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CEPHALOMETRICS FOR ORTHOGNATHIC SURGERY: PRINCIPLES, PLANNING AND PRECISION

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Foreword

In the ever-evolving field of Oral and Maxillofacial Surgery, the importance of precision in diagnosis and treatment planning cannot be overstated, particularly when addressing complex dental and facial deformities. One of the most vital tools in achieving successful outcomes in orthognathic surgery is Cephalometry. This invaluable diagnostic technique enables surgeons to gain a comprehensive understanding of the intricacies of the craniofacial complex, thereby facilitating accurate treatment planning and ensuring favorable surgical outcomes.

This book, Cephalometrics for Orthognathic Surgery: Principles, Planning, and Precision, serves as an essential resource for both the novice and experienced professionals in the field of Maxillofacial Surgery and Orthodontics. It offers a detailed exploration of the foundational principles of Cephalometrics, the historical development of the discipline, and its transformative impact on the success of orthognathic procedures. From the early work of Broadbent and Hofrath to the current advancements in three-dimensional cephalometric analysis, this text offers an in-depth examination of how cephalometric analysis has continually improved surgical precision, enhanced patient outcomes, and facilitated better communication between surgical and orthodontic teams.

The book not only discusses traditional two-dimensional methods but also explores the promising future of three-dimensional imaging technologies, such as Cone-Beam Computed Tomography (CBCT) and Computer-Aided Surgical Simulation (CASS), which have opened up new frontiers in surgical planning and execution. These innovations have revolutionised how surgeons approach and correct Dentofacial deformities, offering more accurate and individualised solutions for patients.

In addition to its technical focus, the book emphasises the role of Cephalometry in ensuring a holistic approach to treatment planning, one that considers individual patient variability, ethnic differences, and the integration of orthodontic treatment to achieve optimal results. By bridging the gap between diagnostic tools and clinical practice, cephalometry provides surgeons with the insights needed to design more effective and personalised treatment plans.

As the field of Orthognathic Surgery continues to evolve, this book provides an indispensable guide to understanding and applying cephalometric analysis. It is an essential tool for clinicians dedicated to refining their skills and improving the outcomes of their patients. The pages that follow are not only a reflection of past achievements in this area but also a forward-looking guide to future innovations in the realm of cephalometric science.

With Regards

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TABLE OF CONTENTS

01	An introduction to cephalometry	1-3
02	Aims and objectives	04
03	The cephalometric technique and its landmarks	5-12
04	Cephalometric techniques and their application in orthognathic surgery	13-43
05	Discussion and summary	44,45
06	Bibliography	46-54

INTRODUCTION

It is indeed a very true saying that, the successful treatment of the Orthognathic surgical patient is dependent on a careful diagnosis; and what better Diagnostic tool can the Oral and Maxillofacial surgeon have in this regard than ‘Cephalometries"?

Orthognathic surgery, a specialized field within oral and maxillofacial surgery, addresses skeletal and dental discrepancies that cannot be corrected by orthodontic treatment alone. The success of such surgical interventions heavily relies on meticulous planning and precise execution, where cephalometric analysis plays a pivotal role. Cephalometrics, the study and measurement of the head, particularly the craniofacial complex, provides clinicians with critical insights into the anatomical relationships and spatial orientation of craniofacial structures. This analytical approach facilitates accurate diagnosis, treatment planning, and postoperative assessment in orthognathic surgery [1-5].

Historical Perspective

The origins of cephalometric analysis can be traced back to the early 20th century, with the advent of standardized radiographic techniques. In 1931, Broadbent in the United States and Hofrath in Germany independently introduced the cephalometric radiograph, providing a two-dimensional representation of the craniofacial skeleton. This innovation allowed for the systematic study of craniofacial morphology and growth patterns, laying the foundation for modern orthodontic and surgical practices. Over the decades, various cephalometric analyses have been developed, each offering unique perspectives on craniofacial relationships. Notable among these are the Steiner, Downs, Ricketts, and Sassouni analyses, each contributing to a comprehensive understanding of craniofacial dynamics [6-8].

Principles of Cephalometric Analysis

Cephalometric analysis involves the identification and measurement of specific anatomical landmarks on standardized radiographs, typically lateral and posteroanterior cephalograms. These landmarks serve as reference points for assessing skeletal and dental relationships in both the anteroposterior and vertical dimensions. Key measurements include angular and linear assessments that provide insights into maxillary and mandibular positions, dental inclinations, and cranial base relationships. For instance, the SNA and SNB angles evaluate the anteroposterior positions of the maxilla and mandible relative to the cranial base, while the ANB angle indicates the skeletal discrepancy between the jaws. Such measurements are instrumental in diagnosing malocclusions and planning surgical interventions [9,10].

Cephalometrics in Surgical Planning

In orthognathic surgery, cephalometric analysis serves as a cornerstone for treatment planning. It enables clinicians to simulate surgical movements, predict postoperative outcomes, and communicate treatment objectives effectively. By analyzing cephalometric tracings, surgeons can determine the magnitude and direction of skeletal movements required to achieve optimal occlusion and facial aesthetics. Furthermore, cephalometric norms, which represent average measurements derived from specific populations, provide a reference framework for assessing deviations and planning corrective procedures. However, it is essential to consider individual variability and ethnic differences when applying these norms, as studies have demonstrated significant variations across populations [11,12]

Advancements in Three-Dimensional Cephalometry

Traditional cephalometric analysis, being two-dimensional, has inherent limitations in representing the complex three-dimensional structure of the craniofacial skeleton. With the advent of advanced imaging technologies, three-dimensional (3D) cephalometry has emerged, offering more accurate and comprehensive assessments. Cone-beam computed tomography (CBCT) provides high-resolution 3D images, enabling precise localization of anatomical landmarks and better visualization of asymmetries. Moreover, computer-aided surgical simulation (CASS) systems integrate 3D imaging with virtual planning tools, allowing for detailed surgical planning and the fabrication of customized surgical splints and guides [13].

Population-Specific Norms and Ethnic Considerations

Cephalometric norms are essential for diagnosing skeletal discrepancies and planning surgical interventions. However, these norms are not universally applicable, as craniofacial morphology varies significantly among different ethnic groups. Studies have highlighted the necessity of establishing population-specific cephalometric standards to ensure accurate diagnosis and effective treatment planning. For instance, research conducted on the Rajasthani population in India revealed distinct craniofacial characteristics compared to Caucasian norms, emphasizing the importance of regional studies in developing appropriate surgical guidelines [14].

Integration with Orthodontic Treatment

Orthognathic surgery is often performed in conjunction with orthodontic treatment to achieve optimal functional and aesthetic outcomes. Cephalometric analysis facilitates the coordination between surgical and orthodontic phases by providing a comprehensive understanding of skeletal and dental relationships. Preoperative orthodontics aims to decompensate dental alignments, setting the stage for accurate surgical corrections. Postoperative orthodontics then fine-tunes occlusion and ensures long-term stability. Cephalometric evaluations at each stage guide treatment modifications and monitor progress, contributing to the overall success of the combined approach [15].

Predictive Modeling and Outcome Assessment

Beyond planning, cephalometric analysis plays a crucial role in predicting surgical outcomes and assessing postoperative results. By comparing preoperative and postoperative cephalograms, clinicians can evaluate the accuracy of surgical movements and the stability of skeletal changes. Such assessments are vital for understanding treatment efficacy, identifying areas for improvement, and conducting longitudinal studies on surgical stability. Additionally, predictive modeling using cephalometric data aids in patient education, setting realistic expectations, and enhancing informed consent processes [16].

Cephalometric analysis stands as an indispensable tool in orthognathic surgery, underpinning the principles of diagnosis, planning, and precision. Its evolution from two-dimensional radiographs to sophisticated three-dimensional imaging reflects the continuous advancement in surgical planning methodologies. By integrating cephalometrics into clinical practice, surgeons can achieve enhanced accuracy, improved aesthetic and functional outcomes, and greater patient satisfaction. Ongoing research and technological innovations promise to further refine cephalometric techniques, solidifying their role in the future of orthognathic surgery [17].

Our study highlights the various aspects of Cephalometric as applicable to the specialty of Orthognathic surgery, an appraisal of the various cephalometric Techniques available including their modifications and of the contributions of this Amazing branch of Radiography to the field of Orthognathic surgery.

AIMS AND OBJECTIVES

This book aims to highlight the various aspects of Cephalometrics as applicable to the specialty of Orthognathic surgery, an appraisal of the various cephalometric Techniques available including their modifications and of the contributions of this amazing branch of Radiography to the field of Orthognathic surgery.

The objectives and of our study include:

1) To review cephalometry and the various cephalometric techniques from their origin to their present day application to the field of orthognathic surgery.

2) To review the advancements that have taken place in the branch of cephalometrics from its raw state to state of the art computerized cephalometric systems available today and their application as related to the diagnosis and treatment planning of the patient with dento-facial deformity.

3) To describe the basic technique of obtaining good, quality cephalograms with minimum distortion and maximum detail.

4) To depict the standard radiographic landmarks i.e.; the various lines, planes and angles which serve as a base for the construction of subsequent cephalograms.

5) To elaborate and describe the various cephalometrics analyses which may be used in the diagnosis and treatment planning of the patient with dento-facial deformity.

6) To discuss broadly the concept of cephalometrics in general and as applied to the study and correction of dentofacial deformities along with its advantages and disadvantages.

THE CEPHALOMETRIC TECHNIQUE

Cephalometric radiography is basically the production of skull radiographs, which are useful in making measurements of the cranium and orofacial complex. The lateral or profile view of the skull is the most common projection used; however posteroanterior and oblique views are also utilized. The basic equipment needed to produce a cephalometric radiograph is a source of X-rays, a patient head Holder (cephalostat or cephalometer) and an image recording system (usually films, screens and film processing) [18].

For the lateral skull view the patient is placed in a vertical position. The patient's head is then positioned with the F-H plane parallel with the floor. For this procedure, the X-ray source is positioned on the right side of the patient at a distance of 5 from the midsagittal plane of the patient. (In some countries, the X-ray source is placed at greater distances and the technique is referred to as teleradiography.) The film is placed perpendicular to the central ray of X-ray beam in both the horizontal and vertical planes. The patient is positioned in the X-ray beam with the right side closer to the X-ray tube and both the external auditory meatus in the central ray. In other words, the central ray of the X-ray beam is directed through the transmeatal axis of the patient (i.e., superposing the right and left external auditory meatus upon each other in the radiograph.) In this position, the midsagittal plane of the patient is plano-parallel to the film [19].

The patient to film distance varies among practitioners of cephalometric radiography. Some practitioners maintain a constant patient to film distance in order to standardize the amount of magnification in the images of all radiographs. Other patient’s prefer to place the film as close as possible to ohain mamu image shans Film exposure factors depend upon the speed of the film.speed of the screens. take to film distance.size of the patient's head, the milliamperage and kilovoltage used in generating the X-ray beam and the film exposure time. Since patient's heads vary in size, one of the other factors must be adjusted to produce radiographs having similar density or blackness. The most common practice is to adjust either exposure time or kilo voltage to compensate for the patient's head size. Both, increased Kv and mA reduce the exposure time. A short exposure time is desirable in order to minimize patient movement and accompanying image blurring or unsharpness in the radiograph [20].

X-ray generators:

Cephalometric radiographs can be made with the conventional dental X-ray machine used for making intraoral radiographs. These machines usually use a self-rectified X-ray tube with a stationary anode, 10 to 15 Ma and 70 Kvp. For cephalometric purposes, the tube head of this type of machine is fixed to a stationary device to direct the X-ray beam in a fixed position relative to the patient and film. With medium speed films and screens, the exposure time is approximately 0.6 to 1.2 Seconds [21].

X-ray generators capable of producing X-ray beams with great intensities of X-radiation are available. These machines may use one or more of the following-mA in the area of 100mA, kV in the region of 100kV, a rectified electric current to the X-ray tube and or a rotating anode in the X-ray tube. These X-ray generating systems are more commonly used in medical radiography;

however they have been adapted to cephalometric radiography. When intense high energy X-ray beams are used holograms can be made with very short exposure times (eg. In the region of one stitch of a second). These techniques require the use of equipment with timers capable of reproducing exact exposure times [22].
The dual use of an X-ray tube head for intraoral and cephalometric radiography is also possible for other systems. Since panoramic radiographs satisfy, to a large measure, the clinician's need for an easily made quick and overall view of the maxilla and mandible, it is not unusual to find panoramic machines with the capability of realigning the X-ray tube head for cephalometric radiographic purposes [23].

Patient positioning:

The patient is positioned differently in the X-ray beam for lateral (profile), poster anterior and oblique views of the skull. In all instances, the patient is in an upright position and may be either standing or seated. If the X-ray generator and film are at fixed height, a system for raising and lowering the patient is needed. This can be easily accomplished with a motorized chair [24].

In addition, the connection between the X-ray source and the film or cassette holder must be rigid in order to maintain a constant relationship of the X-ray beam perpendicular to the surface of the cassette at the spot where the meatus of the patient will be imaged in profile views. The connection of the X-ray source and the cassette holder may be either a metal bar or the wall or floor of the room [25].

A cephalostat or head holder is used to stabilize the patient in a fixed position in the X-ray beam. It basically consists of two ear rods that move simultaneously individually along the path of the central ray. The device holds the patient steady with the central ray in the transnational axis. A variety of additional adjustments have been built into the basic cephalostat. Many of these adjustments have been calibrated to measure standardized patients' positions. Cephalostats with measurement capabilities are called cephalometers. While rotation of the patients head on the transmeatal axis does not change the radiographic image for lateral projection. It is not uncommon for an operator to standardize the position of the F-H plane to be in or close to the horizontal. Standardizing the F-H plane is accomplished on a cephalometer with an orbital pointer. The pointer consists of a vertically adjustable horizontal rad that is positioned at the patient's Orbitale. Another method of standardizing the FH plane is the use of a forehead positioner located at the nasion. Some operators prefer to have the patient oriented in a natural head position. This can be accomplished by placing a mirror on a wall in front of the patient and asking the patient to look directly into the mirror image of their own eyes. In conjunction with the mirror, the operator may place a vertical line on the mirror where the centre of the cephalometric image is located as seen from the patient position (i.e. at night angles to the central ray of the X-ray beam). The line is used by the patient to orient his midsagittal plane in a vertical position. An alternative to the line on the mirror is a plumb bob hung from the ceiling on a line of cord directly in front of the patient's face. The line is perpendicular to the central ray of the X-ray beam and is positioned in the vertical plane i.e. perpendicular to the mirror and located in the middle of the cephalostat. The plum-bob line can be used by both the patient and the operator to position the mid sagittal plane of the patient. Although, patient to X-ray source distance is standardized at 5ft. the patient to film distance may vary among operators. Image magnification may thus vary between radiographs.

Therefore, to indicate the magnification in each radiograph, some cephalometry incorporates a vertical radiopaque ruler or scale located in the midsagittal plane. Measurement of the image of the ruler in a radiograph indicated the amount of magnification in the particular radiograph. This system permits correction of the measurement error due to magnification and normalizes the measurements obtained from a group of cephalometric radiographs made with different degrees of magnification [26-30].

Most cephalometres can be rotated on the vertical axis through 360 degree. The patient can therefore be positioned with the central ray in the midsagittal plane for PA or AP cephalograms, or many different oblique views of the skull. When AP, PA or oblique views are made, the orientation of the FH plane around the transmeatal axis is important because the superposition of different parts of the skull upon each other can occur with different FH plane positions. If the plane is not standardized, vertical dimensions in the radiograph can vary, making subsequent measurements and comparisons unreliable. In most instances, the FH plane is fixed in a Bolton roentgenographic cephalometer produced with lateral and posterior-anterior cephalograms city the patient fixed in position in the cephalometer. The equipment utilizes two X-ray tube head-film holders located at right angles to each other [31].

In dental cephalometric radiography, the position of the patient's mandible is not fixed in the cephalometer. Cephalometric radiographs are made with the patient's teeth in occlusion. Cephalograms, however, can also be made with the mandible in the rest position or the wide open position if desired [32].

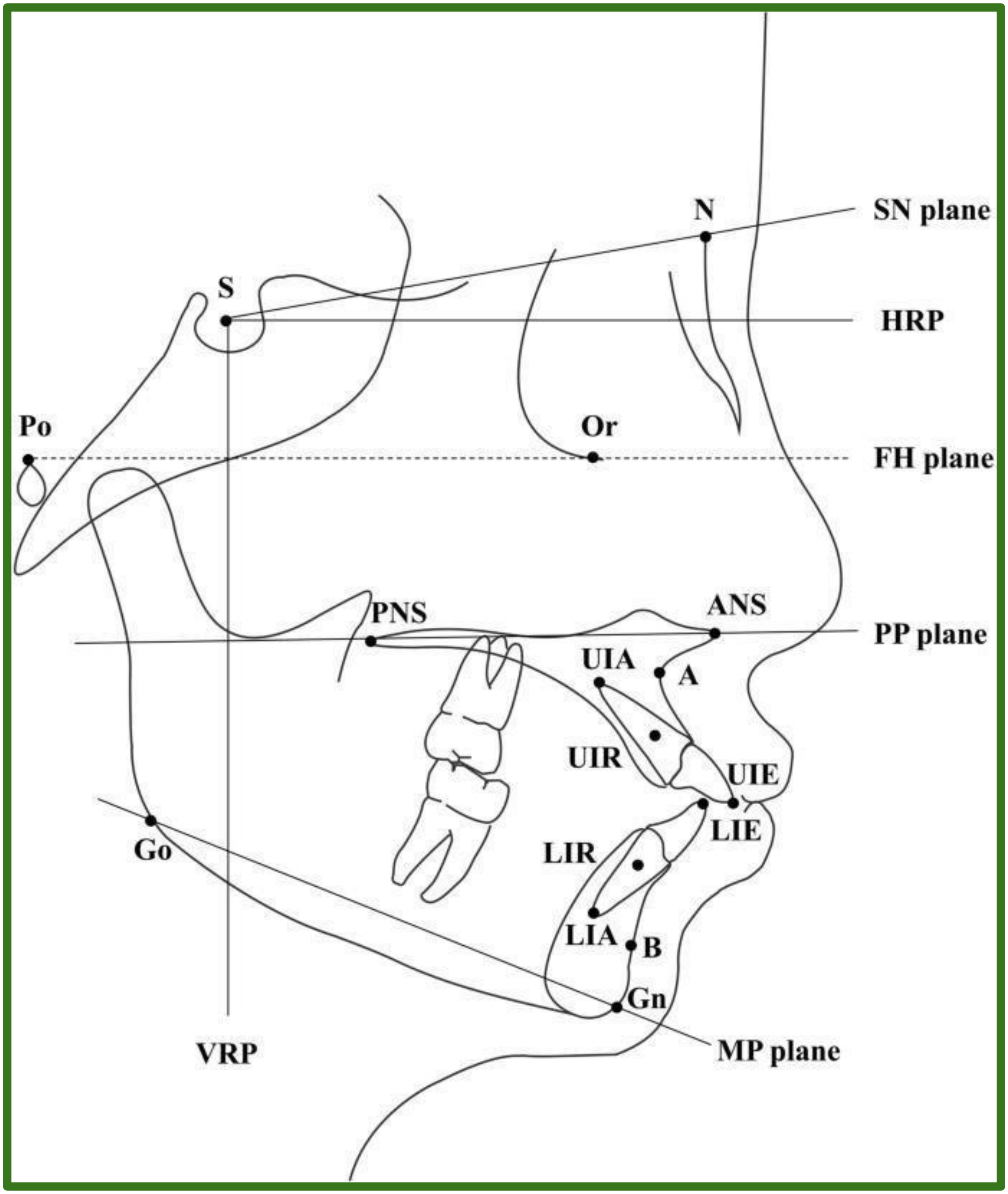

Figure 1: Illustration of cephalometric landmarks

[Courtesy: Sun, Q., Lu, W., Zhang, Y. *et al.* Morphological changes of the anterior alveolar bone due to retraction of anterior teeth: a retrospective study. *Head Face Med* **17**, 30 (2021). https://doi.org/10.1186/s13005-021-00277-z]

CEPHALOMETRIC LANDMARKS- LINES, PLANES AND ANGLES

Cephalometrics makes use of certain landmarks and points which are used as a guide for Measurement and construction of planes.

They are classified as: Anatomical and Dental landmarks.

Anatomical landmarks: They represent the actual anatomic landmarks of the facial skeleton.

Dental landmarks: They are derived secondarily from the anatomical structures in the Facial skeleton.

Following is a description of these landmarks:

Point A: It is the deepest point in the midline contour of the alveolar process between the anterior nasal spine and the Prosthion.

Point B: It is the most posterior midline point in the concavity of the mandible between the most superior point on the alveolar bone overlying the lower incisor and the Pogonion.

Anterior nasal spine: It is the anterior tip of the sharp bony process of the maxilla at the lower margin of the anterior nasal opening.

Articulaire: It is a point at the junction of the posterior border of the ramus and the inferior border at the posterior cranial base.

Basion: It is the lowest point on the anterior rim of the foramen magnum.

Bolton point: The highest pointing profile radiograph at the notches on the posterior end of the occipital condyle on the occipital bone.

Broadbent registration point: It is the midpoint of the perpendicular from the center of the Sella tursica to the Bolton plane.

Glabella: It is the most anterior point on the frontal bone in the midsagittal plane of the bony prominence joining the supraorbital ridges.

Gnathion: It is located in the median plane of the mandible at which point the anterior cune in the outline of the chin merges into the body of the mandible. It is also defined as the most anterior and inferior point of the bony chin.

Porion: It is the superior most point on the upper border of the external auditory meatus.

Prosthion: The lowest point on the maxillary alveolus in the median plane between the maxillary central incisors.

Pterygomaxillaire: Point of intersection of the Pterygoid process of the sphenoid bone and the Pterygoid process of the maxilla where they begin to form the pterygomaxillary fissure.

Sella (S): It is the center of the Sella tursica.

Subnasale: Point where the nasal septum merges inferiorly with the integument of the upper lip.

Stomion: It is the midpoint of the oral slit where the lips are closed.

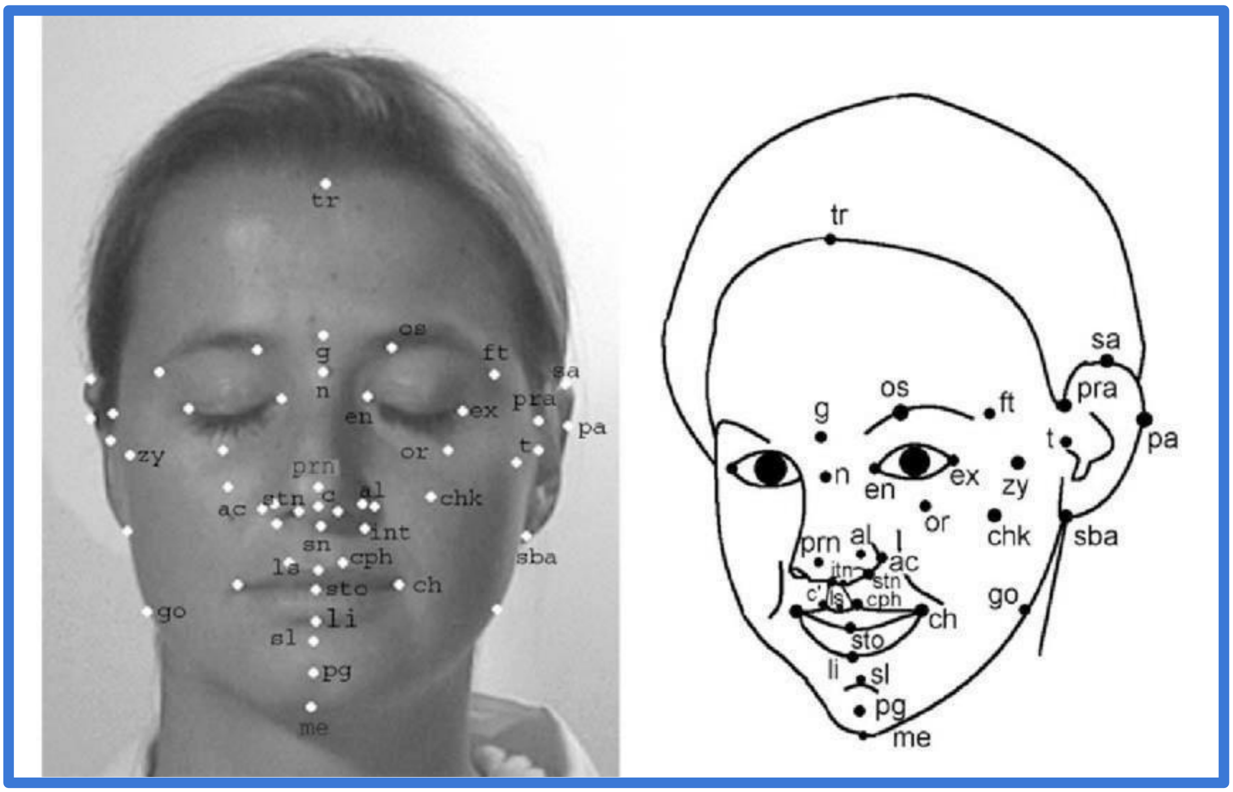

Figure 2: Illustration of soft tissue landmarks

[Courtesy**:** https://www.researchgate.net/publication/285475495_Soft-tissue_facial_anthropometry_in_three_dimensions_From_anatomical_landmarks_to_digital_morphology_in_research_clinics_and_forensic_anthropology/figures?lo=1**]**

Lines and planes in cephalometrics:

S-N line: It represents the anterior cranial base

Bolton plane: It connects three points in pace i.e. the two Bolton points and the Nasion. It represents the cranial base.

Frankfort Horizontal plane: It connects the Orbitale and the Porion

Palatal plane: It connects ANS and PNS.

Occlusal plane: It is a denture plane which bisects the occlusion of the permanent molars and premolars extending anteriorly. In an ideal situation, it also bisects the occlusion of the incisor teeth.

Mandibular plane: It connects the Gonion to the Menton.

Basion-Nasion line: It represents the cranial base.

Facial plane: It connects the nasion to the Pogonion.

Facial axis: It is a line which extends from pt to the cephalometric Gnathion ie; the intersection of the facial and mandibular planes.

Condylar axis: It extends from DC point (Centre of the mandibular condyle on the Basion-Nasion line) to the Xi point (Centre of the mandibular ramus)

Corpus axis: A line from Xi point to the PM point representing the length of the boy Mandible.

A-Pog: A fine from point A to the Pogonion. It represents the maxillomandibular relationship.

E-line: It is the line between the most anterior points of the soft tissue nose and the chin.
Incisal axis: the long axis of the maxillary and mandibular central incisors.

Incisal axis: The long axis of maxillary and mandibular central incisors [33-40].

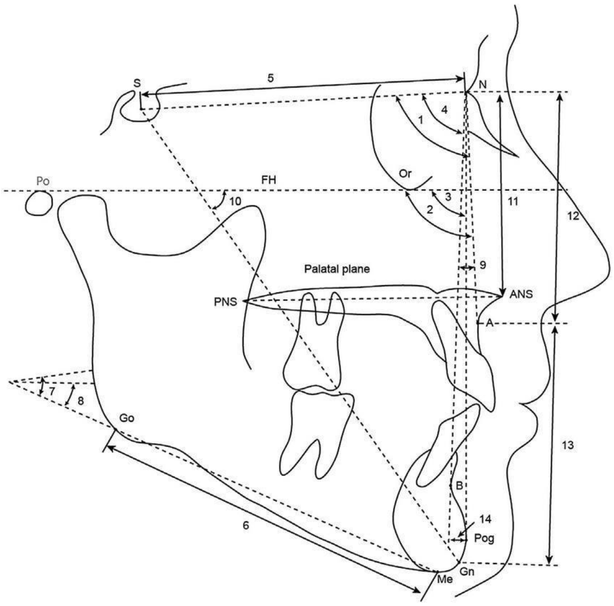

Figure 3: Illustration of lines and planes on lateral cephalogram

[Courtesy: Ye, Bin & Wu, Yeke & Zhou, Yuqiao & Jing, Huan & Hu, Jing & Zhang, Guozhi. (2015). A comparative cephalometric study for adult operated cleft palate and unoperated cleft palate patients. Journal of Cranio-Maxillofacial Surgery. 43. 10.1016/j.jcms.2015.04.015]

CEPHALOMETRIC ANALYSIS AND THEIR APPLICATION IN ORTHOGNATHIC SURGERY

When the surgeon puts to use the tool of cephalometrics as an aid orthognathic surgery, he is confronted by a number of analyses which may be useful in the accurate diagnosis, treatment planning and result evaluation of his case. Thus, a thorough understanding of the available analyses and their evaluation is essential before proceeding further. This chapter will discuss the various cephalometric techniques, both old and new, available to aid the Maxillofacial surgeon.

Downs Analysis

When observing facial profiles Downs noted that generally the position of the mandible could be used in determining whether or not the faces were balanced.

He classified the facial profile into the following four types:

- Retrognathic
- Mesognathic
- Prognathic
- True Prognathism

Since the Frankfort horizontal plane approximates a level position when standing in a posture of distant vision. Downs elected to use his plane as a reference base from which to determine retro, ortho or prognathism.

The following skeletal parameters are employed:

1. **Facial angle:** It is used to measure the degree of retrusion or protrusion of the lower jaw. It is the inferior side angle in which the facial line (Nasion-Pogonion) intersects the Frankfort Horizontal. The mean reading for this angle is 87.8 with a range of 82 to 95.A prominent chin increases this angle, whereas a smaller than average angle suggests a retrusive chin.
2. **Angle of convexity:** In an effort to measure the extent of protrusion or retrusion of the lower jaw, the relationship of the jaws to each other, the convexity of the maxilla and the inclination of the lower jaw, various landmarks and planes were identified and measured.

The following skeletal measurements were used to assess the preceding criteria:

- The angle of convexity is formed by the intersection of line N-point A to point A - Pogonion.
- This angle measures the degree of the maxillary basal arch at its anterior limit (point A) relative to the total facial profile (Nasion-Pogonion).
- It is read in plus or minus degrees starting from 0.

- If the line pogonion-pointA is extended and located anterior to the N-A line, the angle is read as positive. A positive angle suggests prominence of the maxillary denture base relative to the mandible.
- A negative angle of convexity is associated with a prognathic profile. The range extends from a minimum of -8.5 to a maximal or maximum of +10

3. **A-B Plane**: Point A and B are joined by a line and where the line is extended, the angle formed with the line Nasion-Pogonion is read in much the same way as in the previous determination. The A-B plane is a measure of the relation of the anterior limit of the apical bases to each other relative to the apical line. It represents an estimate of the difficulty in obtaining the correct axial inclination and incisor relationship when using orthodontic therapy. Since point B is located behind point A, this angle is usually negative except in class lll cases or class l cases with prominent mandible. A large negative value suggests a class III facial pattern. The readings extend from a maximal of 0 to a minimal of -9 with a mean reading of -4.6

4. **Mandibular plane angle:** The mandibular plane according to Downs is tangent to the gonial angle and the lowest point of the symphysis. The mandibular plane angle is established by relating the MP to the F-H plane High mandibular plane angles occur in both retrusive and protrusive faces and are suggestive of unfavorable hyperdivergent facial patterns. High mandibular plane angles complicate treatment and prognosis; however this angular reading is not sufficient to indicate the nature of difficulty that may be experienced in treatment. The range of readings extend from a minimal or 1 to maximal of 28 with a mean reading of 21.9

5. **Y-growth axis:** The Y-axis is measured as the acute angle formed by intersection of a fine from the Sella tursica to Gnathion with the FH plane. This angle is larger in class ll tendencies. The Y-axis indicates the degree of downward, rearward 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 pattern. An increase in the Y- axis is suggestive of vertical growth exceeding horizontal (or forward) growth of the mandible.
   The range extends from a minimal of 53 to a maximal of 66 with a mean of 59.4

The following dental parameters are employed:

1. **Cant of Occlusal plane:** It is a measure of the slope of the occlusal plane to the Frankfort horizontal. This angle is measured by applying the same method used to measure the angle from the mandibular plane to the Frankfort plane. A parallel relationship of the planes would provide a l reading. When the anterior part of the plane is lower than the posterior, the angle would be positive larger positive angles are found in class ii facial patterns. Long rami tend to decrease this angle. The minimal angular measurement is +1.5, the maximal is +14 and the mean is +9.3
2. **Interincisal angle:** The interincisal angle is established by passing a line through the incisal edge and the apex of the root of the maxillary and mandibular incisors. This angle is relatively small in individuals whose incisors are tipped forward on the denture base. The minimum angular reading is 130, the maximal is 150 and the mean is 135.4

3. **Incisor Occlusal plane angle:** It related the lower incisors to her functioning surface at the occlusal plane. The inferior inside angle is read as a plus or minus deviation from a right angle. The positive angle increases as the teeth incline forward. The minimal angle is +3.5. the maximal+20 and the mean is 14.5

4. **Incisor-Mandibular plane angle:** It is formed by the intersection of the mandibular plane with a line passing through the incisal edge and the apex of the root of the mandibular central incisor. This angle is positive when the incisors are tipped forward on the denture base. The minimal angular reading is-8.5,the maximal +7 and the mean is 1.4

5. **Protrusion of maxillary incisors:** It is measured as the distance between the incisal edges of the maxillary central incisor to the line from point A- Pogonion. This distance is positive if the incisal edge is ahead of the point A-Pogonion line and indicates the amount of maxillary dental protrusion. The reading is negative if the incisal edge lies behind the point A-Pogonion line and indicated retruded position of the maxillary central incisors. The minimal reading is -1mm, maximal +5 and the mean +2.7 [41-46].

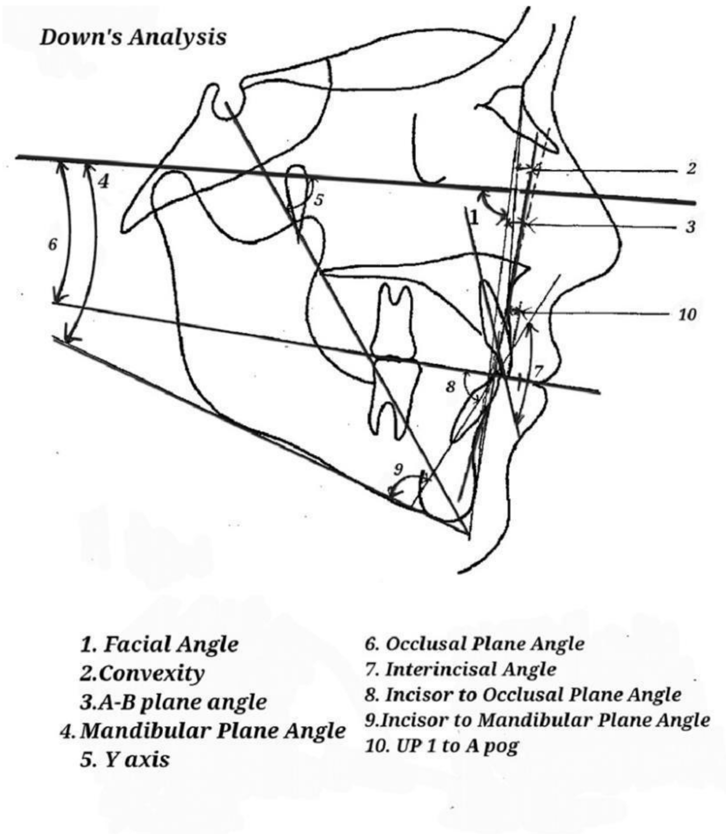

Figure 4: Illustration of Down's analysis

[Courtesy: Rawat S S, Jadhav V V, Paul P (February 19, 2024) A Comparative Analysis of Skeletal and Dental Parameters in Bilateral Cleft Lip and Palate vs. Non-bilateral Cleft Lip and Palate Patients in the Central Indian Population: A NemoCeph Study. Cureus 16(2): e54497. doi:10.7759/cureus.54497]

Steiner's Analysis

The following Skeletal parameters are employed:

1. **SNA:** It is the angle between the SN and NA lines. Normal SNA is 82. It indicates the anteroposterior position of the Maxilla relative to the cranial base. A greater angle indicates a prognathic Maxilla. A smaller angle indicates a retrognathic upper jaw.

2. **SNB:** It is the angle between SN and NB lines. It indicates the relative position of the Mandible relative to the cranial base. Normal value is about 80. A greater angle indicates mandibular prognathism. A smaller angle indicates mandibular retrognathism.

3. **ANB:** It is the difference between SNB and SNA. It indicates the relative positioning of the jaws to each other.

4. **Mandibular plane angle:** It is the angle between SN and Go-Gn planes. The normal value is 32. It is indicative of the growth pattern. Increased value is suggestive of a vertical growth pattern while a low angle suggests a horizontal growth pattern.

5. **Occlusal plane angle:** It is the angle between SN and Occlusal planes. Normal value is 14. Higher angle indicates more anterior facial height. A low angle indicates a low anterior facial height.

The following Dental parameters are employed:

1. **Upper incisor to NA:** It is the angle between the long axis of the upper Central incisor and NA. It indicates the inclination of the upper incisor. A larger than normal angle is seen in class ii div I malocclusion.

2. **Lower incisor to NB:** It is the angle between the long axis of the lower incisor and NB. Normal angle is 25.

3. **Inter-incisal angle:** It is the angle between the long axis of the upper and lower incisors. Normal value is 131. A smaller angle is associated with class 1 bimaxillary protrusion and class ll div I malocclusion.

4. **Upper incisor to NA linear:** This is a linear measurement between the NA plane and upper incisor. Its average value is 4mm. It indicates the relative position of the upper incisor to the NA plane and protrusion or retrusion of the same.

5. **Lower incisor to NB linear:** This is a linear measurement between the tip of the lower incisor and the NB plane. Its average value is 4mm. It is larger than normal in class II div I malocclusion and less in class II div ii and class III cases.

Soft tissue analysis:
A line extending from the soft tissue contour of the chin to the middle of the 'S' formed by the lower border of the nose should just touch the tip of the lips. If the lips are placed beyond this line, it indicates procumberancy and if they are placed behind, it indicates deficiency [47-50].

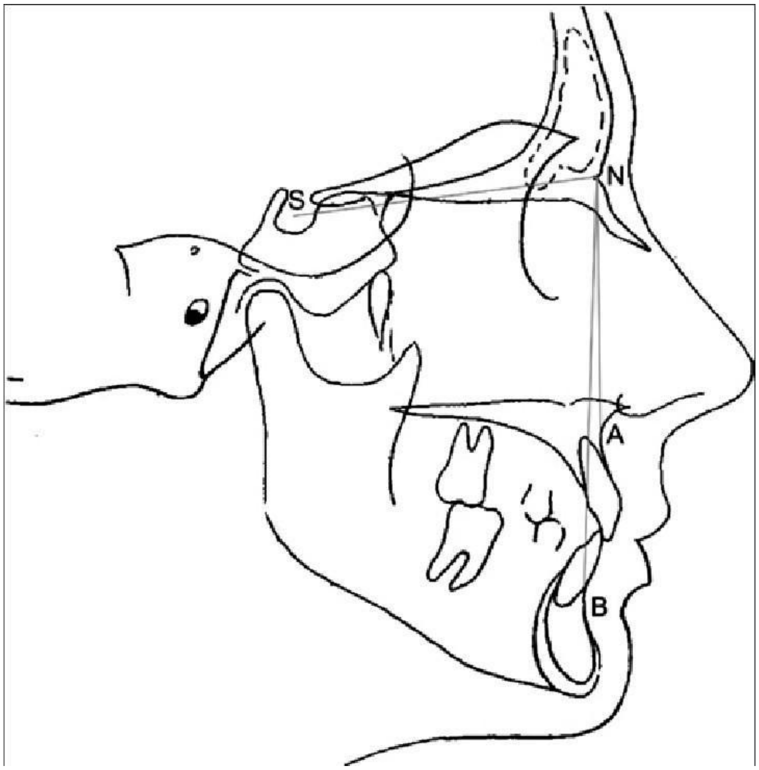

Figure 5: Illustration of Steiner's Analysis

[Courtesy: https://www.researchgate.net/publication/343577467_Which_cephalometric_analysis_for_maxillo-mandibular_surgery_in_patients_with_obstructive_sleep_apnoea_syndrome_Quale_analisi_cefalometrica_per_la_chirurgia_maxillo-mandibolare_in_pazienti_con_sindrome]

Wit's Analysis

Measurements from the cranial base do not always provide a reliable expression of the antero posterior jaw relationship. The Wit's analysis indicates the amount of antero-posterior jaw discrepancy when the ANB angle does not accurately reflect it.

Average value Ao to Bo is 1.5 mm

The greater the deviation from this value, greater is the anteroposterior jaw discrepancy [51].

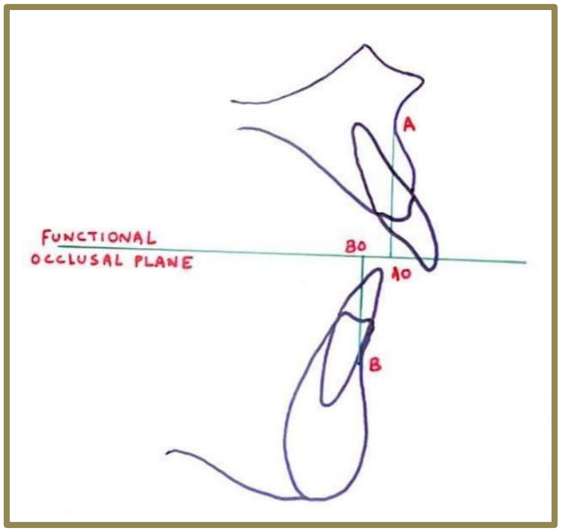

Figure 6: Illustration of Wit’s analysis

Rickett's Analysis

The following Planes are used:

1. **Frankfort horizontal plane:** It extends from Porion to Orbitale.

2. **Facial plane:** It extends from Nasion to Pogonion.

3. **Mandibular plane:** It extends from Gonion to Gnathion.

4. **Pterygoid vertical plane:** It extends on a line drawn from the distal radiographic outline of the pterygomaxillary fissure perpendicular to the FH plane

5. **Basion-Nasion plane:** Extends from the Basion to the Nasion.

6. **Occlusal plane:** The functional occlusal plane is obtained by drawing a line through the molars and premolars.

7. **A-Pog line:** It extends from point A to the Pogonion.

8. **E-line:** It extends from the soft tissue tip of the nose to the soft tissue chin.

The following axes are used:

- Facial axis: It extends from Pt to Gn
- Condylar axis: It extends from De to XI
- Corpus axis:

Interpretation:

1. **Facial axis angle:** It is the angle formed between the Basion-Nasion plane and Pt to Gn plane. The average value is 90. A low angle is suggestive of a retro positioned chin and a high angle suggests a protrusive chin.

2. **Facial depth angle:** It is the angle formed by the facial plane and F-H plane. Average angle is 87 at 9 years of age and increases at the rate of 1 every 3 years. Average adult value is 90. It provides information about the horizontal position of the chin and if the mandible is involved in a skeletal class ii or class III discrepancy.

3. **Mandibular plane angle:** The average value is 26 at 9 years of age and decreases at the rate of I every 3 years. A high angle is associated with an open bite and a low angle is associated with a deep bite.

4. **Convexity at point A:** It is measured from point A to the Facial plane. It is 2mm at 9 years of age. A high convexity is suggestive of class II skeletal pattern while a negative angle is suggestive of a class III pattern.

5. **Lower incisor to A-Pog:** It is used as a reference line to measure the position of the anterior teeth. Ideally the lower incisor is 1mm ahead of the A-Pog line.

6. **Upper molar to Ptv:** This is the distance between Ptv and the distal surface of the upper molar. The average value is 3mm.It assists in indicating whether the malocclusion is due to the position of the upper or lower molar. It also helps in deciding if extraction is necessary.

7. **Lower incisor inclination:** It is the angle between the long axis of the lower incisor and the A-Pog line. The average value is 28. It gives measurement of the lower incisor proclination.

8. **Lower lip to E-plane:** The average value is 2mm. It indicates the soft tissue balance between the lip and the profile [52-57].

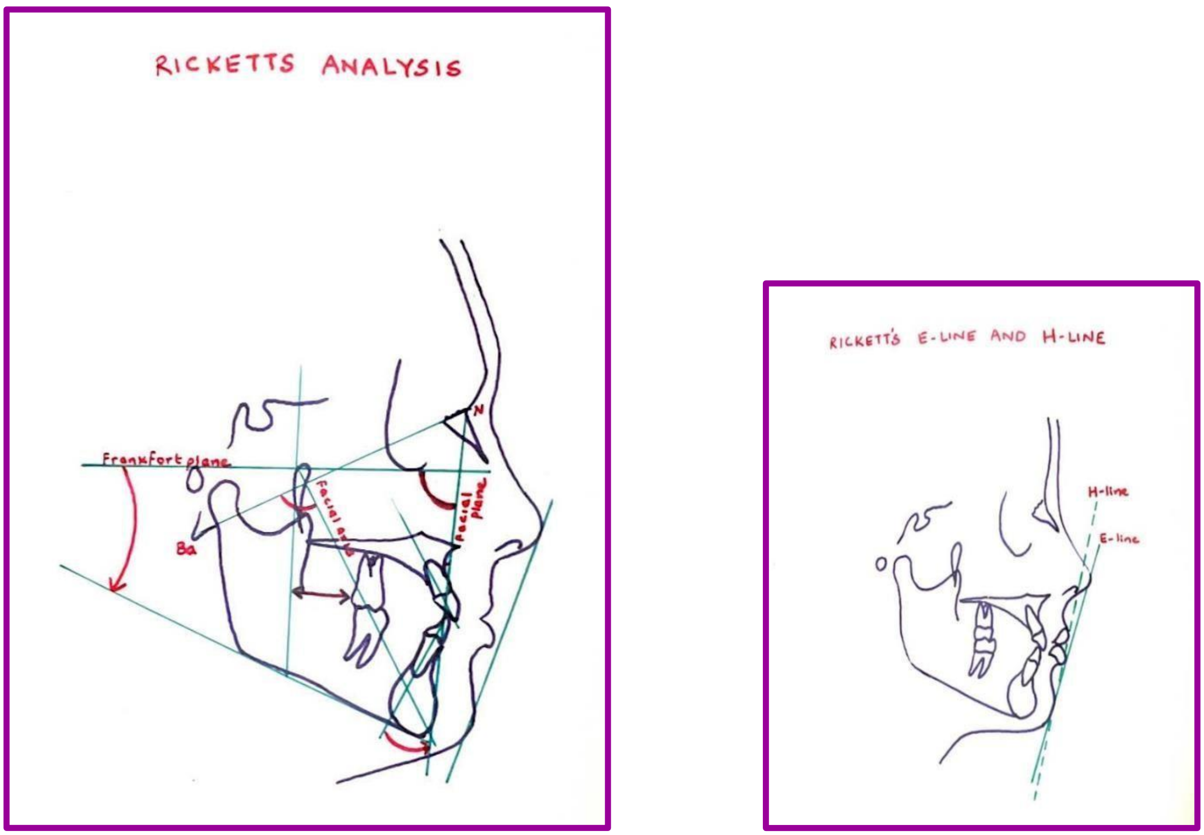

Figure 7: Illustration of Ricketts analysis

McNamara Analysis

It helps in evaluating the following relationships:

- Teeth to teeth
- Teeth to jaws
- Maxilla to Mandible
- Jaws to the cranial base.

It can be analyzed into 2 types.

- Analysis of single film
- Analysis of serial films
- Analysis of single film

Relating the Maxilla to the cranial base:

Nasion perpendicular to point A: This distance is normally 0mm in the mixed dentition period and 1 mm in adult males and females.

Soft tissue profile: The average nasolabial angle is 110. In class all cases the nasolabial angle is more acute while in class III cases it is more obtuse.

Relating the Mandible to Maxilla:

Effective maxillary length: This is the distance between the condylion and point A.

Effective mandibular length: This is the distance between the condylion and the Gnathion.

Maxillo-mandibular differential: It is the difference between maxillary length and the mandibular length.

Lower anterior facial height: It is the distance between the ANS and the Menton. This measurement increases with age. A change in this height cm causes a profound effect on the horizontal relationship of the jaws.

Mandibular angle:

Facial axis angle: Average value is 90. A low angle indicates excessive vertical growth and a high angle indicates a low vertical growth.

Relating the Mandible to the cranial base:

N perpendicular to Pog: It is determined by measuring the distance from Po to the nasion perpendicular.

Relating the upper incisor to the Maxilla:

Antero-posterior position: A vertical line is drawn from point A parallel to the nasion perpendicular. The distance from this line to the facial surface of the upper incisor is 4-6 mm

Vertical position: With the ceph taken with the lips at rest the distance from the incisal edge of the upper incisor to the upper lip is measured and should be about 2-3 mm normally.

Relating the lower incisor to the Mandible:

Antero-posterior position: This is done by measuring the distance between the labial surface of the lower incisor and the A- Pog line. The facial surface of the lower incisor lies 2-3 mm anterior to this line.

Vertical position: It is evaluated on the basis of existing lower anterior facial height.

Analysis of serial films: It is used to evaluate increments of growth and effect of treatment. It includes:

- Cranial base superimposition
- Mandibular superimposition
- Maxillary superimposition
- Maxillary displacement [58-63]

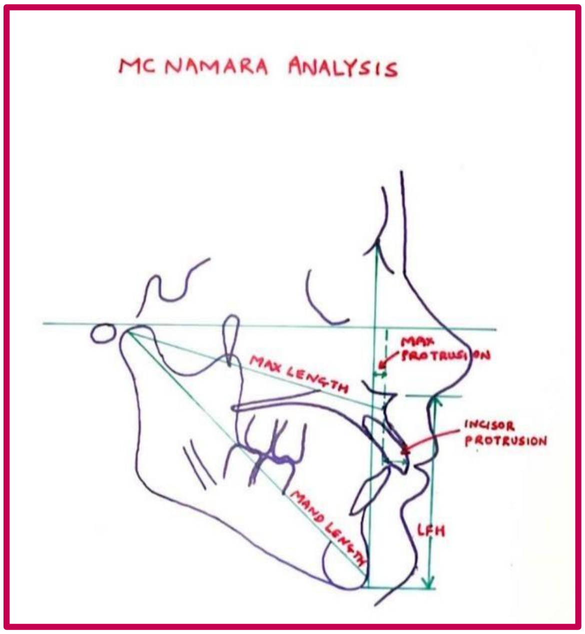

Figure 8: Illustration of McNamara analysis

The COGS analysis

It was developed at the University of Connecticut. It describes the horizontal and vertical position of the facial bones using coordinate system. It makes use of skeletal, dental and soft tissue analysis [64]. The following values and measurements are used:

Cranial base	**Standard value (mm)**
Ar-N	92
Ar-Ptm	35
Ptm-N	57

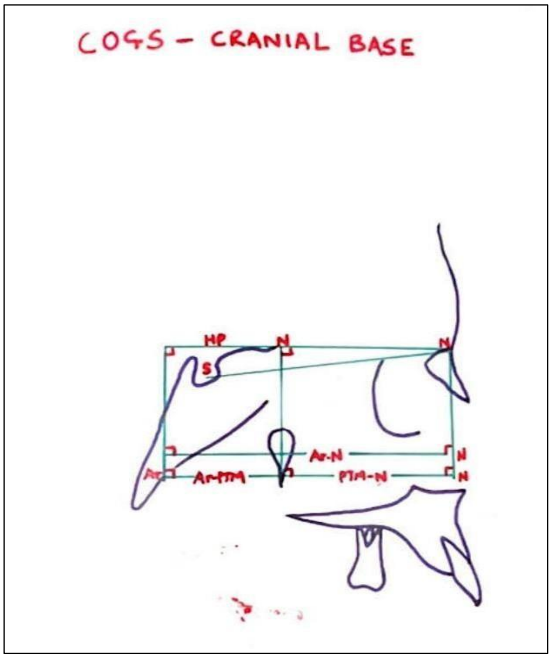

Figure 9: Illustration of cranial base according to COGS analysis

Horizontal skeletal profile	
N-A-Pog	3
N-A	4
N-B	11
N-Pog	10
Vertical skeletal profile	
N-ANS	57
ANS-Gn	71
PNS-N	54
MP-HP	290
Upper incisor-NF	29
Lower incisor-MP	45
Lower molar-MP	31

Dental

OP angle	5
AB-OP	2
Upper incisor - NF	46
lower incisor - MP	90

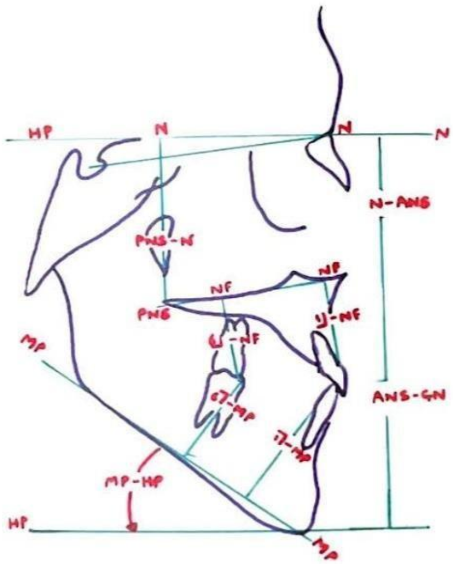

Figure 10: Illustration of vertical skeletal and dental measurements according to COGS analysis

Maxilla-Mandible

PNS-ANS	57
Ar-Go	54
Go-Gn	81
B-Pog	11
Ar-Go-Gn	128

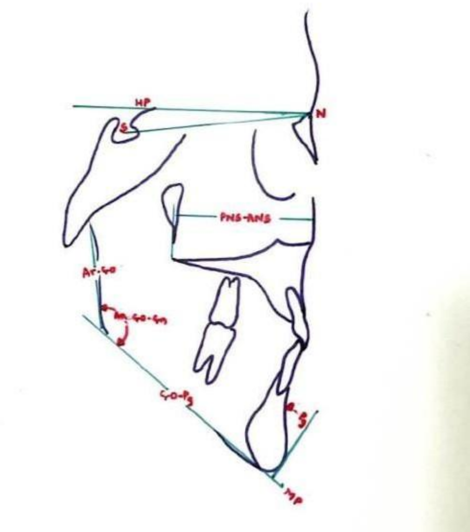

Figure 11: Illustration of length of maxilla and
Mandible according COGS analysis

Moore's mesh diagram

This analysis was developed by Decoster.
The construction of the mesh diagram is as follows:

The Sella-Nasion line is drawn. Line A-Line A is drawn from Nasion at an angle of 85 to the SN plane. LineB-Line B is drawn at right angles to Line A from nasion. Line C-Line C is drawn at right angles to line A and tangent to the lowest point on the bony chin. Line D-Measure the distance between N and B at the place equal to N-S. Now divide their distance into three equal parts. From the point marked make another point on the B-B line at a place equal to 1/3 of the SN line measurement. From this point drop a perpendicular parallel to point A until it meets line C. This line is called the D line. Divide line B into 4 equal parts and draw a perpendicular connecting B to C. Divide line A and B into 4 equal parts and connect three points so as to form a grid of 16 rectangles. Measure the length and width of one of these rectangles. The following landmarks are now added two points where the vertical mesh lines intersect the palate and one point where the vertical mesh line intersects the base of the Mandible.
In view of the great variation in facial dimension found in people with normal occlusion, the greatest value of mesh diagrams is in comparing the profile radiographs in longitudinal studies of individual growth and determining changes brought about by orthodontic therapy during and after treatment [64-67].

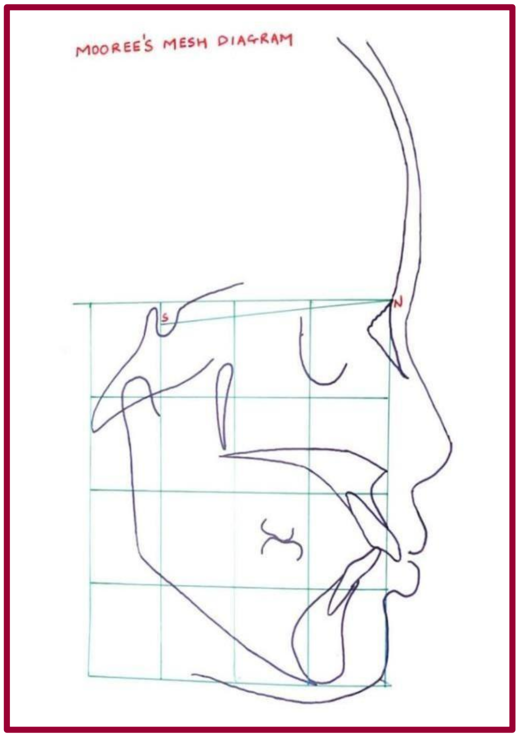

Figure 12: Illustration of Moore's Mesh diagram

Subtelny's analysis

It is a soft tissue analysis.

1. **Skeletal profile analysis:** This is done by measuring the angle N-A-Pog. The mean value is 177.5 at 15 years of age and 175 in adults. Thus it decreases with age.

2. **Soft tissue profile analysis:** It is determined by the angle N-SN-Pog. The mean value is 161 and it does not change with age.

3. **Full soft tissue profile analysis (which includes the nose):** This is measured by the angle N-Nose-Pog. The mean value is 137 for men and 133 for women. The mean value for boys is 137.5 and for girls are 132.9 at 12 years of age. The values vary for different skeletal patterns [68].

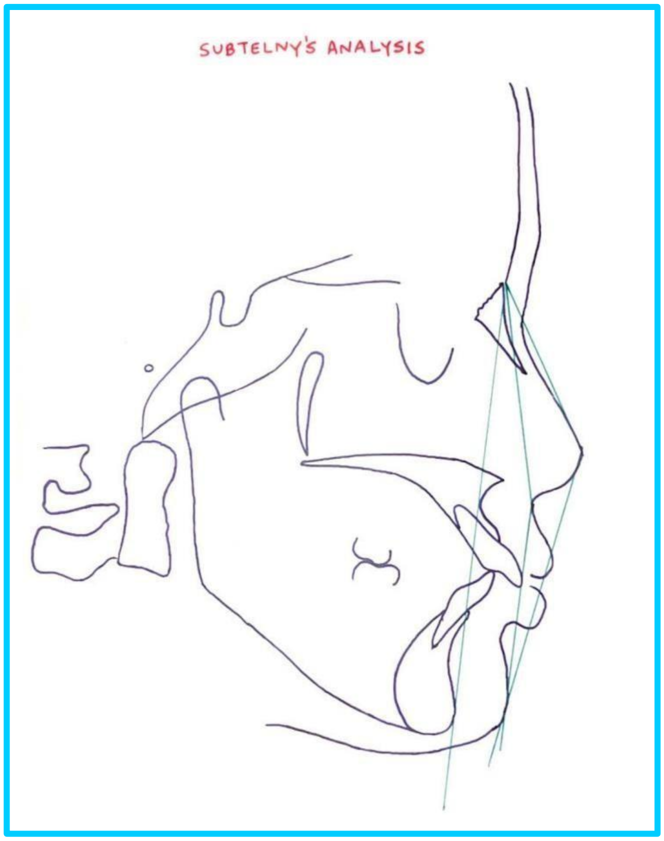

Figure 13: Illustration of Subtelny's analysis

Bjork Analysis

This analysis was done to investigate the effects of variations in jaw growth and prognathism and the relationship between facial form and occlusion. The angles used were N-S-Ar (Saddle angle). S-Ar-Go (Articular angle) and Ar-Go-Gn (Gonial angle) to predict the growth changes in the face. Bjork felt that at the age of Il years the length of the anterior cranial face (S-N) should be equal to mandibular body length 2±1mm (Go-Me) and the ideal ratio of the posterior cranial base length to ramus height is 3:4.The rotation of the Mandible would be clockwise if the ratio between the posterior facial height (S-Go) to the anterior r facial height (N-Me) is 56-62%and anti-clockwise when between 65-80 % [69].

The criteria used are as follows:

Normal values	Criteria
Saddle angle	123+-5
Articular angle	143+-6
Gonial angle	130+-7
Sum of above 3	396
Ant. Cranial base length	71+-3
Post. Cranial base length	32-3
Ramus height	44+-5
Body length	71+-5
Mand. Body : Ant. Cranial base	1:1
SNA	80
SNB	78
ANB	2
Ant. Facial height: Post. Facial ht.	62-65%
Lower incisor to mandibular plane	90+-3
Upper incisor to facial plane	5+-2
Lower incisor to Facial plane	2+-2

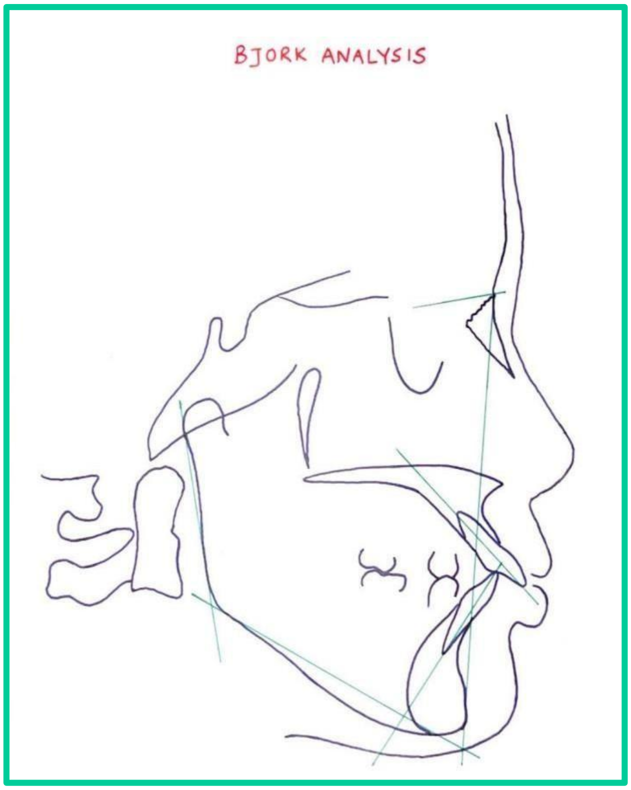

Figure 14: Illustration of Bjork analysis

Tweed's analysis

Angles of the Tweeds triangle and additionally the ANB angle

FMA: It is the angle formed by the FH and the mandibular plane.

Normal value: 25

IMPA: It is the angle formed by the long axis of the mandibular incisor with the mandibular plane.

Normal value: 90

FMIA: It is the angle formed by the long axis of the mandibular incisor with the FH plane

Normal value: 65

ANB angle: The ANB angle is a cephalometric angle used in orthodontics to assess the anteroposterior (sagittal) relationship between the maxilla (upper jaw) and the mandible (lower jaw). It's calculated by subtracting the SNB angle (sella-nasion to B-point) from the SNA angle (sella-nasion to A-point).

Normal value: 2

Tweed's analysis is a two purpose analysis i.e. it helps to determine the position of the mandibular incisor at the end of treatment and secondly to determine the prognosis of treatment.

Determination of prognosis by Tweed's analysis:

- FMA: 16-28: Good prognosis
- FMA: 28-35: Poor prognosis
- FMA: 35 indicates a very poor prognosis [70].

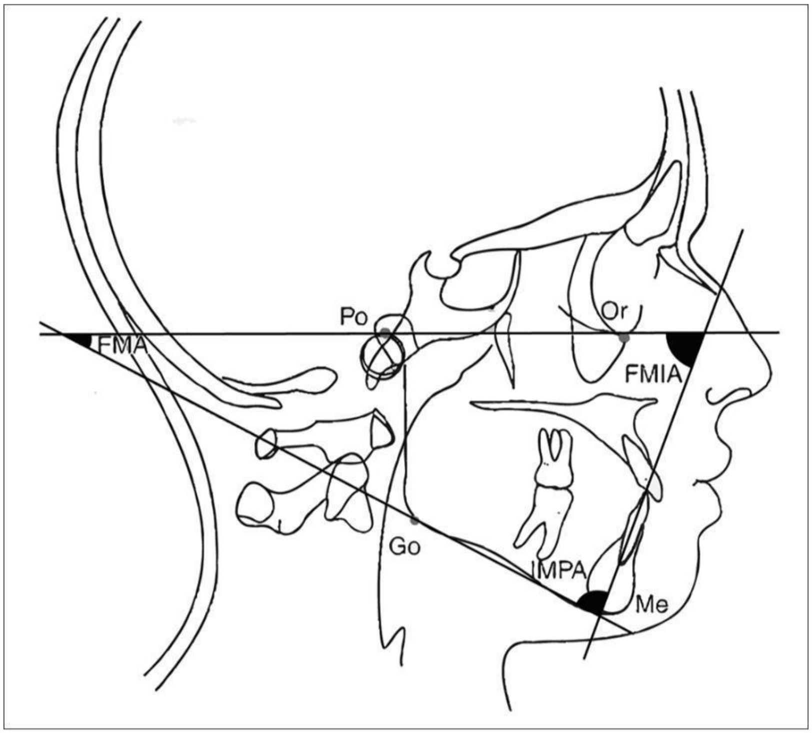

Figure 15: Tweeds Analysis

Quadrilateral analysis

AIM: To identify skeletal deviations in horizontal and vertical planes of space as relates to both the size and the position of the jaws.
Both skeletal and dental component assessment is done.

The measurements used in skeletal assessment include:

1. **Maxillary base length**: measured on the palatal plane between subspinale and the ptm points projected on the palatal plane.
2. **Mandibular base length:** measured on the mandibular plane between point B and point J projected on the mandibular plane.
3. **Anterior lower facial height:** measured between the projection of point A on the palatal plane and point B on the mandibular plane.
4. **Posterior lower facial height:** measured between the projection of ptm pont on the palatal plane and point J on the mandibular plane.
5. **Anterior upper facial height:** measured between the projection of point A on the palatal plane and nasion on the cranial base.

The first four measurements form the basis of quadrilateral assessment of the lower face. It indicates that in a balanced face a ratio of 1:1 exists between the maxillary base length and the mandibular base length and the average of the anterior lower facial height and the posterior lower facial height equals the length of the maxillary or the mandibular bony base [71].

Dental assessment includes

Point A line: The maxillary incisor position is determined by drawing a line through Point A parallel to the anterior lower facial height. The measurement is then made by drawing a perpendicular from this line to the most anterior point on the maxillary central incisor.

Normal value: 5±1 mm

Point B line: The mandibular incisor position is determined by drawing a line through point B parallel to the anterior lower facial height. The measurement is then made by drawing a line perpendicular from this line to the most anterior point on the mandibular central incisor.

Normal value: 2±1mm

Pogonion line: It is constructed by drawing a line tangent to the Pogonion and parallel to the anterior lower facial height. The most anterior point of the mandibular central incisor is then related perpendicular to the Pogonion line. (Indicates if the chin is excessive or deficient)

Normal value: 2mm

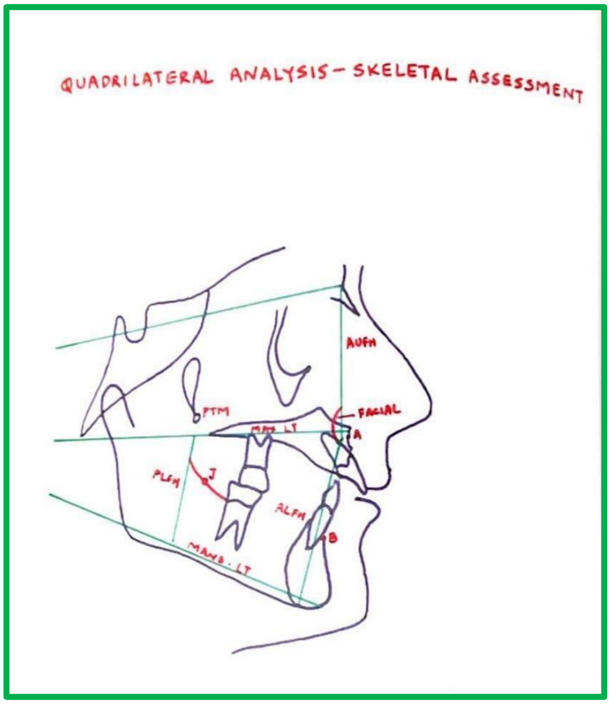

Figure 16: Illustration of skeletal assessment Of quadrilateral analysis

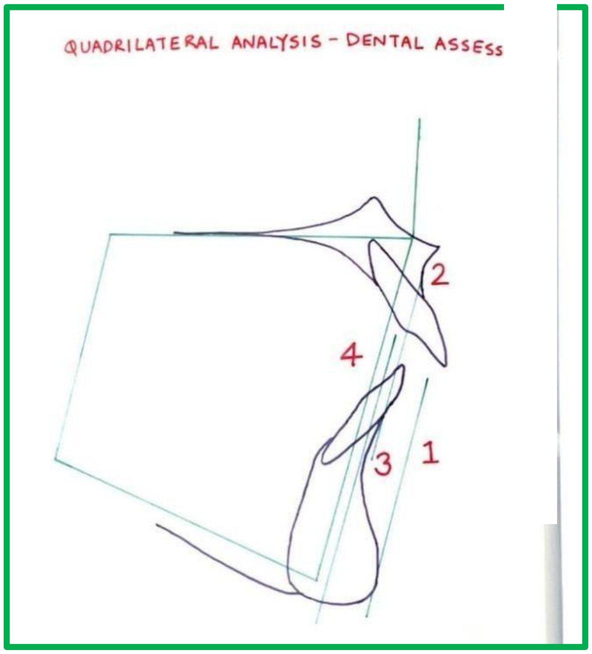

Figure 17: Illustration of dental assessment of quadrilateral analysis

Profile analysis of Schwartz

Three reference lines are constructed for this analysis.

1. H-line: It corresponds to the F-H plane.
2. Pn line: It is a perpendicular from nasion to Pogonion
3. Po line: It is a perpendicular from Orbitale to the H-line

The gnathic field is in between the Pn line and the Po line and permits the assessment of the profile.

In an average straight face the following is observed:

- Subnasale and upper lip touch the Pn line
- The lower lip regresses 1/3 the distance between the Pn line and the Po line.
- Gnathion point is on the Po line
- Pogonion is half way between the Po and the Pn lines
- The width of the gnathic profile is 13-14 mm in children and 15-17 mm in adults [72].

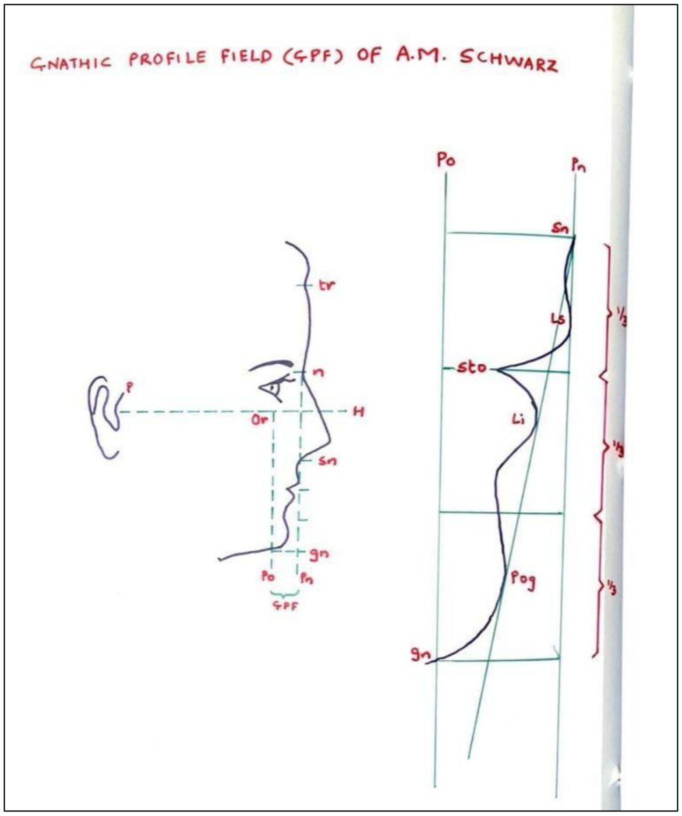

Figure 18: Illustration of Schwartz analysis

Wylie's analysis

It is used to assess antero-posterior dysplasia’s.

The following measurements are made: (points were projected to the FH plane)
- Length of the cranial base from glenoid fossa to the Sella
- Length of the maxillary tuberosity to the Sella
- Length of the maxilla
- Position of the maxillary first molar as measured from the maxillary tuberosity
- Length of the mandible

The following are the standard values for the same.

	Male	Female
Glenoid fossa to Sella	18	17
Sella to ptm	18	17
Maxillary length	52	52
Ptm to max.first molar	15	16
Mandibular length	103	101

The analysis is done on a form wherein the standard values for the particular sex are printed. The patient's values are then entered.

- If the patient's value is more than the standard value the amount of difference is entered in the column titled *orthognathic*.
- If the patient's value is less than the standard value the amount of difference is entered in the column titled *prognathic*.

In the case of mandibular length vice-versa is true. The orthognathic and the prognathic columns are then added up.

- If the orthognathic value is more than the prognathic value then a negative sign is assigned to the difference between the orthognathic and the Prognathic values and a positive sign are assigned if the reverse is true.
- A net positive score indicates a class III tendency while a negative score indicates a class II tendency [73].

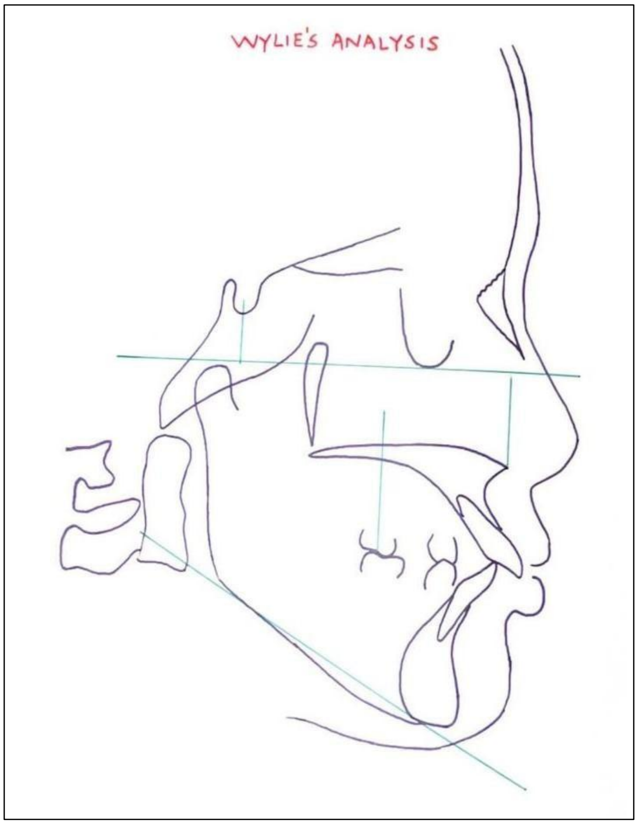

Figure 19: Illustration of Wylie's analysis

Rakosis analysis

Aim: It is used as a diagnostic tool in functional appliance therapy.

It has the following components:

- Analysis of the facial skeleton
- Analysis of the basal bones
- Analysis of the dentoalveolar relationship
- Analysis of the facial skeleton includes:

Analysis of the facial skeleton includes:

1. **Saddle angel:** It is formed by the Sella nasion and Articular

Normal value: 123±5

It is large in retrognathic faces and small in prognathic faces

2. **Articular angle:** It is the angle formed between the sella-auriculair and the Gonion

Normal value: 143+6

It is large in retrognathic individuals and small in prognathic cases.

3. **Gonial angle:** It is the angle between the articulaire-gonion and the menton

Normal value: 128+7

It is small in cases where the pattern of growth of the mandible is horizontal

4. **Facial height:** The anterior facial height is determined by the sella gonion and the posterior facial height is given by the nasion menton. In a horizontally growing individual the anterior facial height is greater than the posterior facial height and vice versa for a vertically growing individual.

Analysis of the jaw bases:
It includes:

- **SNA:** It is large in the prognathic maxilla and small in the retrognathic maxilla.

- **SNB:** It is large in the prognathic mandible and vice-versa.

- **Basal plane angle:** It is the angle formed between the mandibular plane and the palatal plane. It is smaller in the horizontal growth pattern and large in the vertical growth pattern.

- **Inclination angle:** It is the angle formed between the P-N line and the palatal plane.

A large angle indicates upward and forward inclination of the maxillary base while a small angle indicates a downward and backward inclination of the maxillary base.

Linear measurement of the jaw bases are done relative to the SN plane and includes:
1) Maxillary base length
2) Mandibular base length and
3) Length of the ascending ramus.

Analysis of dentoalveolar relationships:
1) Axial inclination of the upper and lower incisors in relation to the SN plane and the mandibular plane respectively. Normal value: 94-100
2) Position of the incisors [74,75]

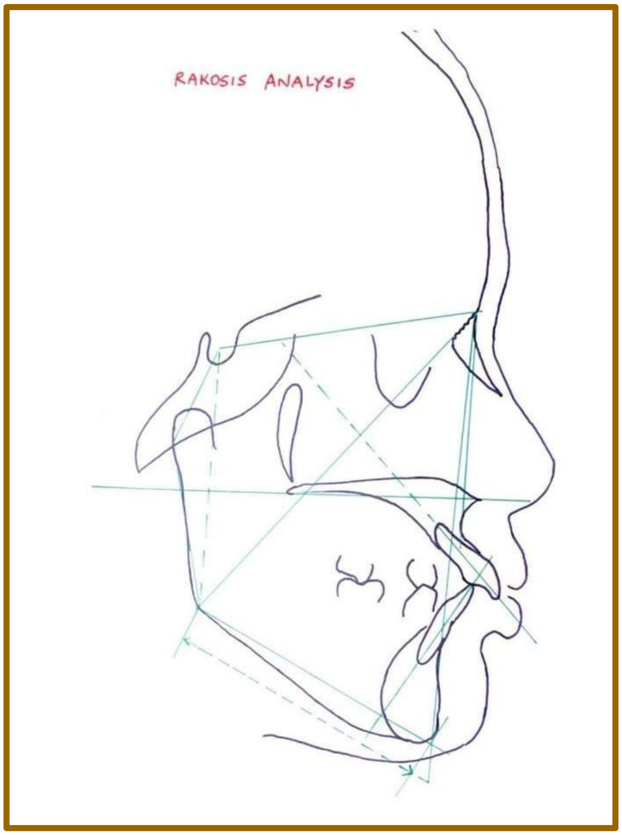

Figure 20: Illustration of Rakosis analysis

Grummon's analysis

It is used to evaluate facial asymmetry

The following landmarks are used:

Ag	Antegonial notch
ANS	Anterior nasal spine
Cg	Crista galli
Fr	Foramen rotundum
J	Jugal process
Me	Menton
MSR	Midsagittal reference line at the crista galli
Nc	Nasal cavity at its widest point
Z	Medial aspect of the zygomaticomaxillary suture
Za	Zygomatic arch
AI	Upper central incisor edge
BI	Lower central incisor edge

The following four horizontal planes are used:

- Z-Z
- ZA-ZA
- J-J
- Menton plane (parallel to the Z plane) [77]

The following are evaluated:

1. **Mandibular morphology:** The left and right triangles are formed by Co, Ag, Me. These are split by the ANS-Me lime and are compared in regards to their linear values, angles and anatomy.

2. **Volumetric comparison:** Two volumes are compared, formed by Co, Ag, Me and a line drawn perpendicular from Co to MSR.

3. **Maxillomandibular comparison of asymmetry:** Perpendiculars are drawn from MSR to J and Ag. Two pairs of triangles are formed by connecting these lines from Cg to J and Ag. Each pair of triangles is bisected by MSR. The two triangles are then compared.

4. **Linear asymmetries:** These are measured from MSR to Co, Nc, J, Ag and Me. The two sides are then compared.

5. **Frontal vertical proportions:** Skeletal and dental measurements are made along the Cg-Me line with divisions at ANS [86]. Al and Bl and the following measurements are made:

Upper facial ratio	Cg-ANS: Cg-Me
Lower facial ratio	ANS-Me: Cg-Me
Maxillary ratio	ANS-AI: ANS-Me
Total maxillary ratio	ANS-Al: Cg-Me
Mandibular ratio	Bl-Me: ANS-Me
Total mandibular ratio	Bl-Me: Cg-Me
Maxillomandibular ratio	ANS-A1: BI-Me

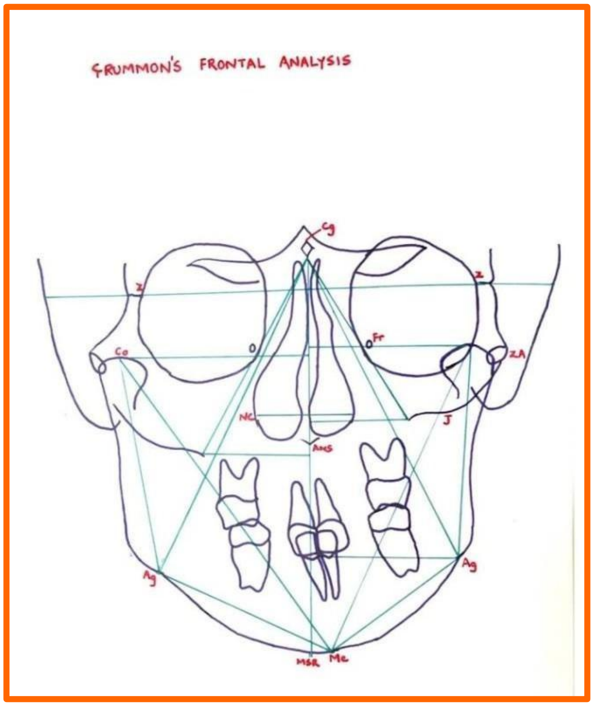

Figure 21: Illustration of Grummon's analysis

DISCUSSION AND SUMMARY

The art and science of cephalometry has evolved, been acknowledged and practiced with an ever increasing enthusiasm and fervour since the first introduction of the technique by Broadbent and Hofrath. It has served generations of practicing orthodontists and maxillofacial surgeons in their efforts toward the correction of the facial form and function of individuals with dentofacial deformities. The literature is flooded with a plethora of cephalometric analysis and techniques all aimed at improving the existing methods and providing a better service to the orthognathic surgical patient.

A number of cephalometric analyses are presently being used in the assessment of dentofacial deformities. These cephalometrics are mostly based on hard tissue assessment alone, although a few methods using soft tissue only or partially hard and partially soft tissues exist. Most of the analysis uses angular and linear measurements, although some are based mainly on measurements of relationships. When the various cephalometric analyses are compared, considerable inconsistency comes to light; so much so that cephalometrics sometimes cannot be considered as a primary diagnostic tool.

It then becomes the duty and obligation of the orthognathic surgeon to choose a standardized method and technique best suited to the needs of his patient which will provide the maximum information and enlightenment to the root of the dentofacial deformity [81-84].

Cephalometrics as a tool in the diagnosis and treatment in orthognathic surgery has several advantages which include:

- It is a non-invasive diagnostic modality.
- The technique is simple and standardized.
- It allows monitoring of both dental and skeletal deformity with the aid of a radiograph and few standard points and planes and thus provides a simplistic method of analysis.
- lt provides assessment of the skeletal growth pattern and form of the facial skeleton and is a valuable source in treatment planning.
- It provides a very efficient means of comparison of the pre and post treatment dental and skeletal changes.
- It provides a baseline reference for future surgical procedures that the patient may have to undergo in relation to the correction of his facial deformity.
- Prediction cephalometry has served as a very valuable method in cephalometry as it can provide the foresight into the results which could be expected postoperatively.
- Cephalometry can also be used as a tool for discussion with the patient about his existing problems and can serve as a means of patient education and motivation.
- The recent advances in digital and computerized cephalometrics have further created new avenues and simplified pathways to the diagnosis and treatment of the orthognathic surgical patient.

Every method has its own disadvantages and cephalometrics is no exception.

Following are some of the inherent disadvantages of cephalometrics:-

- It presents a two dimensional representation of three dimensional deformity
- It relies on a set of anatomical points and landmarks which can be subject to individual anatomic variation.
- Established measurements are used as standard norms for comparison and evaluation and these themselves are subjected to individual variations.
- The operator is faced with a multitude of cephalometric methods and techniques from which to choose from and this can be confusing and misleading at times.
- Surgeons tend to rely on mathematical measurements and ignore the clinical findings which could be more significant pertaining to the case.
- In case of certain dentofacial deformities such as those associated with the craniostenotic syndromes, the standard reference points and plane may be markedly misleading due to the grossly distorted anatomy.
- Cephalometric measurements and tracings can be said to be a combination of science, art and a bit of imaginative thinking and incorporate the inevitable 'operator error'.
- Radiation exposure is an inherent drawback of the procedure
- Other factors such as availability of the equipment and cost are also significant considerations.

Thus, it is clear that though cephalometry is a valuable aid in diagnosis and treatment it has to as a rule be correlated with other parameters such as clinical examination and model analysis so as to provide the optimum treatment to the patient with dentofacial deformity which best suits his needs and who is need of orthognathic surgical correction.

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ABOUT THE BOOK

Discover the Power of Precision

This essential text unravels the science and clinical relevance of cephalometry in orthognathic surgery. From foundational anatomical landmarks to advanced radiographic analyses, "Cephalometrics for Orthognathic Surgery" offers a structured, insightful approach to the diagnosis of Dento-facial deformities and treatment planning.

What's Inside:

- A thorough overview of key cephalometric techniques and applications
- Detailed discussion of landmark-based analyses (Downs, Steiner, Ricketts, McNamara & more)
- Real-world utility in diagnosis, treatment planning, and post-surgical evaluation
- Considerations of both strengths and limitations of cephalometric tools
- Integration of soft and hard tissue evaluations with clinical judgment

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Dr. Vikram Karande is currently working as Professor and Head, Department of Oral and Maxillofacial Surgery at DY Patil Dental School, Pune. He completed his graduation and Master's from the prestigious Nair Hospital Dental College, Mumbai, under the guidance of Dr. Neelam Andrade. He was awarded for securing the highest marks in OMFS in the post-graduate University exams of 2006, Univ. of Mumbai. He has since been actively involved in teaching and research, with 18 years of teaching experience in the field of Oral and Maxillofacial Surgery. His areas of special interest include Pathology , TMJ, Trauma & Dento-facial deformities. He has, to date, published over 30 research publications in both National and International journals. He is also an esteemed member of the editorial board of the Oral Sphere Journal of Dental and Health Sciences.

He has been a Postgraduate Teacher in the subject of Oral and Maxillofacial Surgery at MUHS. He is the recipient of several awards, both at the State and National levels. He was awarded by the Government of India for his work as Assistant Clinical Director during the Special Olympics, as part of the celebrations marking India's 75th year of independence. Additionally, he rendered selfless service during the COVID-19 pandemic and was awarded the title of "COVID warrior" by the Municipal Corporation of Greater Mumbai (MCGM). He has presented several award-winning scientific papers at both the State and National levels during his student days and as a faculty member of Oral and Maxillofacial Surgery.

He has a passion for teaching and academics, and his work has centered on creating innovative teaching methods for both undergraduate and postgraduate students. This book is a reflection of his efforts in this regard, which he completed under the guidance of his mentor, Dr. Neelam Andrade.

Dr. Neelam Andrade

MDS, FRCPS (Glasgow, UK), FAOMSI, FIBSCOMS
Director of Medical Education & Research, Municipal Corporation of Greater Mumbai (MCGM)
Dean & Head of Department, Department of Oral & Maxillofacial Surgery, Nair Hospital & Dental College (NHDC), Mumbai

Dr. Neelam Andrade has over three decades of experience in teaching, performing surgeries, and research, both nationally and internationally. She is a distinguished clinician, administrator, and pioneer in the field of Oral and Maxillofacial Surgery, having made significant contributions to various areas, including Distraction Osteogenesis of jawbones, Temporomandibular Joint Surgery, Dentofacial deformities, Oral Submucous Fibrosis, Trauma, and Oral Pathology.

She is also an accomplished academic, with over 80 National and International publications to her name, and has delivered more than 200 keynote presentations worldwide. Dr. Andrade's leadership extends to her role as the Dean at Nair Hospital & Dental College, Mumbai, and Director of Medical Education at MCGM. She has served as a Ph.D. guide and mentored over 30 postgraduate students.

Dr. Andrade has been instrumental during the COVID-19 pandemic, where she was appointed Dean at Asia's largest NESCO Covid Centre in Mumbai. Her leadership and selfless contributions have earned her numerous accolades, including several prestigious awards for excellence in dentistry, such as the Famdent Excellence in Dentistry award, Best Oral & Maxillofacial Surgeon award, and the T.C. White Fellowship from the Royal College of Physicians & Surgeons of Glasgow, UK.

She has pioneered several surgical techniques and classifications, including Andrade's classification for Oral Submucous Fibrosis and Orofacial Tuberculosis, both of which are internationally recognised and widely followed. Her work has been honoured with the prestigious Dr. M.S.N. Ginwala Best Scientific Paper Award multiple times. She is one of the very few stalwarts in the field to have had the honour of delivering the "MSN Ginwala Oration."

Dr. Andrade has held several key roles, including the past president of the Association of Oral & Maxillofacial Surgeons of India (AOMSI) and as member of various editorial boards. She continues to shape the future of Oral & Maxillofacial surgery through her academic, clinical, and administrative contributions.

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