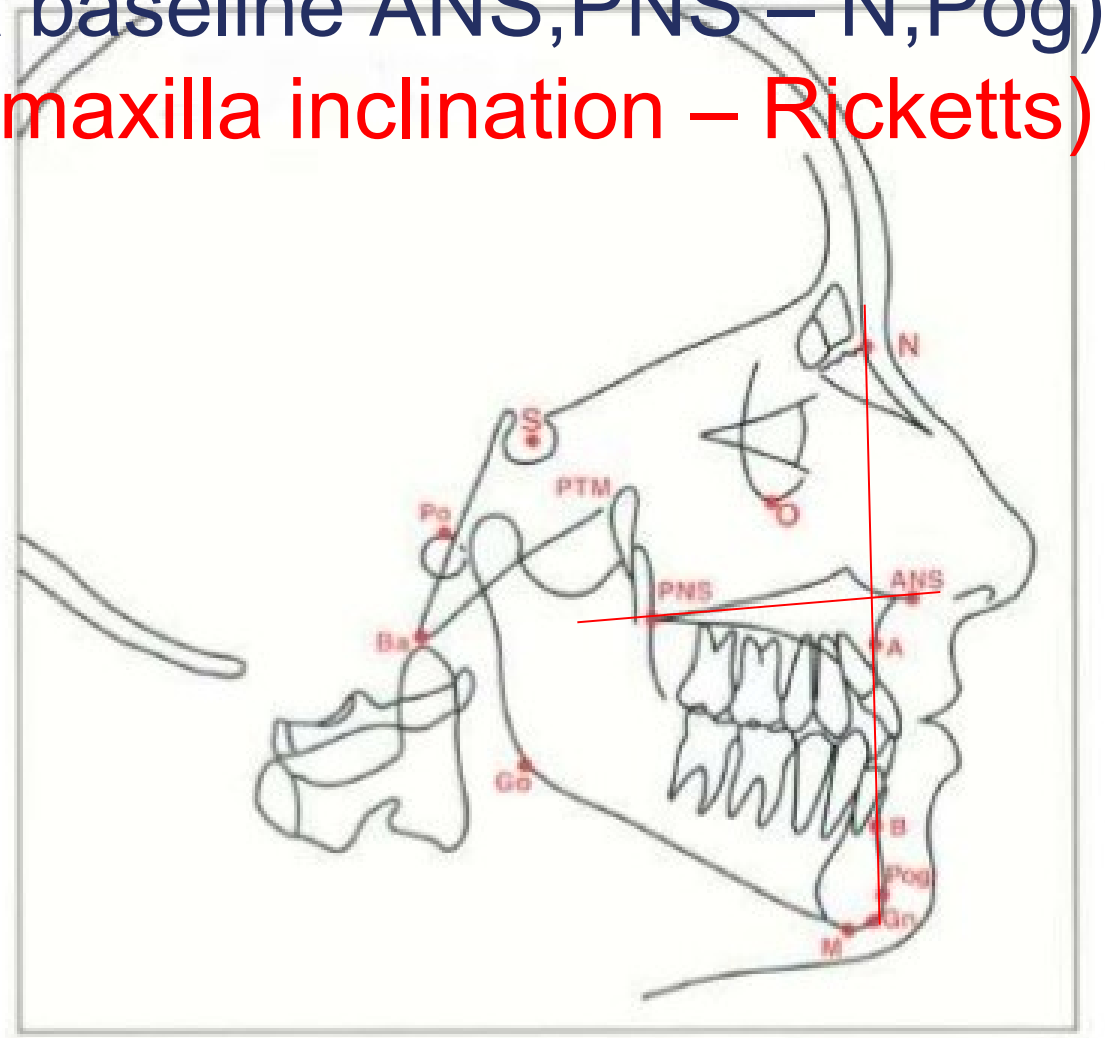




To determine the position of the maxilla in the Vertical dimension

Maxilla baseline ANS,PNS – N,Pog) = 86°

(maxilla inclination – Ricketts)



Mandible in the vertical plane - Ricketts

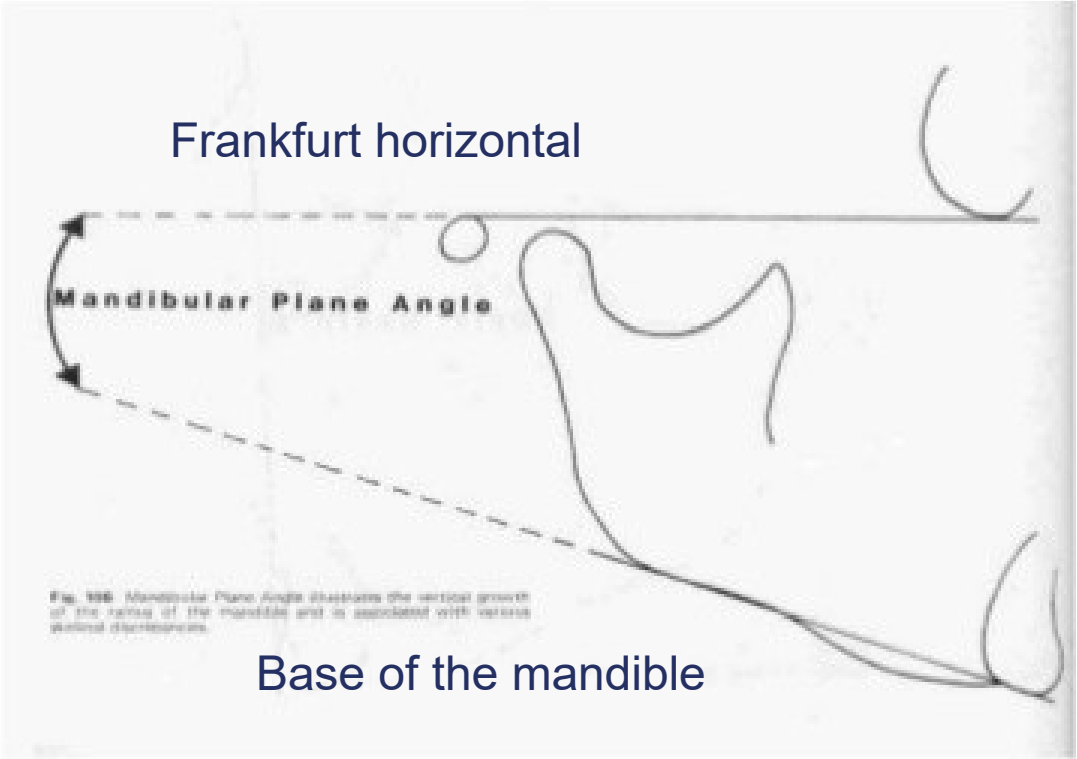
3. Mandibular plane angle:

The mandibular plane angle is formed by the intersection of mandibular plane and the Frankfort horizontal plane.

This angle gives the clinician an indication of the cant of the mandibular corpous and its value depends on the shape & position of the mandible within the craniofacial complex.

High mandibular plane angle is seen in dolichofacial patients with weak musculature and prone to open bite or vertical growth problems.

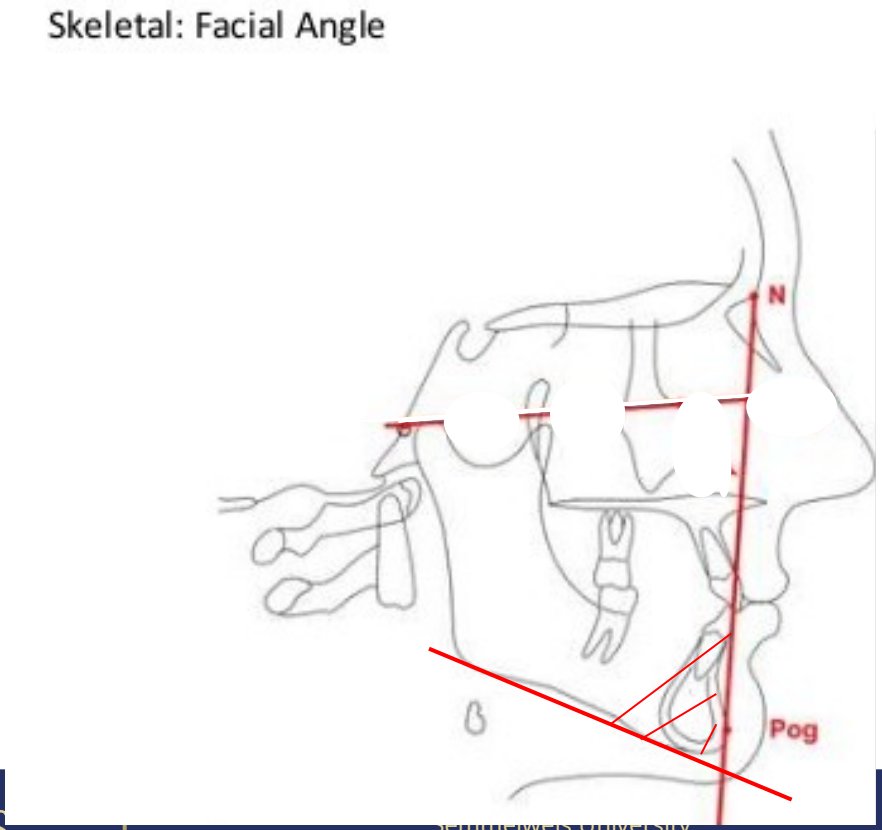
Low mandibular plane angle is found in brachyfacial types with strong musculature and deep bites who tend to have square jaws.



Conus angle

Ricketts

- NPog – mandible line (go-Gn) = 68°



Ricketts Measurements to locate the chin in space

1. Facial axis angle of Ricketts (Ba-N - Pt-Gn):

The angle describes the direction of growth of mandible at chin.

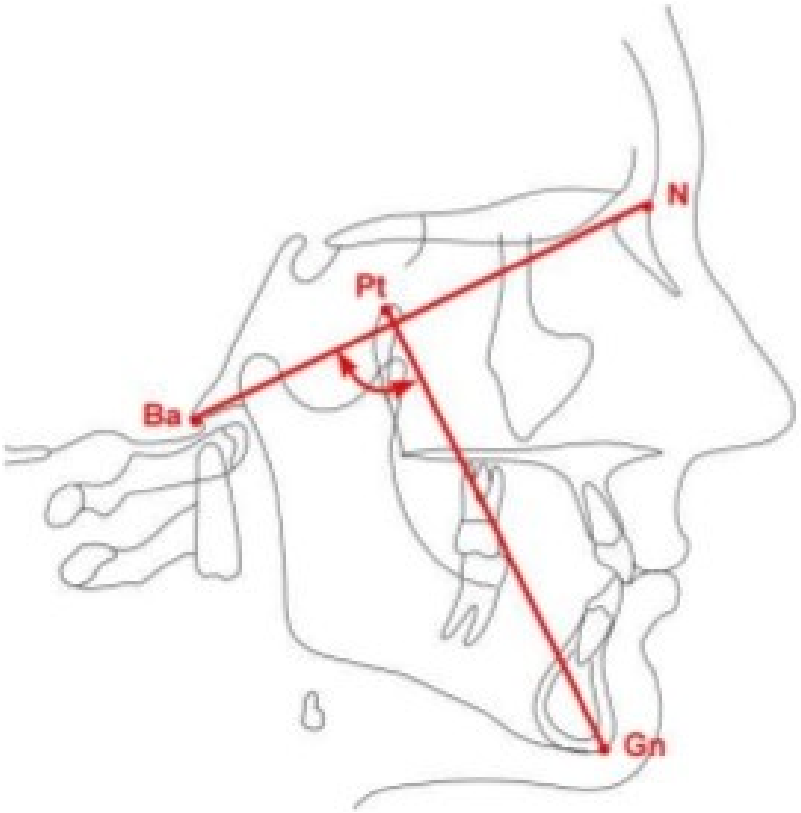
The inferior angle formed by the intersection of the facial axis of Ricketts and the Ba-N line.

This angle on the average approximates 90^{o}.

Facial axis angle remains stable in a normally growing child or reduce a little.

A **value smaller than 90 indicates** (smaller angle) facial growth primarily in the vertical direction and/or a Class II pattern,

whereas a **value greater than 90 degrees indicates** (larger angle) a horizontal growth pattern and/or a Class III tendency.



Ricketts - another way.....

Position of the upper incisors related to the Frankfurt horizontal

Normal: 110°

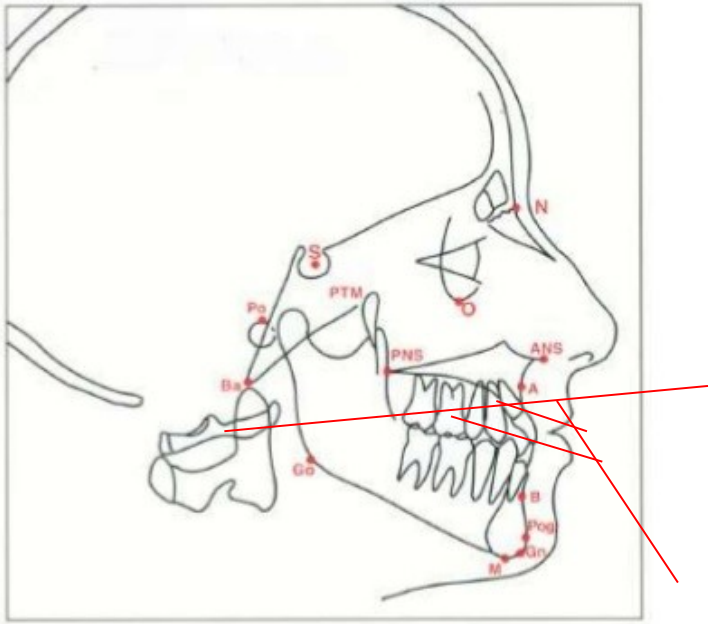
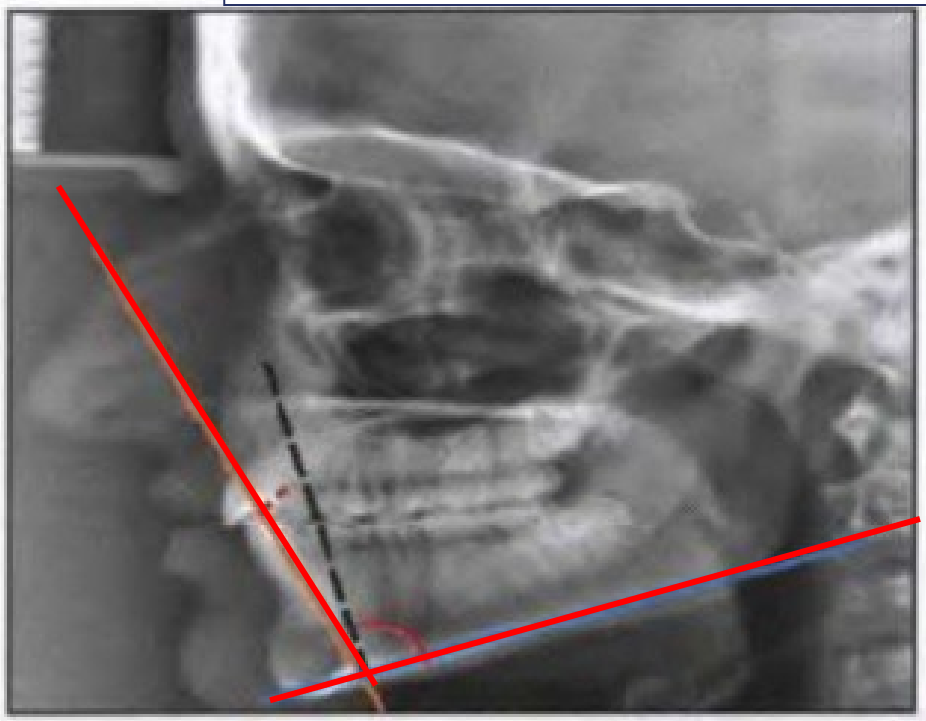


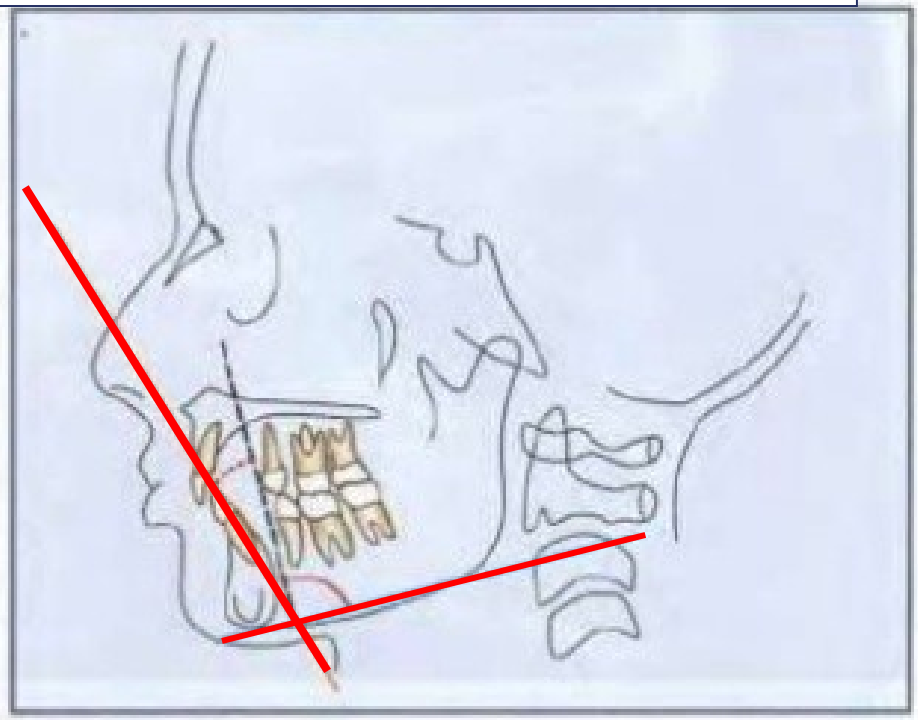
Fig 6–1 Traditional lateral cephalometric headfilm landmarks used with Steiner analysis.

Ricketts – another way…..

Dental:

The lower incisors related to the mandible line
Normal: 90°



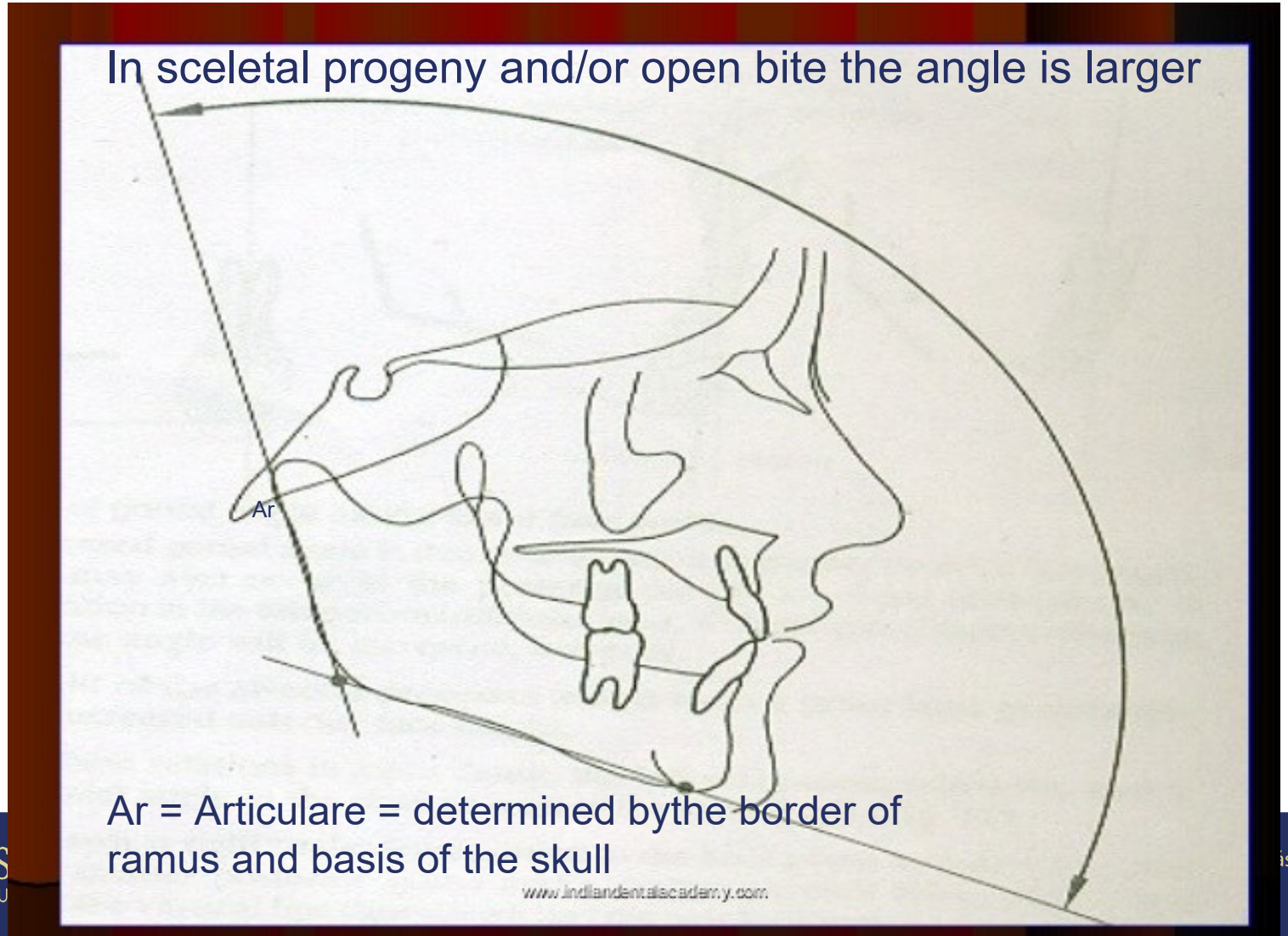


The angle is positive when incisors are tipped forward. i.e, they are proclined forward.
The value increases as the proclination increases.

Gonion angle(Hasund, Steiner, Ricketts)

a the angle between corpus and ramus of the lower jaw

126°



Ricketts

5. Mandibular arc:

The mandibular arc is the angle formed by the intersection of the condylar axis (DC-Xi) and the distal extrapolation of the corpus axis.

It describes the configuration of the mandible;

A **large angle** is indicative of a 'strong' and 'square' mandible; (brachyfacial pattern)

Smaller angles suggest a short ramus, obtuse-shaped mandible and vertical growth pattern. (dolichofacial)

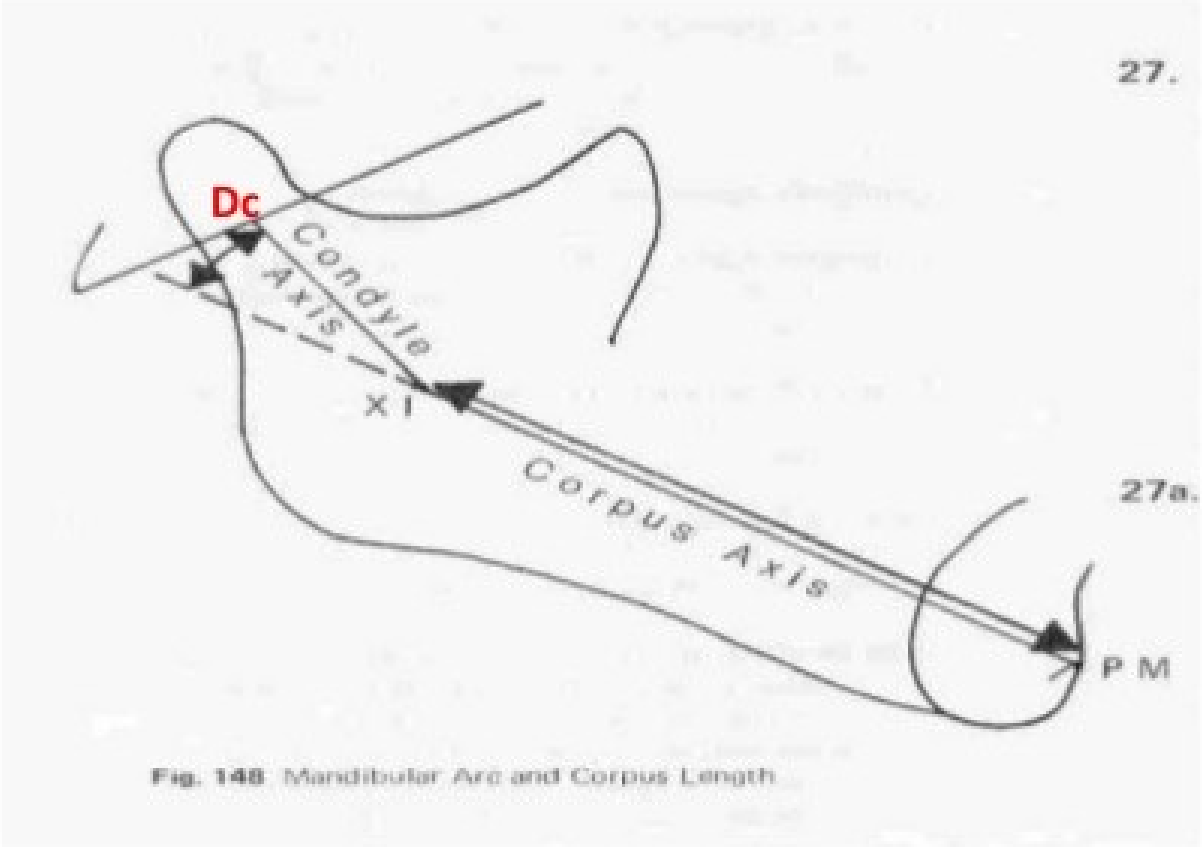


Fig. 148 Mandibular Arc and Corpus Length

Ricketts

4. Lower facial height:

This is the angle formed by the intersection of a line from anterior nasal spine (ANS) to Xi-point and the corpus axis (Xi-Pm).

A **larger angle** indicates a divergence of mandible and maxilla or vertical growth trend. (Dolichofacial pattern with weak musculature & prone to skeletal open bite)

Low values of angle are suggestive of horizontal facial pattern. (Brachyfacial pattern with strong musculature & a deep overbite)

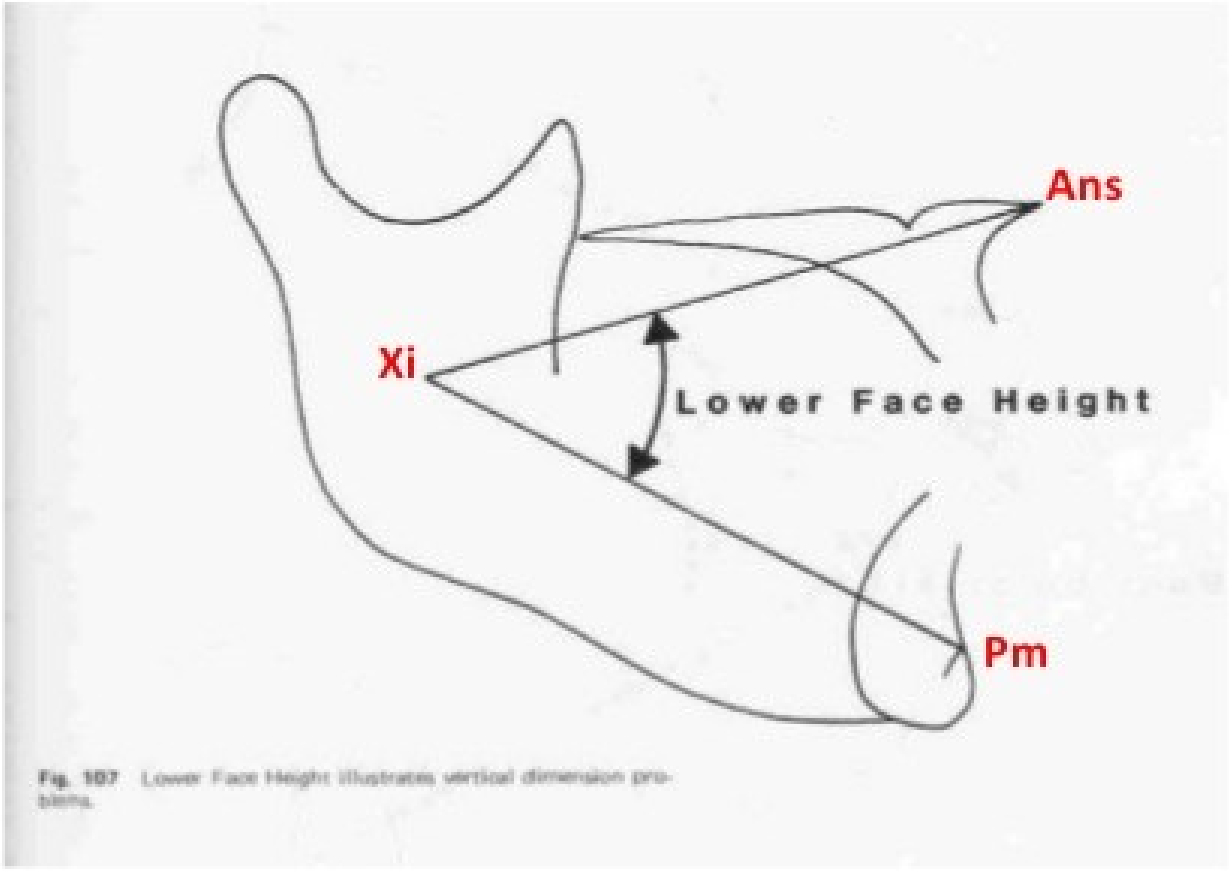


Fig. 107 Lower Face Height illustrates vertical dimension problems.