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Assessment of The Anterior Facial Height

A Project Submitted to The College of Dentistry, University of Baghdad, Department of Orthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

By

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Certification of the Supervisor

I certify that this project entitled " Assessment of The Anterior Facial Height" was prepared by fifth-year student Ali Khudhair and Ghadeer Mohammed under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Prof. Dr. Dhiaa Jaafar Nasir
Date :

Dedication

To everyone who has supported, encouraged and inspired me, especially to my beloved parents, teachers and valued friends for all their guidance, love and concern that made it possible for me to reach this point as well as to my supervisor who gave me the courage, commitment and awareness to follow the best possible path, with incomparable style.

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List of Abbreviation	
UAFH	upper anterior facial height
LAFH	Lower Anterior Facial Height
TAFH	total anterior facial height
Sn	Subnasale
Me	Menton
G	Glabella

Introduction

Anterior facial height (AFH) is a key measurement in craniofacial morphology, referring to the vertical dimension of the lower face from the nasion (the bridge of the nose) to the menton (the lowest point of the chin). It plays a crucial role in orthodontic and orthognathic diagnosis, as variations in AFH can influence facial aesthetics, occlusion, and overall craniofacial balance.

For aesthetic reasons, measuring anterior facial height is an essential vertical evaluation in orthodontics. Facial height becomes vital in the growth and development of facial harmony and is also a significant factor in determining the facial profile. One factor distinguishing an individual's facial shape from others is the facial skeletal type, such as a class I (straight) skeletal typeface, versus individuals with a class II (convex) skeletal typeface will be different.

Dento-facial aesthetics is an essential aspect of contemporary orthodontics, reflected by increasing demands for many aspects of patient's aesthetic improvement. Facial vertical height determines an individual's aesthetics and is vital to establishing facial harmonies. One of the facial vertical problems is related to anterior facial height. Vertical facial height is strongly influenced by the vertical position of the maxilla and mandible, so that it can be affected by the relation between the skeletal jaw. This study aims to determine the difference between the anterior facial height and the skeletal jaw relation.**(Darwis et al., 2024)**

Aims of the study

The aim of this study was to clinically evaluate the measurments of anterior facial height
among students of College Of Dentistry in University Of Baghdad in both genders.

Chapter One
Review Of Literature

1.1 Normal occlusion

was first clearly defined by **Angle (1899)** which was the occlusion when upper and lower molars were in relationship such that the mesiobuccal cusp of upper molar occluded in buccal cavity of lower molar and teeth were all arranged in a smoothly curving line. **Houston et al, (1992)** defined normal occlusion as an occlusion within accepted definition of the ideal and which caused no functional or aesthetic problems. **Andrews (1972)** had previously also mentioned of six distinct characteristics observed consistently in orthodontic patients having normal occlusion, viz., molar relationship, correct crown angulation & inclination, absence of undesirable teeth rotations, tightness of proximal points, and flat occlusal plane (the curve of Spee having no more than a slight arch and deepest curve being 1.5 mm). To this, **Roth (1981)** added some more characteristics as being features of normal occlusion, viz., coincidence of centric occlusion and relationship, exclusion of posterior teeth during protrusion, inclusion of canine teeth solely during lateral excursions of the mandible and prevalence of even bilateral contacts in buccal segments during centric excursion of teeth. **Oltramari, PVP et al (2007)** maintain that success of orthodontic treatments can be achieved when all static & functional objectives of occlusion exist and achieving stable centric relation with all teeth in Maxim intercuspal position is the main criteria for a functional occlusion**.(Muhamad et al., 2015)**

1.1.2 Ideal occlusion

is a hypothetical state, an ideal situation. **McDonald & Ireland (1998)** defined ideal occlusions as a condition when maxilla and mandible have their skeletal bases of correct size relative to one another, and the teeth are in correct relationship in the three spatial planes at rest**. Houston et al (1992)** has also given various other concepts relating to ideal occlusion in permanent dentition and these concern ideal mesiodistal & buccolingual inclinations, correct approximal relationships of teeth, exact overlapping of upper and lower arch both laterally and anteriorly, existence of mandible in position of centric relation, and also presence of correct functional relationship during mandibular. **(Muhamad et al., 2015)**

1.1.3 Malocclusion

can be defined as an appreciable deviation from the ideal that may be considered aesthetically or functionally unsatisfactory. Malocclusion has been described in numerous ways, ranging from specific classifications to indices of treatment need and outcome. Unlike a disease process, when the presence of specific features classifies the disease, a wide range of occlusal traits can constitute a malocclusion.

Angle classified occlusion according to the molar relationship, and this remains the most internationally recognized classification of malocclusion **(Angle, 1899).**

He therefore based his classification of occlusion on this relative mesiodistal position

• Class I – the position of the dental arches is normal, with first permanent molars in normal occlusion.

• Class II – the relations of the dental arches are abnormal, with all the mandibular teeth occluding distal to normal. Angle recognized two subdivisions under class II:

• Class II division 1 – upper incisors are protruding.

• Class II division 2 – upper incisors are palatally inclined.

• Class III – the relations of the dental arches are also abnormal, with all mandibular teeth occluding mesial to normal.

Canine Classification The permanent canine relationship also provides a useful anteroposterior occlusal classification:

• Class I – the maxillary permanent canine should occlude directly in the embrasure between mandibular canine and first premolar.

• Class II – the maxillary permanent canine occludes in front of the embrasure between mandibular canine and first premolar.

• Class III – the maxillary permanent canine occludes behind the embrasure between mandibular canine and first premolar.

Incisor Classification A more clinically relevant method of classifying malocclusion is based upon the relationship of the maxillary and mandibular incisors. This represents a truer reflection of the underlying skeletal base relationship and also highlights what is often of most concern to the patient.

• Class I – the lower incisor tips occlude or lie directly below the cingulum plateau of the upper incisors.

• Class II – the lower incisor tips occlude or lie posterior to the cingulum plateau of the upper incisors. This classification is further subdivided into:

• Class II division 1 – the overjet is increased with upright or proclined upper incisors

• Class II division 2 – the upper incisors are retroclined, with a normal or occasionally increased overjet.

• Class III – the lower incisor tips occlude or lie anterior to the cingulum plateau of the upper incisors**.(Cobourne & DiBiase, n.d.)**

1.1.4 Skeletal classification:

Salzmann in 1950 was the first to classify the underlying skeletal structure:

A. Skeletal Class I: Purely dental with the bones of the face and jaws being in harmony with one another and with the rest of the head. The profile is orthognathic (Straight). Then he added divisions to the skeletal I, Division 1: Local malrelationship of incisors, canines and premolars; Division 2: Maxillary incisor protrusion; Division 3: Maxillary incisors retrusion; Division 4: Bimaxillary protrusion.

B. Skeletal Class II: Distal mandibular development in relation to the maxilla. The profile is prognathic (Convex). He subclassified skeletal II into: Class II/1: Narrow maxillary arch with crowding in the canine region; Class II/2: Lingually Inclined maxillary incisors, the laterals may be normal or proclined.

C. Skeletal Class III: Over growth of the mandible with obtuse mandibular angle. The profile is retrognathic profile (Concave).

He grouped them into class I (straight), class II (convex) and class III (concave). Salzmann's classification did not specify that the problem is due to maxillary protrusion, mandibular retrusion or a combination of both. The same is true for the concave profile, his method did not specify that the problem is due to maxillary retrusion, mandibular protrusion or a combination of both.

The author who agrees with all scholars that skeletal class I has a straight profile, cases of Skeletal I the problem is dental malrelationships. Salzmann's Skeletal II (convex profile) did not indicate either whether it is due to protruded maxilla or retruded mandible or a combination of both .Skeletal II could be of three types; type 1 (retruded mandible), type 2 (protruded maxilla) and type 3 (combination of both).

The same applies for Class III (concave profile), it could be due to maxillary retrusion (Skeletal III type 1), or mandibular protrusion (Skeletal II type 2), or a combination of both(skeletal III type 3) **.(Mageet, 2016)**

1.2 Mandibular Rotation:

Mandibular growth is a complex process that occurs through both endochondral and intramembranous ossification, involving multiple growth sites and centers. These include the condyles, symphysis, and alveolar processes, each contributing to the overall shape and size of the jaw**(Aboobacker et al., 2024).** The rotation of the mandible during growth affects the vertical relationships of the face.**(Karlsen, 1997)**Mandibles grow upward and backward and is displaced downward and forward is what orthodontists knew for most years.

The technique of superimposing a longitudinal series of radiographs on constructed landmarks within the area of the cranial base supported the "forward-downward" growth concept of the face. Even though most mandibular growth occurs in the superior and posterior regions, the superior changes (especially those in the condylar region) are far greater than the posteriorly directed changes. By the use of metallic implants, Bjork was able to demonstrate that the apparent relative constancy of the inclination of the lower border of the mandible masks the existence of systematic rotations of the deep structures of the mandibular corpus**(Mall & Bhosale, 2023)** .Björk drew attention to the possibility of predicting the mandibular growth pattern by looking at specific anatomic mandibular structures. He suggested seven structural signs seen on lateral head films for the identification of the mandibular growth rotation:

(1) inclination of the condylar head, (2) curvature of the mandibular canal, (3) shape of the lower border of the mandible, (4) inclination of the symphysis, (5) interincisal

angle, (6) interpremolar or intermolar angle, and (7) anterior lower face height.**(von Bremen & Pancherz, 2005).**

(2) This concept of rotation does not only occur in the mandible but is seen in the whole of the dentofacial complex. The direction of growth at the condyle dictates whether the lower jaw grows vertically or horizontally. The extent to which the mandible will be lowered in the facial pattern is determined by the vertical component of the growth of the mandibular condyle and the lowering of the medial cranial fossa, and hence of the temporal bone**.(Mall & Bhosale, 2023)**

GROWTH ROTATION (BJORK'S CLASSIFICATION)

According to the type of rotation and the center of rotation, the growth of the mandible can be divided into**(Björk, 1969):**

1.2.1 Forward rotation

Type I

This causes deep bite, in which the upper and lower dental arches come into contact, resulting in an underdevelopment of the anterior face height. It is primarily caused by a forward rotation at the joint centers.Factors such as strong muscle pressure or occlusal imbalance, often triggered by tooth loss, can contribute to the development of this condition.

.(Aboobacker et al., 2024)

Type II

The mandible undergoes anterior rotation during growth, with its center defined by the incisal margins of the lower anterior teeth. This rotation is a consequence of the increase in anterior height combined with significant development of the posterior face height the posterior part of the mandible rotates away from the maxilla. The increase in posterior facial height occurs in two stages.

First, the condylar fossae descend following the bending of the cranial base, causing the middle cranial fossa to descend in proportion to the anterior one. Second, the height of the ramus rises, particularly in cases of vertical growth at the mandibular component, which is caused by the larger condyles. Figure 1 exclusively illustrates the latter. Due to the vertical direction of condylar growth, the mandible is lowered more than it is advanced. This downward movement takes place alongside a forward rotation concerning the maxilla, where the center is located at the incisal edges of the lower incisors.

. **(Aboobacker et al., 2024)**

Type III

The forward rotation of the mandible during growth modifies the occlusion of the anterior teeth. In cases of significant maxillary or mandibular overjet, the center of rotation shifts backward in the dental arch to the level of the premolars, rather than resting at the incisors. This rotation also affects the inclination of the teeth. The inter-incisor angle changes less than the jaw's rotation, indicating a functional connection between the lower and upper incisors. This leads to increased alveolar prognathism and the forward eruption of the incisors **(Aboobacker et al., 2024)** .

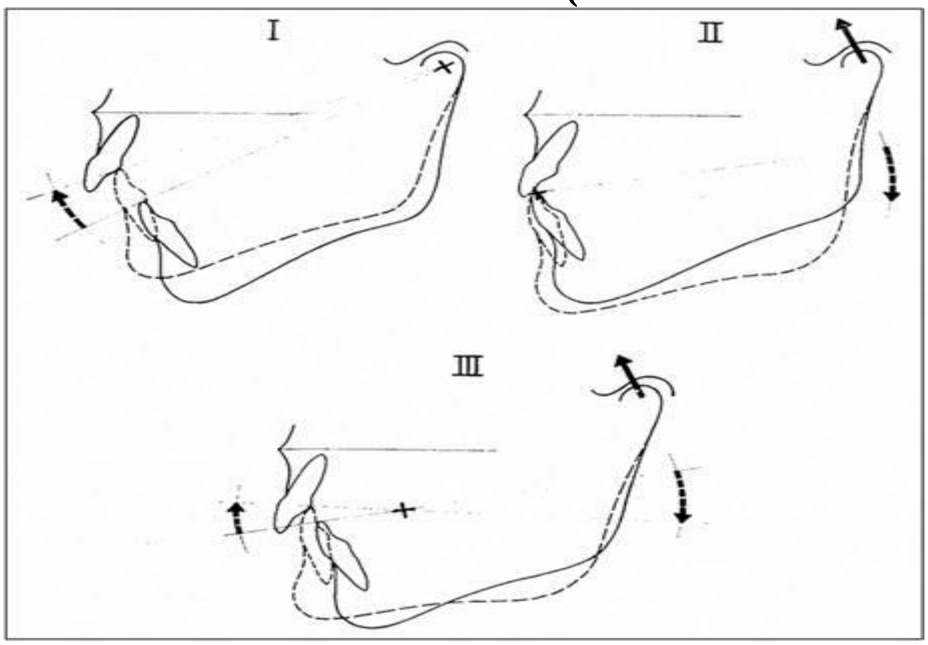


Figure 1.1: Forward rotation of the mandible with the center at the joints (I), with the center at the incisal edges of the lower incisors (II), and with the center at the premolars (III).

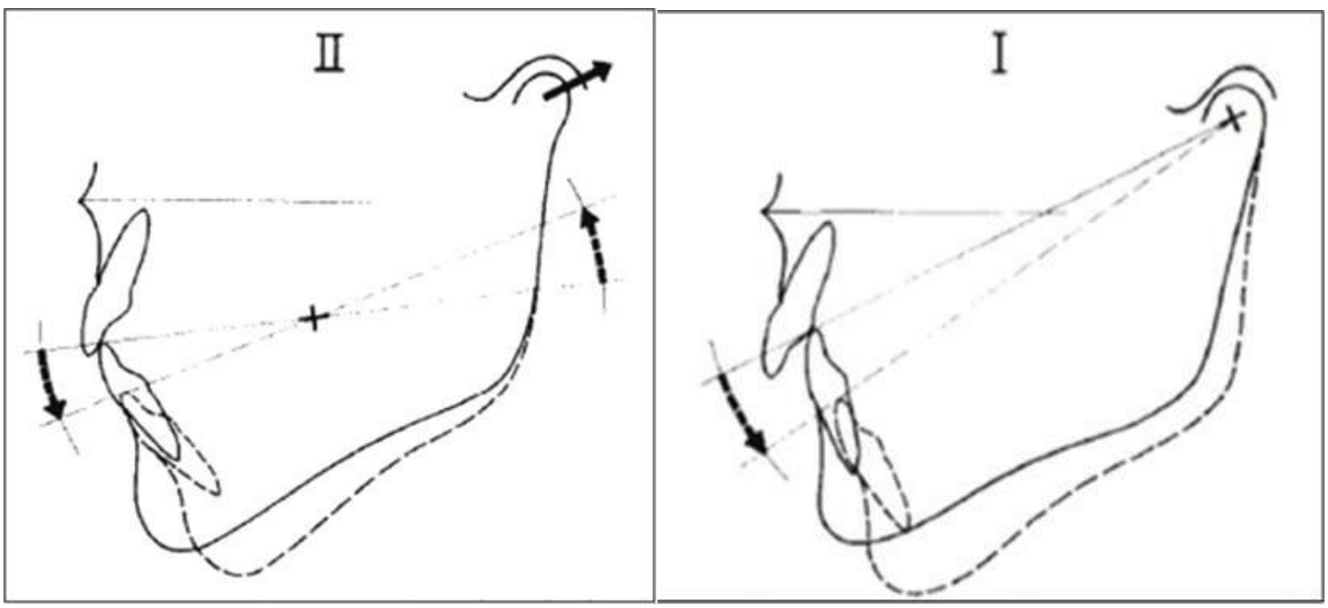
1.2.2 Backward Rotation

Type I

In the temporomandibular joint, the precise location of the center of rotation can be identified. This phenomenon becomes evident in situations where orthodontic interventions are implemented to correct the occlusal plane, thereby increasing the vertical dimension of the lower anterior facial region. As the cranial base undergoes growth and development, it becomes more horizontally oriented, resulting in an upward displacement of the mandible toward the posterior. In certain cases, this can manifest as an open bite**.(Aboobacker et al., 2024)**

Type II

The center of resistance is situated at the last molar that is, in contact. The growth at the condyles primarily occurs in the sagittal direction. The mandible undergoes an increase in length but is further propelled forward by the muscles and ligaments attached to it. Consequently, the symphysis moves backward, causing the chin to be positioned lower than the rest of the face. The soft tissues may not correspondingly follow this movement, resulting in the appearance of a double chin. Moreover, there is a skeletal open bite present, along with inadequate closure of the lips. The lower incisors are inclined backward and meet the upper incisors. The molars and premolars of the mandible are inclined forward**(Aboobacker et al., 2024)**



1.2 Figure: backward rotation of the mandible .

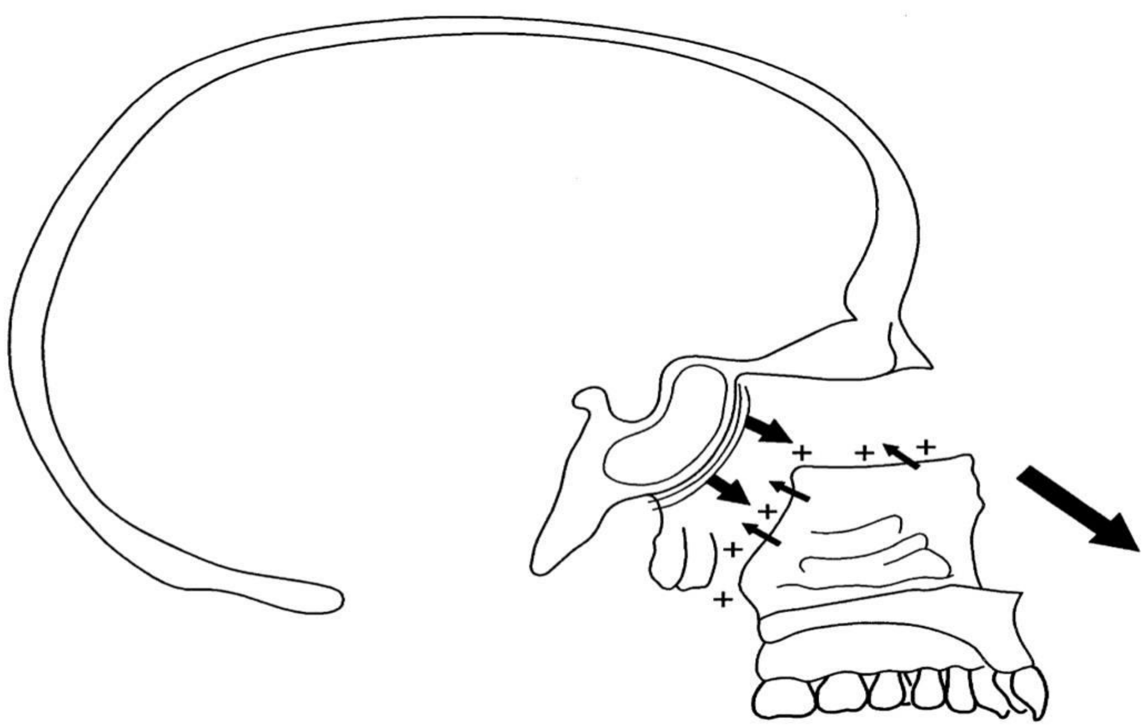
1.3 Vertical growth of the maxilla and mandible

The maxilla derives from the first pharyngeal arch and ossification of the maxillary complex is intramembranous, beginning in the 6th week i.u. The maxilla is the third bone to ossify after the clavicle and the mandible.

Growth of the maxillary complex occurs in part by displacement with fill-in growth at sutures and in part by drift and periosteal remodelling.

A forwards displacement of the maxilla gives room for the depostion of bone at the tuberosities.

Downward growth occurs by vertical development of the alveolar process and eruption of the teeth, and also by inferior drift of the hard palate, i.e. the palate remodels downwards by deposition of bone on its inferior surface (the palatal vault) and re sorption on its superior surface (the flower of the nose and maxillary sinuses).**(Mitchell, n.d.)**



1.3 Figure: Forward and downward displacement of the maxillary complex associated with deposition of bone at sutures. **(After Enlow, D. H. (1990) Facial Growth, W. B. Saunders Co., Philadelphia).**

The mandible

derives from the first pharyngeal arch and ossifies intramembranously, beginning in the 6th week .

Most mandibular growth occurs as a result of periosteal activity. Muscular processes develop at the angles of the mandible and the coronoid processes, and the alveolar processes develop vertically to keep space with the eruption of the teeth. As the mandible is displaced forwards growth at the condylar cartilage fills in posteriorly while at the same time periosteal remodelling maintains its shape

Bone is laid down on the posterior margin of the vertical ramus and resorbed on the anterior

margin, and this posterior drift of the ramus allows lengthening of the dental arch posteriorly. At the same time the vertical ramus becomes taller to accommodate the increase in height of the alveolar processes**.(Mitchell, n.d.)**

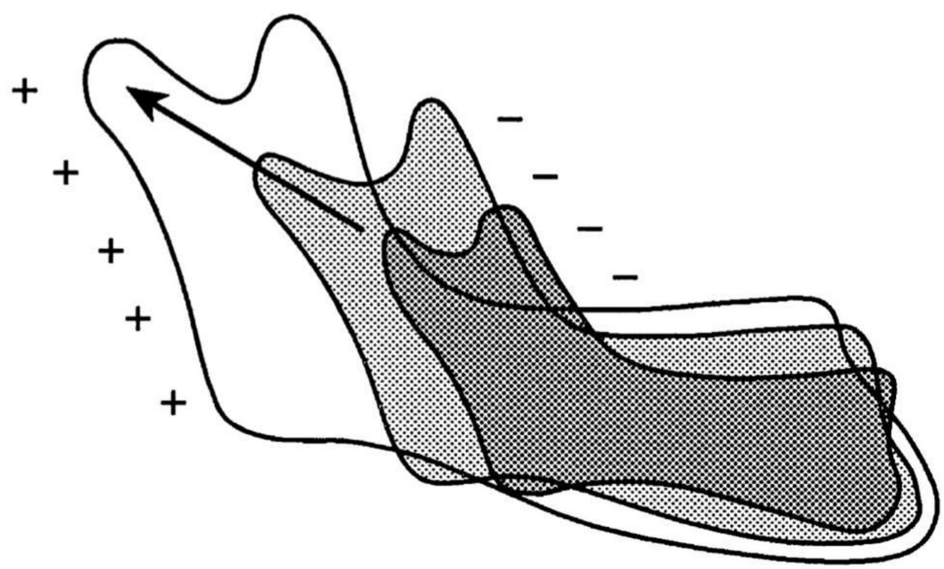


Figure1.4 : Growth at the condylar cartilage 'fills in' for the mandible following anterior displacement, while its shape is maintained by remodelling, including posterior drift of the ramus**. (After Enlow, D. H. (1990) Facial Growth, Saunders, Philadelphia).**

1.4 Facial beauty

The esthetic aspects of the face have become a primary area of focus in our society as people search for ways to improve their facial beauty in the present and over the long-term. **(Shimogaki, 2007; Anic-Milosevic et al 2008).**

It might be expected that faces would display some common features, but they are often as different from each other as they are from the rest of us. If we are able to accept that appreciation of facial beauty is innate, then presumably it must depend on recognizable difference in our faces. If so then it should be possible to define and measure them . **(Jacobson, 1995).**

Mouth and eyes are the most visible structures of a human face and they have a significant importance in formation of someone's personality (Baldwin, 1980), while some authors consider mouth to be even more important than the eye. **(Terry and Davis, 1976)**.

One of the objectives of the orthodontic treatment is the improvement of facial appearance; therefore it is necessary to be able to define the good looking face. The introduction of anthropometric direct method, for measurement of facial features was first practiced by for orthodontic purposes. From that time and up to date this direct facial measurements is used in the clinical diagnosis and treatment planning**(Hellman, 1939).**

Orthodontists have begun to pay particular attention to the facial profile and soft tissues when evaluating a patient for treatment. However, the concern for facial esthetics is not a new concept to the orthodontic specialty. Angle and Tweed both believed orthodontic treatment affected the patient's facial profile, although their treatment objectives happened to differ. **(Tweed, 1953).**

The harmony in size and relation of the dental arches are important in maintaining normal occlusion of teeth besides the influence of the orofacial musculature labially, buccally and lingually. The human dental arch form is of prime importance to the dentists as well as to anthropologist. It is useful in prosthodontic and orthodontic procedures and for describing evolutionary changes in dentition and their variation. **(Raberin et al., 1993)**

The size and form of the dental arches vary among individuals according to the tooth size, tooth position, pattern of craniofacial growth and by several genetic and environmental factors. **(Al-Hadithy, 2005).**

It had been recognized for some time that facial beauty was directly affected by the harmonious facial proportions, while this was an intuitive statement for most aesthetic surgeons, **(Farkas, 1994).**

1.5 Facial Symmetry

Facial symmetry has been shown to be associated with attractiveness and is therefore one of the main pillars in the perception of facial aesthetics.The facial symmetry can semi objectively, yet effectively, be assessed utilizing the midsagittal plane, which allows comparison of both facial halves. Being perpendicular to the Frankfurt horizontal plane, this plane can be understood as the sagittal extension of the midline. A symmetrical face is defined by equal distances of facial components on both sides to the midline. **(Rhodes, G. (2006). The evolutionary psychology of facial beauty. *Annual Review of Psychology*)**

1.6 Facial Proportions

The face can be divided vertically into three thirds. The upper third is defined between the borders of trichion (i.e., hairline) cranially and the glabella caudally and therefore consists of the forehead and the upper aspects of the periorbital region.

The middle third is defined between the borders of the glabella cranially and the subnasale caudally and holds the lower aspects of the periorbital region and the nose. The lower third is defined between the borders of the subnasale cranially and the menton caudally. Furthermore, the face can also be divided horizontally, into five fifths. The most lateral fifth is bordered laterally by the postaurale (i.e., the most posterior point on the helix) and medially by the lateral canthus. The second most lateral fifth is bordered by the lateral canthus laterally and by the medial canthus medially. The most medial fifth is bordered by the medial canthus on both sides. It has been described previously that the length of these vertical thirds and horizontal fifths should be equal in an aesthetic face Also, it was reported that the golden ratio (i.e., 1.618) serves as a useful ratio for aesthetic facial proportions. The facial length (i.e., distance between trichion and menton) should be 1.618 times longer than the facial width (i.e., distance between zygomas on both sides).

The distance between the trichion and the most lateral point of the nostril ("upper aspect of the face") should ideally be 1.618 times as long as the distance between the most lateral point of the nostril and the menton ("lower aspect of the face"). The golden ratio can also be applied in the lower face where the distance between the lateral canthus and stomion should be 1.618 times as long as the distance between stomion and menton. **(Farkas, L. G. (1994).** ***Anthropometry of the Head and Face*****. Raven Press.).**

1.7 Development of the Facial Soft Tissues

Characteristics of vertical, anteroposterior and transverse facial skeletal patterns reported correlate with anterior facial height. From the anatomic point of view, the anterior facial height is three parts:

(1) lower facial height or LAFH (Lower Anterior Facial Height)

(2) upper anterior facial height or UAFH.

(3) total anterior facial height or TAFH.

For aesthetic reasons, measuring anterior facial height is an essential vertical evaluation in orthodontics.Facial height becomes vital in the growth and development of facial harmony and is also a significant factor in determining the facial profile.

One factor distinguishing an individual's facial shape from others is the facial skeletal type, such as a class I (straight) skeletal typeface, versus individuals with a class II (convex) skeletal typeface will be different.1,4 Problems in this skeletal classification may be due to maxillary prominence, mandibular anteroposterior retro position and or a combination of both. According to human natural metabolism, anterior facial height measurement occurs during growth and development. Growth spurts, as remarkable growth,have an essential rule for patient treatment planning. The growth spurt is an increase in the speed of growth that begins a period of accelerated growth and occurs in middle adolescence. Occasionally, the skeletal facial vertical height also plays the role of jaw disharmonies, which impacts malocclusion and facial aesthetics .**(Proffit, W. R., Fields, H. W., & Moray, L. J. (2007)**

1.8 Oral habit

Oral habits such as abnormal function or size of the tongue and digit sucking have been associated with the classical traits of the long face morphology. Non-nutritive sucking in the first few years of life is consistently associated with vertical malocclusions such as an anterior open bite. These nonnutritive sucking habits are often not limited to the vertical plane, but may also affect the transverse dimension manifesting as posterior crossbites . **(Cozza et al., 2005)**.

anthropometric points to describe facial morphology, and found a high prevalence of severe facial convexity in adolescents who had been breastfed for relatively short periods and exhibited prolonged mouth-breathing habits that persisted until after the age of 6 to years 9. **(Thomaz et al., 2012).**

1.8.1 Mouth breather

Respiratory needs are the primary determinant of the posture of the jaws and tongue (and of the head itself, to a lesser extent). Therefore it seems entirely reasonable that an altered respiratory pattern, such as breathing through the mouth rather than the nose, could change the posture of the head, jaw, and tongue. This in turn could alter the equilibrium of pressures on the jaws and teeth and affect both jaw growth and tooth position. To breathe through the mouth, one must lower the mandible and tongue and extend (tip back) the head. If these postural changes were maintained, three effects on growth would be expected:

(1) anterior face height would increase, and posterior teeth would super-erupt.

(2) unless there was unusual vertical growth of the ramus, the mandible would rotate down and back, opening the bite anteriorly and increasing overjet.

(3) increased pressure from the stretched cheeks might cause a narrower maxillary dental arch.

The association has been noted for many years: the descriptive term adenoid faces has appeared in the English literature for at least a century, and probably longer . **(Proffit, 2019).**

1.9 long face syndrome

Diagnosis of the long face syndrome is based on the assessment of morphology of the facial skeleton, intraoral examination of the patient and a cephalometric analysis of lateral cephalograms **(Wolford et al., 1981; Angelillo et al., 1982; Sobieska et al., 2015).**

An increase or decrease in anterior facial height is a common feature of certain craniofacial syndromes as:

1.10 Crouzon Syndrome

• Feature: Often associated with midface hypoplasia, which can lead to reduced lower anterior facial height.

• Cause: Mutations in the FGFR2 gene.

1.5 Figure : Comprehensive management of Crouzon syndrome

Clinical note: Affected individuals frequently present with shallow orbits, exophthalmos, and dental malocclusion. **(Kreiborg, S. 1981).**

1.11 Apert Syndrome

1.6 Figure: Craniofacial disorder with apert syndrome.

• Feature: Increased anterior facial height due to maxillary hypoplasia and craniosynostosis.

• Cause: Mutations in the FGFR2 gene.

Clinical Note: Syndactyly of the hands and feet is also a hallmark feature of this condition. **(Cohen, M. M. Jr. 1993).**

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1.12 Marfan Syndrome

• Feature: Increased anterior facial height due to long, narrow facial structures.

• Cause: Mutations in the FBN1 gene affecting connective tissue.

Clinical Note: Patients also present with systemic features like long limbs, scoliosis, and cardiovascular abnormalities. **(Loeys, B. L., et al. 2010).**

1.7 Figure : Orthodontic-surgical treatment of a patient with marfen syndrome.

1.13 Down Syndrome

• Feature: Reduced lower anterior facial height, often due to maxillary hypoplasia. **(Varlık et al., 2010).**

• Cause: Trisomy 21.

• Clinical Note: Other craniofacial features include a flat nasal bridge and a small chin. **(Cohen, W. I. 1999)**.

1.8 Figure : Orthopaedic problems in down syndrome.

Chapter two
Material and method

2.1.1:The sample :

Eighty young adult students (40 males and 40 females) were selected from the college of dentistry, university of Baghdad. After the research purpose was explained to the students and an agreement was obtained from them to participate in this study.

2.1.2 Criteria of Sample Selection:

a. Inclusion criteria:

Young adult Iraqi students with age range 18-25 years
, having skeletal I relation (straight face) with normal occlusion depending on Angles classification and
skeletal II pattern (convex face), having Class II division 1 depending on Angles relation.

b. Exclusion criteria:

1-History of facial trauma

2- Congenital dentofacial deformities like cleft lip and palate, facial plastic surgeries
3-Developmental or/and pathological asymmetries.

2.1.3 Instruments and equipment

The following materials were used during intra-oral examination dental mirror, gloves, mask, disinfectant (Fig. 2.1) and digital sliding caliber caliper (Fig. 2.2).

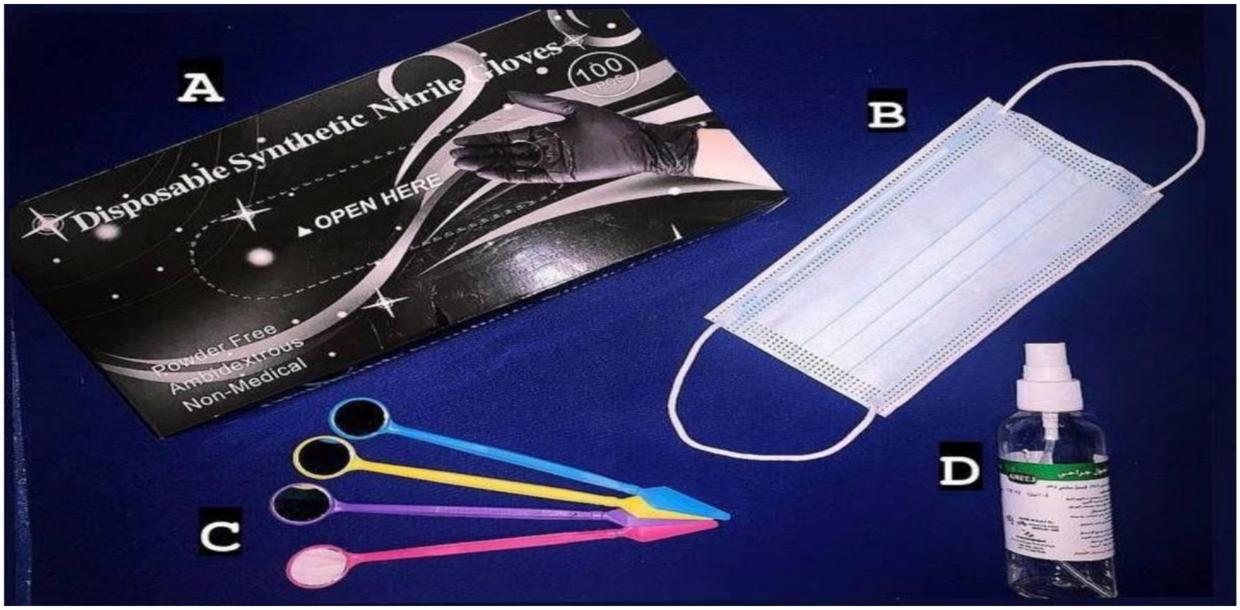

Figure 2.1: Materials that were used in the measuring procedure to ensure infection control.

Figure 2.2: Digital sliding caliber.

Figure 2.3 : measurement of upper anterior facial height .

METHOD

The current research was done in University of Baghdad College of Dentistry from January 2025 to April 2025. All the selected sample was subjected to extra-oral clinical examination to determine skeletal relation, subjects having straight face (skeletal I relation) and convex facial appearance (skeletal II) relation) were subjected to intra-oral examination to select cases of normal occlusion and Class II div.1 to be enrolled in this research as following:

A- **Normal occlusion** in which the mesiobuccal cusp of the upper molar occludes in the buccal groove of the lower molar. If the teeth were arranged on a smoothly curving line of occlusion.**(Proffit DDS et al., 2019).**

B- **Class II division 1** in which Lower molar distally positioned relative to upper molar, line of occlusion not specified.**(Proffit DDS et al., 2019).**

1.1 Measuring of the facial proportion:

Using the digital sliding caliper with a sensitivity of 0.01 mm, the following facial proportions were measured:

1- Upper anterior facial height LAFH : Measured from the Glabella point (G), which is the most prominent anterior point on the forehead in the mid-sagittal plane. to the soft tissue Subnasale (Sn) which is located at the junction between the lower border of the nose and beginning of the upper lip in the mid-sagittal plane.**(Cobourne & DiBiase, n.d.).**

2- Lower anterior facial height LAFH : Measured from the subnasale point (Sn) to the soft tissue Menton (Me')which is located at the lowest point on the contour of the soft tissue chin**(Cobourne & DiBiase, n.d.).**

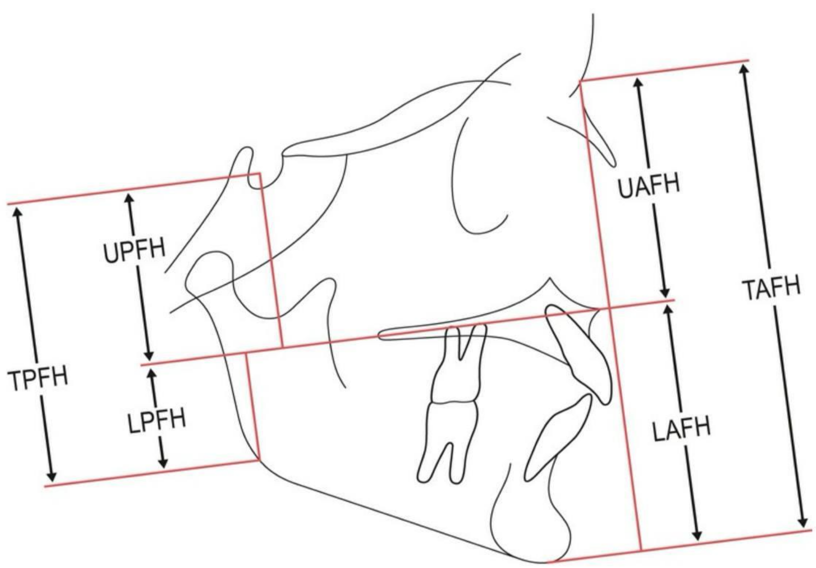

Figure 2.4 : Face heights. LAFH, lower anterior face height. TAFH, total anterior face height; UAFH, upper anterior face height.

-The registered measurements were collected and grouped and arranged in tables, then statistical analysis was done that includes

1- Descriptive analysis: Includes means and standard deviation
2- Inferential statistics: Includes
   A- Intraclass correlation coefficient test to assess the inter-examiner and intra-examiner calibration procedure.
   B- Normality test: Shapiro-Wilk test was used to assess the pattern of the measured data, whether normally or abnormally distributed.

   C- Independent t- test to compare between means of registered data.

If the p-value is equal to or less than 0.05 or 5%, the result is considered statistically significant, while if the p-value is more than 0.05 the result is considered as nonsignificant.

Pilot study:

Intra examiner calibration was repeated after 2 weeks for 5 subjects (10 variables) to avoid memory bias, then inter-examiner calibration was done with the aid of qualified orthodontist for 5 subjects (10 variables), by using intraclass correlation coefficient test, good to excellent reliability was found.

Table 2.1: Intraclass correlation coefficient test

Pilot study	Intraclass correlation coefficient test
Intra examiner	0.8
Inter examiner	0.95

Chapter Three

Results

Table 3.1 shows normality test of all measured variables, it is clear that all measured variables were normally distributed using Shapiro-Wilk test.

Table 3.1: Normality test for the analyzed data

Variables	Shapiro-Wilk		
	Statistic	df	Sig.
UFH-N-F	0.96	19	0.574
LFH-N-F	0.966	19	0.704
TFH-N-F	0.971	19	0.788
UFH-N-M	0.914	19	0.086
LFH-N-M	0.937	19	0.231
TFH-N-M	0.967	19	0.719
UFH-CLII-F	0.934	19	0.208
LFH-CLII-F	0.963	19	0.639
TFH-CLII-F	0.977	19	0.902
UFH-CLII-M	0.951	19	0.41
LFH-CLII-M	0.952	19	0.427
TFH-CLII-M	0.912	19	0.082

The significance level is 0.05

Table 3.2 shows that All the measured facial heights are higher in males than in females in both analyzed type (normal occlusion and Class II div. 1 malocclusion), however statistically significant difference was found between both sexes using independent t-test for all measured variables.

Table 3.2: Comparison of facial heights between males and females in normal occlusion and Class II div.1 malocclusion

	group	N	Mean	SD	t	df	Sig.
UFH Normal occlusion	F	20	55.67	2.56	-1.052	38	0.30
	M	20	56.89	4.53			
LFH Normal occlusion	F	20	60.08	4.64	-4.451	38	**0.00**
	M	20	66.26	4.12			
TFH Normal occlusion	F	20	115.75	5.25	-3.635	38	**0.00**
	M	20	123.15	7.45			
UFH CLII div.1	F	20	55.07	3.45	-0.752	38	0.46
	M	20	55.81	2.70			
LFH CLII div.1	F	20	55.15	3.74	-10.621	38	**0.00**
	M	20	66.78	3.16			
TFH CLII div.1	F	20	110.22	5.13	-7.476	38	**0.00**
	M	20	123.27	5.89			

The significance level is 0.05

Table 3.3 shows that lower facial height is less in Class II div. 1 than in normal occlusion in both sexes, however statistically significant difference using independent t-test was found in females only, on the other hand comparable results was fond regarding upper facial height between normal occlusion and Class II div.1 malocclusion with non-significant statistical difference in both sexes, hence significant difference was found between total facial height of normal occlusion and Class II div. 1 malocclusion in females only, this is appear clearly in Fig. 3.1 .

Table 3.3: Comparison of facial heights between normal occlusion and Class II div.1 malocclusion in both sexes

	group	N	Mean	SD	t	df	Sig.
TFH- Female	Norm. occl.	20	115.75	5.25	3.367	38	**0.00**
	CLII	20	110.22	5.13			
TFH-Male	Norm. occl.	20	123.15	7.45	-0.058	38	0.95
	CLII	20	123.27	5.89			
UFH-Male	Norm. occl.	20	56.89	4.53	0.648	38	0.52
	CLII	20	56.10	3.11			
LFH-Female	Norm. occl.	20	60.08	4.64	3.697	38	**0.00**
	CLII	20	55.15	3.74			
UFH-Female	Norm. occl.	20	55.67	2.56	0.623	38	0.54
	CLII	20	55.07	3.45			
LFH-Male	Norm. occl.	20	66.26	4.12	-0.766	38	0.45
	CLII	20	67.18	3.42			

The significance level is 0.05

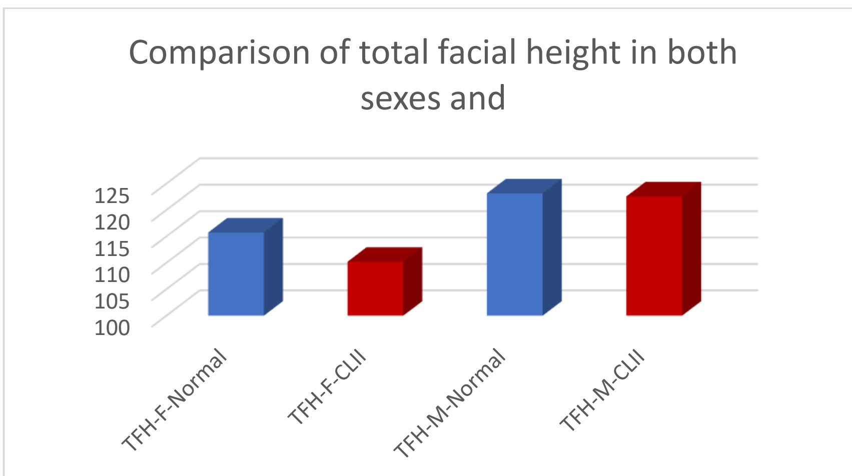

Figure 3.1: Comparison between total facial heights in normal occlusion and Class II div. malocclusion in both sexes.

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