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Facial Types and Orthodontics

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Certification of the Supervisor

I certify that this project entitled " Facial form and orthodontics " was prepared by the fifth-year student Ali Al-Karar Najeh Ameen under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor signature:

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Date 2 / 5 / 2023

بسم الله الرحمن الرحيم

(لَقَدْ خَلَقْنَا الْإِنْسَانَ فِي أَحْسَنِ تَقْوِيمٍ)

صدق الله العظيم

التين - 4

Dedication

This work is dedicated to my family, my father and mother and my friends for their great support and for always believing in me. To my supervisor for his guidance and Support Thank you from all my heart.

Acknowledgment

First of all, thanks and praise to Allah, the Almighty, for inspiring and giving me strength and patience to complete this work, praying and peace be upon His Prophet Mohammed and his Household.

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Introduction:

Facial types play a critical role in orthodontics as they significantly impact the diagnosis and treatment planning of orthodontic cases. The unique skeletal and soft tissue characteristics of different facial types affect not only the esthetic outcome but also the functional and occlusal outcome of orthodontic treatment. Therefore, it is essential for orthodontists to have a thorough understanding of facial forms and how they relate to orthodontic treatment (**Naini,2017).**

The facial type can be evaluated through cephalometric analysis, clinical examination, and digital photography **(Proffit, 2013.)**

Basically, there are three vertical facial types and three anteroposterior facial types. vertical facial types are the **Mesofacial type** that has mesoprosopic face and skeletal and dental Class I pattern, having normal maxillo-mandibular relationship with harmonious musculature and a pleasant issue profile. **Dolichofacial type** which has leptoprosopic face, this pattern is usually associated with Class II, division1 malocclusion. The face is long and narrow and the dental arches frequently exhibit dental crowding. **Brachyfacial type** which has euryprosopic face and the face is short and wide, the mandible is "strong" and "square" and the dental arches are also broad when compared to the ovoid Class I and the narrow Class II division1 arches **(RMO, 2000; Raw *et al*, 2016; Thailander *et al,* 2001; Raji and Garba, 2010).**

Anteroposterior facial types are **Mesognathic** (Orthognathic) facial type that has slight jaw protrusion, flat facial outline and straight profile. **Retrognathic** facial type that has prominent maxilla, mandible posterior to normal and concave profile, and **Prognathic** facial type that has prominent mandible, normal maxilla and concave profile (Proffit ***et al*., 2007).**

Aims of study

This review aimed to identify the different facial types, concerning their classifications, their characteristic features, and their relation with the dental arch form.

Chapter One: Review of Literature

1.1. Growth and Development:

Proffit *et al*. (2007) stated that the term growth usually refers to an increase in size or number while the term development refers to an increase in complexity.

1.1.1. Development of the Facial Soft Tissues

According to **(Bishara, 2001)** skeletal muscles of the head and neck are derived from cells that migrate into this region from somitomeres and from the most cranial somites. Muscles of mastication (Masseter, Temporalis, Medial Pterygoid and Lateral Pterygoid) in addition to the anterior belly of Digastric, Mylohyoid, Tensor Veli Palatini, and anterior Tympani are all derivatives of the first arch. Whereas, the muscles of facial expressions (Frontalis, Orbicularis Oris, Orbicularis Zygomaticus, and Platysma) are derived from the second arch. Facial development results mainly from the enlargement and movement of the frontonasal process, maxillary processes and Mandibular processes. The Mandibular processes are fused anteriorly to form the chin and the lower lip. Nasal placodes are formed by the surface ectodermal thickening of the inferior and lateral portions of the frontonasal process.

1.1.2. Growth and Development of the Craniofacial Complex:

1.1.2.1. Cranial Vault(Brain Case):

It comprises the frontal bone, the parietal bones, squamous part of temporal, and part of occipital and sphenoid bone **(Scott and Symons, 1982;**

Carter, 2004). The frontal bone articulates with the parietal bones at the coronal suture. The parietal bones articulate with each other in the midline at the sagittal suture, also articulate with the occipital bone, behind, at the lambdoid suture. On each side, the occipital bone articulates with the temporal bone **(Snell, 2008).**

1.1.2.2. Nasomaxillary Complex:

The upper facial region consists of nasal, lacrimal, maxilla, zygomatic, vomer, palatine, and pterygoid bones. This regional complex is closely related to the anterior segment of the cranium formed by frontal, ethmoid, and sphenoid bones. **(Poffit, 2012).**

-Postnatal Growth and Development of the Nasomaxillary Complex:

According to **Proffit *et al.* (2007)**, the maxilla develops postnatally entirely by intramembranous ossification. Since there is no cartilage replacement, growth occurs in two ways:

- By apposition of bone at the sutures that connect the maxilla to the cranium and cranial base, and
- By surface remodeling.

A. Sutural Growth

Scott (1957) stated that the sutures of the craniofacial skeleton can be grouped into a number of suture systems. The sutures making up each system are so arranged as to permit growth in a certain direction. The maxillary and craniofacial suture systems are so arranged as to permit downward and forward growth of the upper facial skeleton and especially of the maxilla.

B. Surface Remodeling (Enlow and Bang, 1965)

Bone deposits are added along the posterior margin of the maxillary tuberosity. This functions to lengthen the dental arch and to enlarge the

anteroposterior dimensions of the entire maxillary body. Coordinated with this increase is the progressive movement of the entire zygomatic process in a corresponding posterior direction.

The palatine processes of the maxilla grow in a generally downward direction by a combination of surface deposition on the entire oral side of the palatal cortex with resorptive removal from the opposite nasal side as well as from periosteal labial surfaces of the anterior maxillary arch.

1.1.2.3. Mandible:

1.1.2.3.1. Growth and Development of the Mandible:

In contrast to the maxilla, both endochondral and periosteal activity are important in growth of the mandible **(Proffit *et al*., 2007)**. Between four months of age and the end of the first year, the symphysial cartilage is replaced by bone.
The condyle grows by surface apposition of cartilage and it is possible that interstitial growth of cartilage occurs also **(Israel, 1978; Gardiner *et al*., 1998).** Growth at the condyle usually occurs in a backwards, upwards, and outwards direction **(Scott and Symons, 1982).**

The growth at the condyles compensates for the vertical displacement of the mandible and accommodates for the eruption of the teeth vertically**.** The vertical relationship of the mandible to the upper facial structures was determined not only by growth at the condyles, but also by the length of the muscle and fasciae attached to it. Growth in length of these is, in turn, influenced by growth in length of the neck and the cervical vertebrae **(Jones and Oliver, 2000).**
The general increase in the dimensions of the body of the mandible that occurs throughout growth is due to surface deposition of bone. Though some increase in its height is produced by the deposition along its lower border, this is of small amount; by far the greatest increase is produced by alveolar growth. This occurs throughout

the whole growth period and is of course closely associated with eruption of the teeth and their attainment of the occlusal plane **(Scott and Symons, 1982).**

On the other hand, bone resorption at the anterior border and deposition at the posterior border of the two rami account for the anteroposterior growth of the mandibular rami and body **(Bishara and Ferguson, 2001).**

1.1.2.3.2. Mandibular Rotation

Mandibular rotations are widely known and frequently used in determining the prognosis of both vertical and posterior skeletal deviations, and it is an important phenomenon in human facial growth **(Cohen-Levy *et al*., 2010; Kim *et al*., 2018).** Since the mandible is suspended under the cranium, the mandibular displacement and growth will depend not only on the growth of the condyles, but also on the lowering of the maxillary complex and of the articular fossae relative to the anterior cranial base. Lowering of the maxillary complex will displace the anterior tooth-bearing part of the mandible, whereas condylar growth and lowering of the articular fossae will displace its posterior part **(Solow, 1980).**

If the amounts of lowering of the anterior and posterior parts are not equal, the mandibular displacement will contain a component of rotation, **(Björk , 1960)** chose a descriptive system involving a center which is fixed relative to the mandible, namely the fulcrum in the dental arch around which the mandible revolves.

Björk (1969) stated that forward rotation may occur in the following ways:

Type I: In this type, the one that is usually considered there is a forward rotation about center in the joints which gives rise to a deep-bite, in which the lower dental arch is pressed into the upper, resulting in underdevelopment of the anterior face height.

Type II: Forward growth rotation of the mandible about a center located at the incisal edges of the lower anterior teeth is due to the combination of marked development of the posterior face height and normal increase in the anterior height. The posterior part of the mandible then rotates away from the maxilla.

Backward rotation of the mandible is less frequent than forward rotation.

Two types have been recognized (Björk, 1969):

Type1: Here the center of the backward rotation lies in the temporomandibular gilts, this is the case when the bite is raised by orthodontia means, by a change in the intercuspation or by a bite-raising appliance, and results in an increase in the anterior face height. The underdevelopment of the posterior face height leads to a backward rotation of the mandible, with overdevelopment of the anterior face height and possibly open bite as a consequence.

Type II: Backward rotation here occurs about a center situated at the most distal occluding molars. This occurs in connection with growth in the sagittal direction at the mandibular condyles. As the mandible grows in the direction of its length it is carried forward more than it is lowered in the face, and because of its attachment to muscles and ligaments it is rotated backward.

The rotation of the mandible has an important effect on growth pattern as it could produce different facial types (**Schudy, 1965).**

1.2. Facial Types:

1.2.1. History of facial measurements

Orthodontists were numerically expressing soft tissue proportion over forty years ago.

- **Gosman (1950) measured the following facial proportions:**

1- Bicondylar width: - the greatest width between the head of condyles. The mean of his measurement was 126.8 mm.

2- Bigonial width. The greatest width between the gonial angles. The mean of his measurement was 95.87 mm.

3- Bizygomatic width. The distance between the most lateral points of the Zygomatic arch; the mean of his measurement was 132 mm.

4- Nasal width. The mean of his measurement was 34 mm.

- **Dottaviano and Baroudt (1974) Divided the face into 3 thirds:**

1- Upper third: - from the hair line to the nasal vertex.

2- Middle third: - from the nasal vertex to the columellar-lip angle.

3- Lower third: - from the columellar-lip angle to the inferior line of the chin.

- **Powell and Humphreys (1984)** did a comprehensive study on facial proportions. They explained two methods for evaluating facial height.

From hair line to soft tissue menton, divided into 3 equal thirds in esthetic balanced face (Fig. 1.)

a- upper third:- from hair line to glabella

b- middle third:- from glabella to subnasale,

c- Lower third: - from subnasale to soft tissue menton.

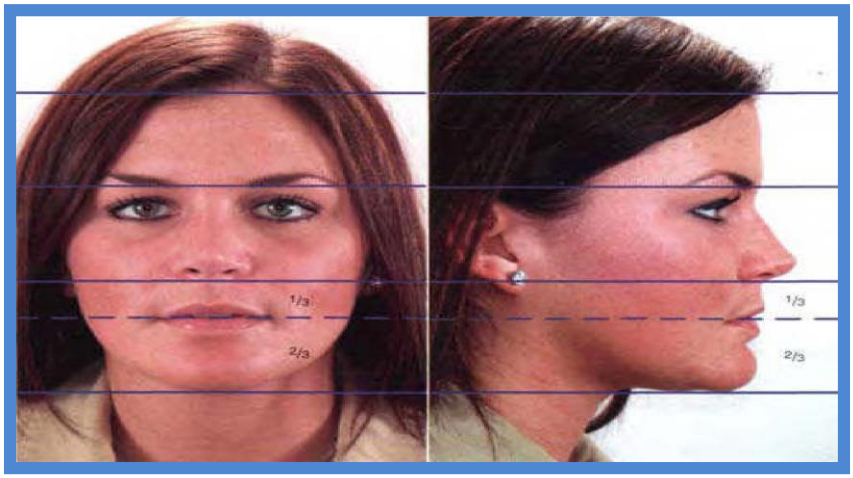
From nasion to menton, divided into

a- Mid facial height: - from nasion to subnasale and form 43% of total Nasion menton length.

b- Lower facial height.-from subnasale to menton, and form 57%of total Nasion Menton length.

They divided the face into five major esthetic masses (Forehead, eyes, nose, lips and chin).

1. Forehead: since the forehead is a. relatively stable mass and is seldom modified, it can be used as a base line reference point for the remaining measurements of the face, the boundaries of it are in the upper one third of the face.
2. The eyes: The boundaries of the orbits are in the lower one third of upper face and the upper one third of the mid face. The "rule of the fifths" breaks down the full face sagittally into five equal parts from helix to helix; each of the five segments should be one eye distance in width.
3. Nose: They considered nose width about equal to the inter canthal distance or approximates one-eye in width. They considered the base of columella of the nose (base of the nose) as subnasale.
4. The boundaries of the lips are included in the lower facial height. The upper lip is measured from subnasale to stomion superius, and the lower lip and chin is measured from the stomion inferius to the gnathion. The normal face should have ratio in length of 2:1 (Lower lip to upper lip) and upper lip form 0.33 of lower facial third and lower lip form 0.66 of lower facial third.
5. Chin: The boundaries of the chin are in the lower facial third, they can be measured from a point at the mentolabial sulcus to menton (or gnathion).



(Fig 1): Division of the face in to three thirds (Proffit *et al*,2007)

(Connor and Moshir, 1985), divided the face into: -

1- Upper facial height-the linear measurement between the eye and subnasale.

2- Lower facial height- the linear measurement between subnasale and soft tissue menton, in addition to that, they measured upper lip length between stomion to soft tissue menton they believed, ideally lower lip should be twice the upperlip length.

The face is divided into three thirds which are roughly equal in vertical dimension. Vertical height of the supraorbital ridges to the base of the nose should equal the height of the lower face (**Proffit and Fields, 2000; Nanda, 2005; Briscoe *et al.*, 2010).**

1.2.2 Facial Index

The facial index is calculated to find the facial morphological types by measuring the relation between facial height and width directly from the face. The length of the anatomical face is measured as a straight line from the nasion to the gnathion. The facial width, the distance between the most laterally projecting points of the zygomatic arch, is measured between the right and left zygions in living persons. The facial height is measured from nasion to gnathion (**Martin and Saller, 1957; Bianchini *et al.*, 2007; Jahanshahi *et al.*, 2008 and Heimer *et al.*, 2008).** (Figure 2).

The facial index is the relation between the height and width of the face, as follows:

$$\text{Facial Morphological Index} = \frac{\text{Facial height}}{\text{Bizygomatic diameter}} \times 100$$

Fig:2 Facial type the index **(Martin and Saller, 1957; Bianchini *et al.*, 2007; Jahanshahi *et al.*, 2008 and Heimer *et al.*, 2008).**

(Fig. 3) Facial index; facial height to bizygomatic width, bitemporal width, bigonial width **(Naini and Gill, 2008).**

Land marks for facial index are **(Raji & Gabra,2010; Jeremic *et al.*,2013)**

1. Nasion: The most anterior midpoint of the nasofrontal suture.
2. Gnathion: In the midline lowest and anterior most point on the chin.
3. Zygomatic prominence: Most lateral point of the zygomatic arch.
4. Morphological facial height: Measured from nasion to Gnathion.
5. Morphological facial width: Byzigomatic distance.

1.2.3 **Classification of the Face**:

Classification of the faces has been done from photograph, skull, radiograph, and by direct measurements. Facial types have been assessed either from the frontal or lateral view.

1.2.3.1 Frontal View:

Ricketts (1980) categorized facial types in the transverse plane and described three basic facial patterns,

- Mesofacial (normal) which is the most average facial pattern
- Brachyfacial (wide) which is horizontal growth pattern and
- Dolichofacial (narrow) which is a vertical growth pattern (Rickets; 1964, Rickets et al; 1980). (fig:4)

Fig: 4 Facial Types in Transverse plane

Powell and Humphreys (1984) described the face as either round, or oval or square diamond or pear shape type.

Graber (1988) described three facial types:

- ❖ The brachycephalic is likely to have a broad dental arch to go with the broad facial structure;
- ❖ The mesocephalic probably have an average dental arch form and
- ❖ The dolichocephalic is most likely to have a long and narrow dental arch to harmonize with the long and narrow face.

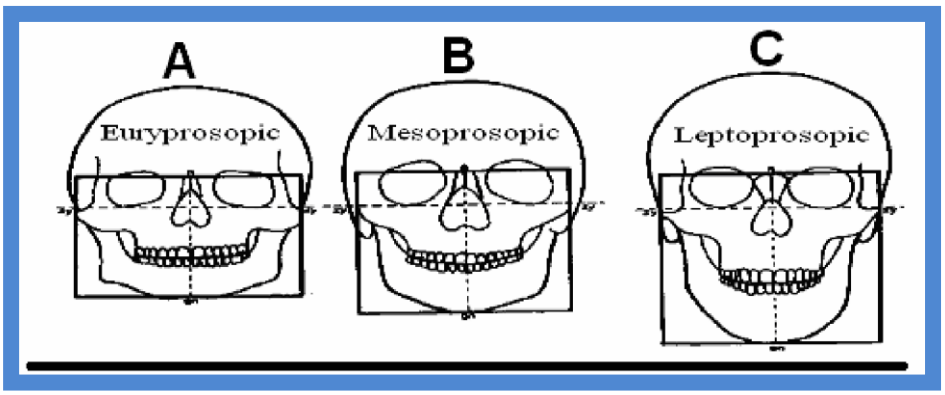
Farkas and Munro (1987); Proffit (1991); Salem(2003) (fig:5) Have determined facial types, by calculating the ratio between interzygomatic distance and anterior facial height, then the face type for each subject is classified as follows:

- Euryprosopic: The facial index is > 0.93
- Mesoprosopic: The facial index is ≤ 0.93 and ≥0.83
- Leptoprosopic: The facial index is<0.83

Euryprosopic facial type is broader and shorter, and frontally appears flat or shallow. It is also characterized by: wide-set eyes; a short, rounded "pug like" nose, with straight or convex bridge and an upturned nasal tip; an upright bulbous forehead; and prominent cheekbones. This facial type corresponds to the brachycephalic headform.

Mesoprosopic facial type is the more neutral and lies between the leptoprosopic and Euryprosopic facial types.

Leptoprosopic facial type the face is narrow, long and protrusive. The eyes are closely set, the forehead is sloping, the supraorbital rims are prominent, and the nose is thin, long and protrusive. This facial type corresponds to the dolichocephalic headform.



(Fig. 5) Frontal Face forms **(Farkas and Munro, 1987; Proffit *et al*, 1991)** A- Euryprosopic. B- Mesoprosopic. C- Leptoprosopic.

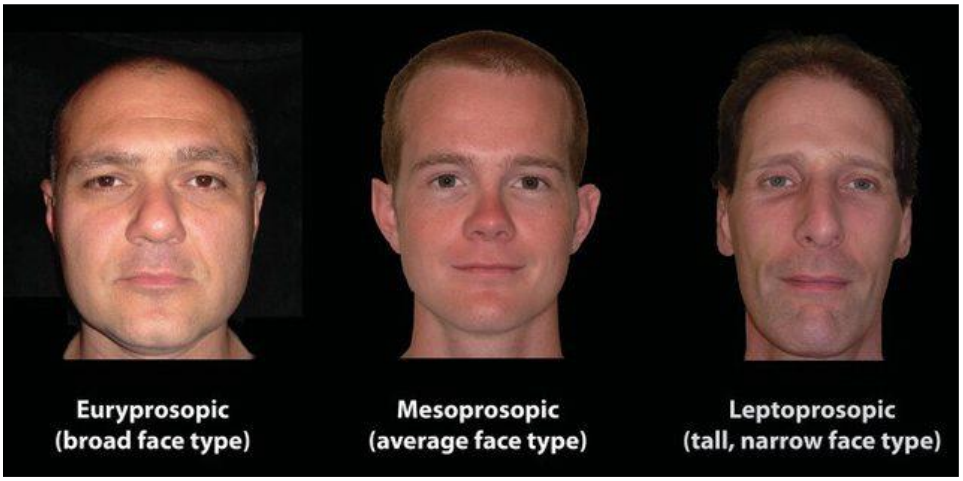


Fig:6 Facial Types according to **(Farkas and Munr, 1987; Proffit 1991)**

Arnett and Bergman (1993) classified the faces as wide or narrow, short or long, round or oval, square or rectangular.

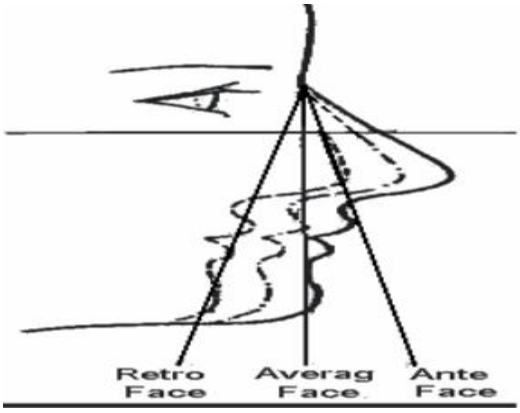
- **The square face** was described as having almost equal distances at the inter-parietal, inter-zygomatic and inter-gonial areas.
- **The oval face** was described as having the inter-zygomatic distance as the widest dimension of the face.
- **The tapered face** was described as having the inter-parietal distance as the widest dimension and the face is directed or tapered toward the chin.

1.2.3.2 Classification of the Facial Profile:

Rakosi (1982) has classified the face in profile view depending on the position of the subnasale relative to the Nasion perpendicular, distinction may be made between the following types: Retro face : Subnasale behind on the nasion perpendicular, average face: Subnasale lying on the nasion perpendicular and ante face: Subnasale in front of the nasion perpendicular.

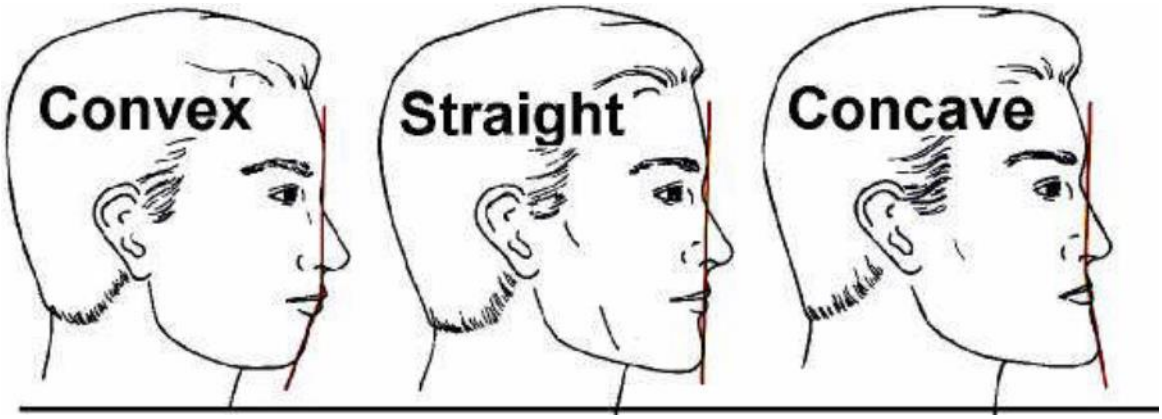
Patient with straight profile usually have normal occlusion or class I malocclusion, those having convex profile having an increase in the probability of having a class II malocclusion associated with retrusive mandible or a protrusive

maxilla, patient with concave profile having an increase in the probability of having a class III associated with retruded maxilla, a protrusive mandible or both see (fig7).



(Fig:7) Profile facial Classification of Rakosi **(Rakosi, 1982)**

Proffit *et al.* (2007) classified the faces into straight, convex, and concave. a convex profile therefore indicates a skeletal Class II jaw relationship, whereas a concave profile indicates a skeletal Class III jaw relationship (fig 8).



(Fig:8) Profile analysis of jaws proportion in anteroposterior plane (**Proffit,2000)**

1.2.4 Facial Types

The likelihood of birth defect in oro-facial tissue is high due to the structural and developmental complexity of the face and the susceptibility to intrinsic and extrinsic perturbation, which result in distortion of the proper mandibular and /or maxillary growth during fetal development **(Joshi *et al.*, 2014)**. The reason for different patterns of head, faces and overall statures is probably attributed to the dominance of one germ layer on the other germ layers **(Raw *et al;* 2016).**

1.2.4.1 Vertical Basic facial types:

Basically, there are three vertical facial types:

1.2.4.1. a Mesofacial type:

it has mesoprosopic face and skeletal and dental Class I pattern, having normal maxillo-mandibular relationship with harmonious musculature and a pleasant issue profile, see (fig:9). It tends to be associated with normally positioned bony bases in the three dimensions of space. If a malocclusion is present, it's etiological factors will generally be more dentoalveolar in nature and usually require less complex treatment. The face is neither too long nor too wide and is associated with similar jaw characteristics and dental arch configurations. The prognosis for orthodontic treatment is usually very favorable because of the aforementioned characteristics **(RMO,2000; Raw *et al*.,2016).**

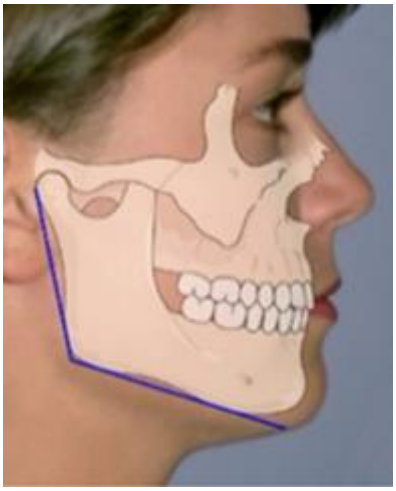


Fig: 9 the mesofacial type

1.2.4.1. b Dolichofacial Type:

It has leptoprosopic face, this pattern is usually associated with Class II, division1 malocclusion. The face is long and narrow and the dental arches frequently exhibit

dental crowding. The musculature is "weak", more often than not, the patient exhibits an anterior open bite tendency due to the vertical growth pattern of the mandible, the maxilla exhibits excessive vertical and the mandibular plane angle is steeper than normal. This growth pattern will result in long and narrow alveolar dental arches in the upper arch. The soft tissue may be strained due to excessive anterior vertical height, especially if the teeth are protrusive **(RMO, 2000; Thailander *et al.*,2001).** The forehead slopes because the forward growth of the upper part of the face carries the outer table of the frontal bone with it. A larger frontal sinus than is characteristic because of the greater separation of inner and outer bones of the forehead, whereas The glabella and supraorbital rims are prominent, and the nasal bridge is high. There is a tendency toward an aquiline or Roman nose because the more prominent upper part of the nasal region induces a bending or curving of the nasal profile. Because the face is relatively narrow, the eyes appear close set, and the nose is correspondingly thin. The nose also is typically prominent and quite long, and its point has a tendency to tip downward. The lower lip and mandible are often set in a somewhat recessive position because the long dimension of the nasal chambers leads to a downward and backward rotational placement of the lower jaw (the dolichocephalic head form also has a more open cranial base flexure, which adds to the downward mandibular rotation). These factors contribute to a downward inclination of the occlusal plane and a marked curve of occlusion **(Kuroda *et al*., 2015)**

- **Cephalometric features are (Rickett, 1981)** (fig:10) **:**

1. Increased gonial angle
2. Steep mandibular plane angle.
3. There is an increase in the lower anterior facial height (ANS-Me points).
4. Mandibular base is usually narrow.

- **Dental features of dolichocephalic facial type (Gupta & Kharbanda, 2012):**

- Narrower dental arch form
- More U-shaped dental arch
- Greater arch length than arch width
- Tendency towards a more V-shaped maxillary arch
- Narrow intermolar width and/or intercanine width.

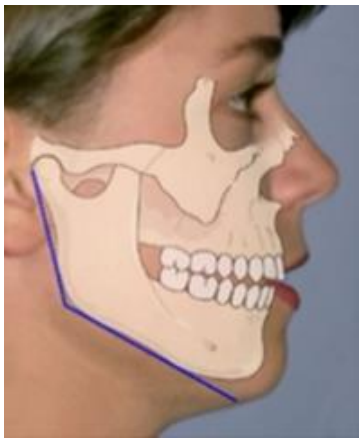


Fig: 10 dolichofacial type

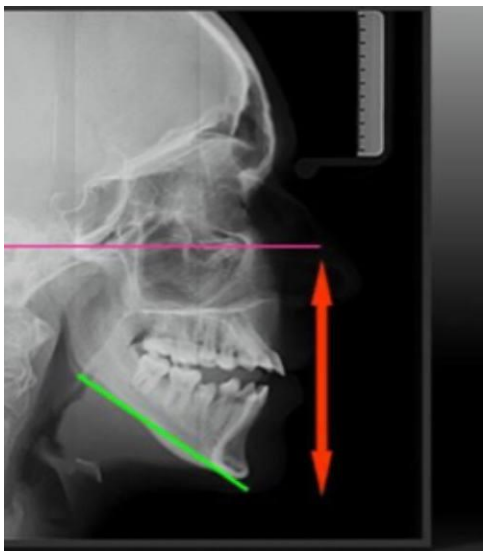


Fig: 11 Lateral ceph. of patient with dolicofacial type

1.2.4.1. c Brachyfacial Type:

It has euryprosopic face and the face is short and wide, the mandible is "strong" and "square" and the dental arches are also broad when compared to the ovoid Class I and the narrow Class II division1 arches. Patients with a brachyfacial pattern usually exhibit deep anterior overbites, which are often skeletal discrepancies. The mandibular vector of growth is usually more forward than downward, producing a favorable prognosis of orthodontic treatment. The majority of untreated ideal occlusions found in the population exhibit brachyfacial tendencies as this muscle growth pattern is very favorable to normal dental development **(RMO,2000; Raji and Garba, 2010).**

The round, broad facial type is characterized by a more upright and bulbous forehead, with the upper nasal part of the face less prominent than in the dolichocephalic face. The nasal chambers are horizontally shorter but wider, in contrast to the narrow but more prominent nasal region characterizing the dolichocephalic head form. The net capacity of the airway in both instances is thus equivalent. There is less protrusion by the supraorbital ridges, the glabella is less prominent, and the frontal sinus is smaller. The nose is shorter vertically as well as horizontally and tends to be more puglike. The nasal bridge is lower, the nasal sides are broader, and the end of the nose often tips upward. The eyes appear widely set and the zygomatic bones seem prominent because the nose and forehead are less prominent. The face appears quite flat and broad, in contrast to the more angular, narrow, deep, and topographically bold appearance of the dolichocephalic face (**Kuroda *et al.*, 2015).**

- **Brachyfacial type has some properties) Proffit, & Sarver, 2013):**
- Characterized by a broad and shortened face

- Tendency to have a protrusive maxilla and/or retrusive mandi
- Wide intermolar width and/or intercanine width
- Increased likelihood of skeletal deep bite. See (fig: 12)

- **The cephalometric features are** (fig: 13) **(Ricketts, 1981):**

1. Maxillary protrusion and/or mandibular retrognathism
2. Decreased lower anterior facial height
3. Decreased gonial angle which is highly represents the mandibular plane forward rotation.

Dental features of brachyfacial type (Gupta & Kharbanda, 2012):

- Wider dental arch form
- More parabolic dental arch
- Greater arch width than arch length
- Tendency towards a more U-shaped maxillary arch
- Wider intercanine and intermolar distance.

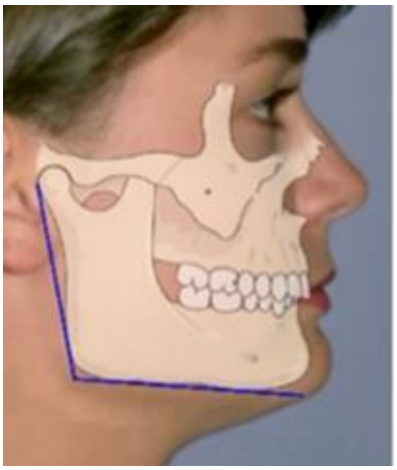


Fig: 12 brachyfacial type

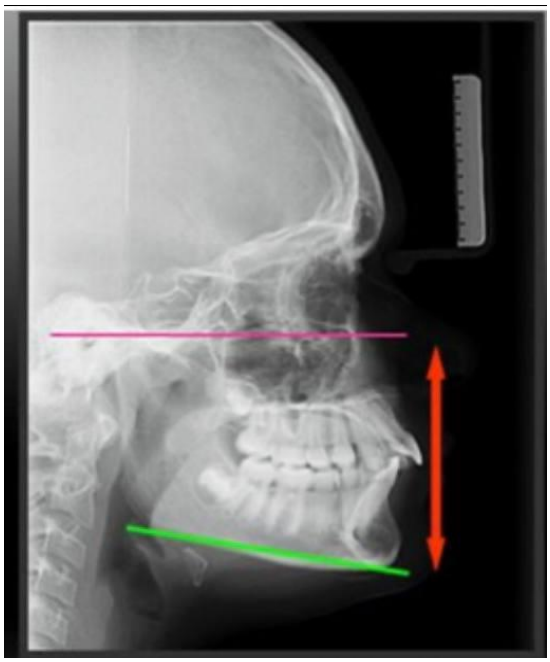


Fig:13 Lateral ceph. of patient with brachyfacial pattern

1.2.4.2 Anteroposterior Facial types:

Proffit *et al*. (2007) classified the faces into straight, convex, and concave. This can be done with the patient either sitting upright or standing, but not reclining in a dental chair, and looking at the horizon or a distant object. With the head in this position, the relationship between two lines is recognized, one dropped from the bridge of the nose to the base of the upper lip, and a second one extending from that point downward to the chin (Fig:14). These line segments should form a nearly straight line. An angle between them indicates either profile convexity (upper jaw prominent relative to chin) or profile concavity (upper jaw behind chin). A convex profile therefore indicates a skeletal Class II jaw relationship, whereas a concave profile indicates a skeletal Class III jaw relationship.

Anteroposterior Facial Types:

1. Mesognathic (Orthognathic) facial type: Has slight jaw protrusion, flat facial outline and straight profile.
2. Retrognathic facial type: Has prominent maxilla, mandible posterior to normal and concave profile.
3. Prognathic facial type: Has prominent mandible, normal maxilla and concave profile.

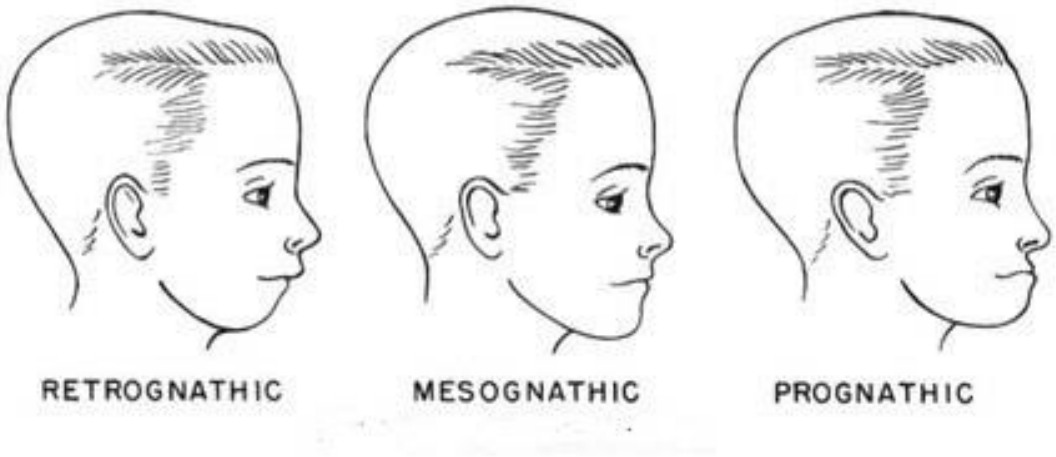


Fig: 14 Anteroposterior Facial types

1.3 Methods of Facial Measurements

1.3.1 Direct Methods

a. Craniometry

Physical measurements of dry skull(Craniometry), and sometimes knows as craniology was one of the scientific methods for measurements of the head and neck, this method was used by ancient Greek, but the use of measurements to compare

skulls was not developed until the 17th century, many of dentoskeletal landmarks could be defined by craniometry **(Finaly, 1980; Proffit, 2012).**

b. Anthropometry

prior to the advent of cephalometric radiography, dentists and orthodontists used anthropometric measurements to help establish facial proportions. It is also better to make the measurements clinically rather than waiting for the cephalometric analysis, because soft-tissue proportions, as seen clinically, could determine facial appearance **(Proffit *et al*., 2007).**

The anthropometric instruments used in this method included large and small sliding calipers and obstetric spreading calipers, and all measurements were done next to the skin **(Pryor, 1966).**

1.3.2 Indirect Methods

a. Cephalometric analysis

Cephalometric analysis was introduced by Broadbent in 1930, it allowed for dentoskeletal structures measurments without interference from soft tissue of varying thickness **(Park, 1986).**

Cephalometric analysis is the process of evaluating skeletal, dental and soft tissue relationships of a patient, by comparing the measurements performed on the patient's cephalometric tracing with the population norms to arrive at a diagnosis of the patient's orthodontic problems **(Daskalogiannakis, 2000).** Lateral cephalometric radiographs have been widely used in the field of orthodontics in order to monitor and predict facial growth (Bjork, 1969), to determine the diagnosis and the treatment plan of an individual patient's malocclusion, to classify skeletal

and dental anomalies with respect to cranial base, skeletal pattern, inter-and intra-arch dental relationships and soft tissue profile **(Janson *et al*., 1994).**

b. Photographs

Photographs can be used to assess the symmetry of the face, profile and facial types, serves as a record of the patient and to assess the progress of a case by comparing the preoperative and postoperative photographs **(Lee *et al*.,2010).**

Photographic analysis has several benefits over the radiographic analysis such as, absence of harmful exposure to radiation, evaluation of craniofacial structure including the contribution of muscles and adidose tissues, and availability of technical assistance **(Ferrario *et al*, 1993).**

- **Types of Photographs used in Orthodontics:**

a. Facial photographs (Graber and Vanarsdall, 2000) stated that ideal photographic representation of the face, the following facial photographs are recommended as the expected routine for each patient:

1. Frontal view: This recommended for facial analysis.

2. Frontal dynamic (smile) view: this recommended to demonstrate the amount of incisor show on smile (percentage of maxillary incisor display on smile), as well as any excessive gingival display.

3. A close-up image of the posed smile view: This is now recommended as a standard photograph for careful analysis of the smile relationships.

4. A three-quarter view (45-degree) photograph: This can be quite useful for examination of the mid-face and is particularly informative of mid-face deformities, including nasal deformity.

5. Profile view: This recommended profiling analysis, common method used for positioning the patient properly is to have the patient look in a mirror, orienting the head on the visual axis.

6. An optional submental view: Such a view may be taken to document mandibular asymmetries.

B. Intra-oral photographs:

The intra-oral photographic series consists of five views: right and left lateral, anterior, and upper and lower occlusal views. The major purpose of the int2ral photograph is to enable the orthodontist to review the hard and soft tissue findings at the clinical examination as all the diagnostic data are being analyzed **(Graber and Vanarsdall, 2000; Sandler and Murray, 2002).**

1.4 Facial type and Dental Arch form:

Appraisal of the facial types or forms is a vital aspect in orthodontic diagnosis, treatment planning and prognosis. Many factors play role in establishing the facial morphology like the anatomy of masticatory muscles **(Chan *et al.*, 2008),** the anatomy of dento-alveolar complex **(Tsunori *et al.*, 1998)** and the types of occlusions **(Dibbets *et al.*, 1996)**. The craniofacial complex growth direction is determined by the facial types and this is important in choosing the type of biomechanics used to treat orthodontic cases **(Collett *et al.*,1993)**.

The relation between the facial forms and the dental arch forms had been studied by different authors. **Tsunori *et al.* (1998)** found that the long-face pattern included a narrow dental arch, while the short face pattern had wide arch. **Graber *et al.* (1972)** found that leptoprosopic (dolichocephalic) individuals have narrow dental arches, while euryprosopic (brachycephalic) individuals have broad, round dental arches. Mesoprosopic (mesocephalic) individuals fit somewhere in between these two.

Al-Shalabi (2002) concluded that there is weak relation between facial forms and arch forms. **Salem (2003)** found an association between mid-arch form with mesoprosopic and euryprosopic facial form in males while in females there was an association of mid arch form with mesoprosopic facial form. **Al-E'nizy (2010)** found a high association between the mid arch form and the average face type and between the narrow arch form with the long face type and the wide arch form with the short facial type. **Ahmed and Ali (2012**) concluded that the relation between facial type and dental arch form is a direct one, and as the facial type graduated from leptoprosopic to mesoprosopic to euryprosopic the maxillary dental arch form increases from narrow to mid to wide. **Paranhos *et al* ., (2014)** concluded that the facial type was not associated with mandibular dental arch forms in individuals with normal occlusion; moreover, **Nayar *et al*., (2015)** failed to find a significant relation between the facial and arch forms. Most of the listed studies used the ratio between the facial height and width as a measure to classify the facial forms with different methods to assess the arch form.

1.5 Key aspects of facial analysis (Marincevic and Pavlicevic, 2015):

Facial analysis plays a crucial role in orthodontics as it provides valuable information about the patient's skeletal and dental relationships, soft tissue profiles, and facial aesthetics

Some of the key aspects of facial analysis in orthodontics include:

1. Facial proportions: The orthodontist evaluates the patient's facial proportions by analyzing the relationship between the different facial features such as the eyes, nose, lips, and chin. This helps to identify any asymmetries or imbalances in the face that may be corrected with orthodontic treatment.
2. Profile evaluation: The orthodontist evaluates the patient's profile by examining the relationship between the nose, lips, and chin. This helps to

identify any overbite, underbite, or protrusion issues that may require orthodontic correction (**Kokich ,2007).**

3. Soft tissue analysis: The orthodontist evaluates the patient's soft tissue profile, including the lips, cheeks, and other facial features. This helps to identify any issues with the patient's facial aesthetics that may be corrected with orthodontic treatment.
4. Skeletal analysis: The orthodontist evaluates the patient's skeletal relationship by examining the position of the upper and lower jaws and their relationship to each other. This helps to determine if the patient has a normal skeletal relationship or if there is any discrepancy that needs to be corrected with orthodontic treatment.
5. Dental analysis: The orthodontist evaluates the position, alignment, and occlusion (bite) of the teeth to determine if there are any dental issues that need to be addressed. This includes examining the spacing between the teeth, the presence of crowding, and any malocclusions (e.g., overbite, underbite).
6. Photographic analysis: In addition to clinical examination, the orthodontist may also use photographs to analyze the patient's facial features. This can include standardized facial photographs, intraoral photographs, and extraoral photographs (**Proffit *et al*, 2013).**

By carefully analyzing all of these factors, the orthodontist can create a comprehensive treatment plan that addresses both the dental and facial issues of the patient. This helps to ensure that the patient achieves not only a healthy and functional bite but also an optimal facial appearance.

Chapter two:

Discussion

Facial types play a crucial role in orthodontic diagnosis and treatment planning, and the assessment of facial type is very important in planning orthodontic treatment and its prognosis. Different facial types have unique skeletal and soft tissue characteristics that can influence treatment outcomes and esthetic results. Moreover, the facial type indicates the direction of growth of craniofacial complex. The terminology used to describe the facial type stemmed from anthropometry which employs measurements taken in living individuals as well as indices that represent the facial proportions. There are three basic vertical facial type termed Dolichofacial (long and narrow face), brachyfacial type (short and broad face) and the intermediat type(Mesofacial). One important consideration in orthodontics is the patient's facial profile. The facial profile can have a significant impact on the overall aesthetics of a person's smile, and it can also affect the way that orthodontic treatment is planned and carried out.

There are three main types of facial profiles: straight (normal), convex and concave. A convex facial profile is characterized by a protruding or prominent upper jaw, while a concave facial profile is characterized by a retruded or recessed upper jaw.

Chapter three:

Conclusions

1. Facial type which is also referred to as facial pattern or facial skeletal pattern is an important determinant factor when selecting the most appropriate orthodontic treatment plan.
2. There are three main facial types:
    a. Mesocephalic facial type: an average face associated with normally positioned bony bases in three dimensions of space resulted from harmonious closure of cranial sutures.
    b. Brachycephalic facial type: Characterized by short and wide face, usually exhibit deep anterior overbites, which are often skeletal discrepancies.
    c. Dolicocephalic facial type: A long and narrow face characterizes the dolicocephalic facial type and the dental arches frequently exhibit dental crowding. The maxilla exhibits excessive vertical growth pattern and a clockwise rotation of the mandible during growth.
3. Cephalometric analysis, clinical examination, and digital photography are all useful tools for evaluating facial types and creating best treatment plan.

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