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Aesthetic facial lines in orthodontics

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Surgery

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Certification of the Supervisor

I certify that this project entitled "*Aesthetic facial lines in orthodontics*" was prepared by the fifth-year student Hiba Majid Qassim under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

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Date: 8 / 5 / 2022

Dedication:

Whenever we search about knowledge, we realize that we have lack of information and discover how we small against this beautiful thrilling world.

Graciously, I dedicate this modest research to

My Father & Mother

My brothers

My Friends specially Zainab Tariq and Zainab Maher

All my respected teachers and doctors specially

Dr. Mervat and Dr. Saif Saadedeen

The biggest supporter Dr. Noor Falah who works with me devotedly

And finally to my iconic special person who gives me motivation to work hard in life and get better than who I am Nadia Qassim

Many thanks to all of you.

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In the Name of Allah, the Most Merciful, The Most Compassionate all praise is to Allah, the Lord of the worlds; and prayers and peace be upon Mohamed His servant and messenger. First and foremost, I must acknowledge my limitless thanks to Allah, the Ever-Magnificent; the Ever-Thankful, for His help and blessing.

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Table of Symbols & Abbreviation

Abbreviation	Word
Gl	Glabella
Sn	Subnasale
Me	Menton
NHP	Natural Head Position
NS	Negative space
BC	Buccal coridor
etc.	Et cetera

Introduction:

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**).

Aim of the study:

Review the macro-aesthetic appearance of the face and micro-aesthetic appearance of maxillary anterior teeth, facial measurements and aesthetics lines in orthodontic.

Chapter 1:

1. Review of Literature

1.1 Facial Esthetics versus Facial Proportions

Cesare Lombroso (1836-1909) described how murderers, gangsters, fire raisers, alcoholics, epileptics, and dwarfs could be distinguished from “normal” people by anthropometric assessment and evaluation of asymmetry of the face, shape of the skull, tooth form, shape of nostrils, size of masseter muscle, and size of frontal sinus (*Lombroso, 1890; Vegter and Hage, 2000*).

Ricketts was the first who claimed that the analysis of a physically beautiful face should be achieved mathematically, and he claimed to use the golden proportions “*the ratio that is most attractive to the human eye and mind*” in that respect, **Ricketts** visualized dozens of photographs of magazine models to select pairs of distances or measurements that represent a golden proportion in those beautiful faces (*Ricketts, 1982a; Ricketts, 1982b; Jefferson, 2004*).

1.2 Natural head position:

In order to assess facial proportions, patients must be examined in natural head position (NHP) (**Moorrees and Kean, 1958**). NHP is a standardized and reproducible position of the head in space, when the subject is focusing on a distant point at eye level, the true vertical may be taken as a line parallel to a plumb line hanging from the ceiling and the true horizontal will be at right angles to this. In some patients, the Frankfort plane may be parallel to the true horizontal.

Mills (1968) published a grid method of assessing lateral head radiographs in which the subjects were recorded in natural head position. Mills, guided by the

works of **Moorrees and Kean (1958)** used a very similar radiographic technique (Figure 1), except that the stool, not the cephalostat was adjusted for height.

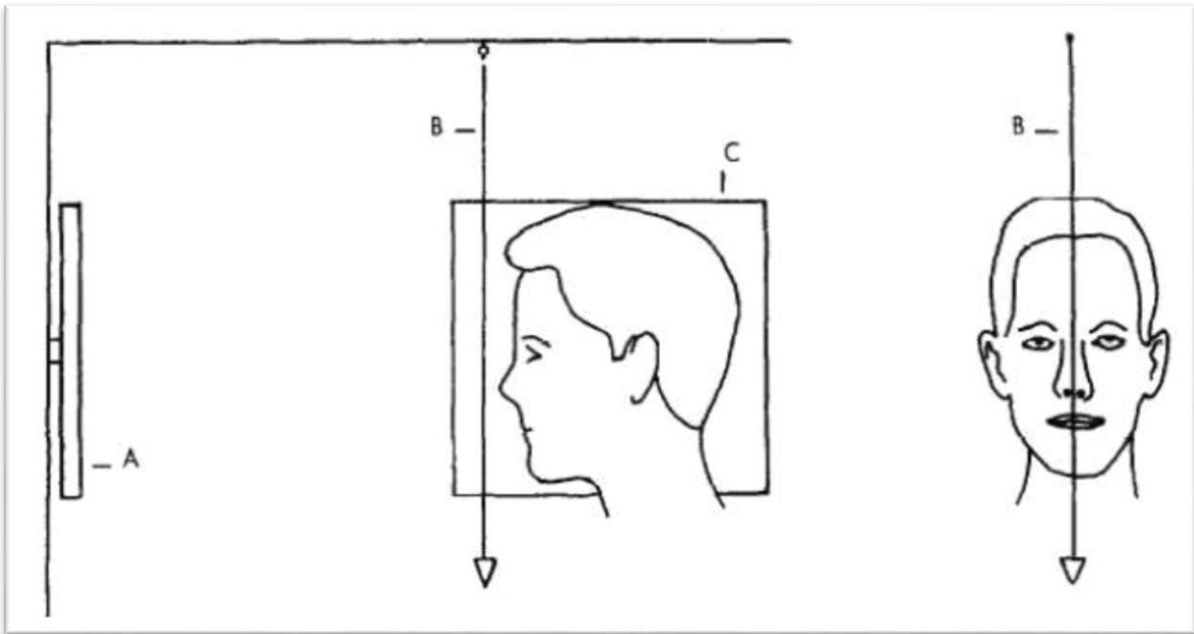


Figure 1. Natural head position registration during lateral head radiograph exposure. A. Mirror, B. Plumb line, C. Cassette (Mills ,1968).

1.3 Classification of Aesthetic Appearance

An interesting division of aesthetics in orthodontics was presented by (**Sarver and Ackerman, 2005**), who divided aesthetics into three sections:

1. Macro-aesthetics: which refers to the face, its proportions and harmony.
2. Mini-aesthetics: which includes smile aesthetics.
3. Micro-aesthetics: which includes the dental aspect.

As shown in (**Figure 2**)

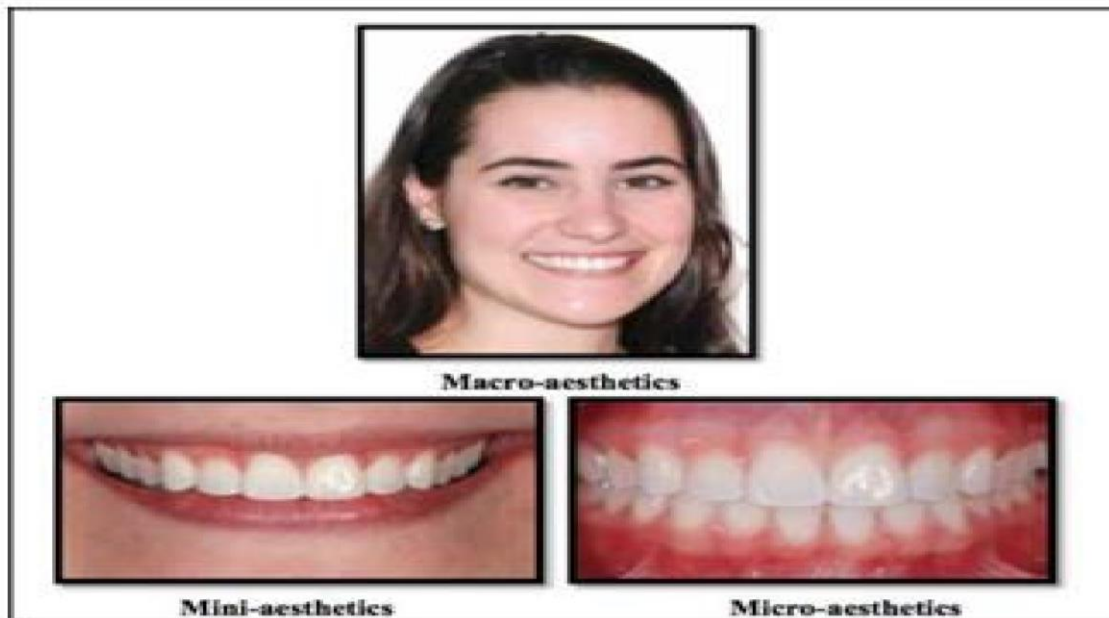


Figure 2: Classification of Esthetic Appearance (Brandão and Brandão, 2013).

1.3.1 Macro-Aesthetics

Macro-aesthetics consideration: It encompasses the interrelationships between the face, lips, gingiva and teeth and the perception that these relationships are pleasing (*Sarver, 2011; Brandão and Brandão, 2013*) and it includes:

1.3.1.1 Vertical and Frontal proportions.

The vertical relation was measured in terms of facial height, the upper anterior facial height was represented by the distance from the point between the eyebrows “glabella” to the base of the nose “subnasale”, the lower anterior facial height was the distance from the soft tissue menton (base of the chin) to the base of the nose, after marking the points of glabella (Gl), subnasale (Sn), menton (Me) with a marker, the facial heights were measured with a vernier (*Roberts-Harry and Sandy, 2003*).
As shown in Figure 3:

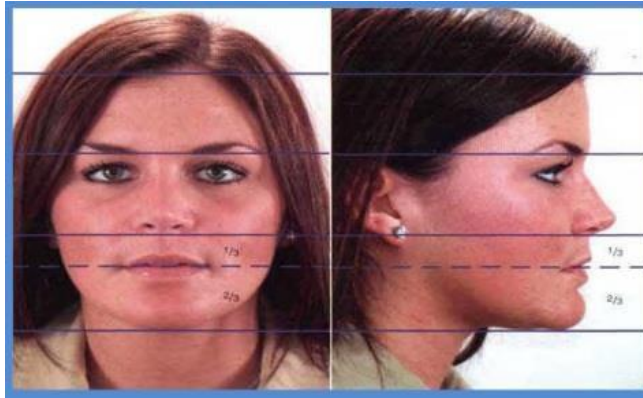


Figure 3: Division of the face into three thirds. (Proffit et al, 2007)

The facial height to width ratio (Facial index) gives the overall facial type, such as 'long' or 'short' or 'square' face (**Figure 4**). The proportionate facial height to width ratio is 1.35:1 for males and 1.3:1 for females. (Naini and Gill, 2008) **Bizygomatic facial width**, measured from the most lateral point of the soft tissue overlying each zygomatic arch (zygion), is approximately 70% of vertical facial height.

Bitemporal width, measured from the most lateral point on each side of the forehead, is 80–85% of bizygomatic width.

Bigonial width, measured from the soft tissue overlying the most lateral point of each mandibular angle (soft tissue proportions is important in any prosthodontic treatment plan aimed at altering the occlusal vertical dimension, as well as in planning dentofacial surgery).



Figure 4. Facial height to width ratio (facial index). Facial height (white); bizygomatic width (white); bitemporal width (red); bigonial width (blue). (Naini and Gill, 2008)

Types of faces were divided according to the view of looking (Rickett's , 1964) categorized facial types in the transverse plane and described three basic facial patterns as follows :

-**Mesofacial (Normal)**, which is the most average facial pattern.

-**Brachyfacial** , having a short or broad face

-**dolichofacial** , having a long face.

Arnett and bergman (1993): classified facial types as follows:

-**Square face:** was described as having almost equal distances at the interparietal, interzygomatic and intergonial areas.

-**Oval face:** was described as having the interzygomatic distance as the widest horizontal dimension of the face (more than interparietal and intergonial distances).

-Tapered face: was described as having the widest dimension of the face in the interparietal area and the face tapered toward the chin.

1.3.1.2 Facial Symmetry:

Evolutionary, as well as cultural, pressures may contribute to our perceptions of facial attractiveness. Biologists predict that facial symmetry should be attractive, because it may signal mate quality. We tested the prediction that facial symmetry is attractive by manipulating the symmetry of individual faces and observing the effect on attractiveness, and by examining whether natural variations in symmetry (between faces) correlated with perceived attractiveness. (Cosmides, and Tooby, 1992).

1.3.1.3 Transverse facial proportions:

The 'rule of fifths' describes the ideal transverse proportions of the face to comprise equal fifths, each roughly equal to one eye width. The alar base width should be equal to the intercanthal width. This is important clinically as surgical anterior repositioning of the maxilla tends to increase the alar base width. (Zimble and Jongwook, 2005)

1.3.1.4. Facial Profile:

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. (Graber & Swain; 1994, Proffit and Fields; 2000, Bishara; 2001) As shown in figure 5:

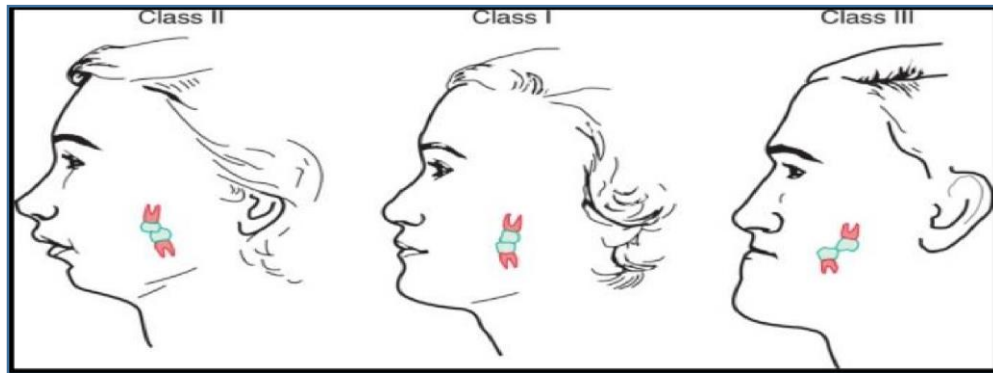


Figure 5: Angle classification, Facial profile and molar relationship (Moyers, 1988).

1.3.1.5 Lip aesthetic, Lip Line and Smile Line:

The appearance of whole face can be affected by the position of the lips (Mathews, 1978). Where the lower lip can determine the relative prominence of the chin. If retruded, the chin prominence enhanced. While if it protruded, the chin prominence diminished, also the upper lip can determine the relative prominence of the nose in the same manner (Goldstein , 1997).

Lip line indicates to the position of the upper lip during smile formation and thereby determines the display of teeth or gingivae (Goldstein, 1976). The ideal level of the lip line is approximately at the center of the crowns of the maxillary incisor teeth with the lower lip in front of the maxillary incisors (Foster, 1985). There are three types of lip lines: high, medium and low as follows: (Goldstein, 1997).

- i. A high lip line exposing a lot of gum tissue above the front teeth.
- ii. A medium lip line revealing up to, but not including, the upper gum line of the front teeth.
- iii. A low lip line which doesn't reveal the gum tissue at all

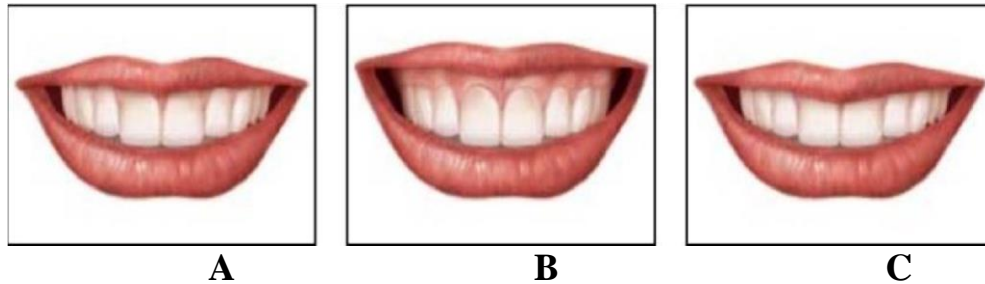


Figure 6: Lip Lines: A- medium lip line B- high lip line c- A low lip line (From Tjan and Miller,1984)

Tjan and Miller (1984) divided the smile line into three types: a high smile line, revealing the complete maxillary incisors and a continuous band of the gingiva; an average smile line, revealing 75–100 per cent of the maxillary incisors; and a low smile line, revealing less than 75 per cent of the maxillary incisors. Excessive gingival display can severely detract from an attractive smile. Although, in western society, it has been suggested that no more than 2 mm of the maxillary gingiva should be visible when a person smiles (**Fricker, 1988**), there has been no scientific evidence to support this view in the Asian community, particularly in Iraqi population.

Aesthetic assessment of the lips must also be undertaken. The acronym ‘LAMP’ may be used to assess the length, activity, morphology and posture of the lips (**Naini and Gill, 2008**):

-Lip length

- Maxillary incisor exposure at rest:2–4mm.
- Lip line Depends on upper lip length and vertical maxillary incisor position □
Lower lip should cover incisal third of maxillary incisors. **-Lip activity**
- A strap-like lower lip often retroclines incisors (commonly occurs in Class II division 2 malocclusions).

- Flaccid lips are less likely to significantly alter position with anteroposterior dental movement.

-Lip morphology

- Everted lips may be due to interposed proclined maxillary incisor teeth.
- Flat or backward sloping lips give an ‘aged’ appearance to facial profile.
- Full lips are less likely to significantly alter position with anteroposterior dental movement.
- Thin lips are more likely to ‘flatten’ with incisor retraction.
- Vermilion show of lower lip slightly more than upper lip (by 2–3 mm).

-Lip posture

- Lips held together at rest (competent).
- Lips habitually held apart at rest by more than 3–4mm (also termed lip incompetence).
- Potentially competent (lips are unable to be held together due to interposed incisor teeth).

1.3.1.6 Nasal projections:

The nose is the central and most prominent feature of the face. It’s contour, character and size have a great effect on the smile. The action of smiling procedures has an average of 14% widening of alar width (**Rigsbee et al., 1988**).

1.3.1.7 Aesthetic of Chin:

According to (**Goldstein, 1997**) the chin participates to the contour of both the full face and the profile. The receding chin is more common than the protruding chin. Correcting a poorly proportioned chin enhances the smile by creating a proper esthetic balance to the face as a whole.

1.3.2 Teeth-lip relationship (Mini Aesthetics):

1.3.2.1 Smile Arc:

Ackerman et al. (1998); Sarver (2001); Ackerman and Ackerman, (2002) defined the smile arc as the relationship of the curvature of the incisal edges of the maxillary incisors, canines, premolars and molars to the curvature of the lower lip in the posed social smile.

According to Ackerman et al. (1998); Lewis (2004), the smile arcs are classified as:

- I. Consonant smile arc: if the incisal edges of the maxillary teeth follow, or are parallel to, the contour of the lower lip.
- II. Flat smile arc: if the incisal edges of the maxillary teeth and the contour of the lower lip are straight.
- III. Reverse smile arc: if they are aligned in an arc opposite to the lower lip line. As shown in figure 7:

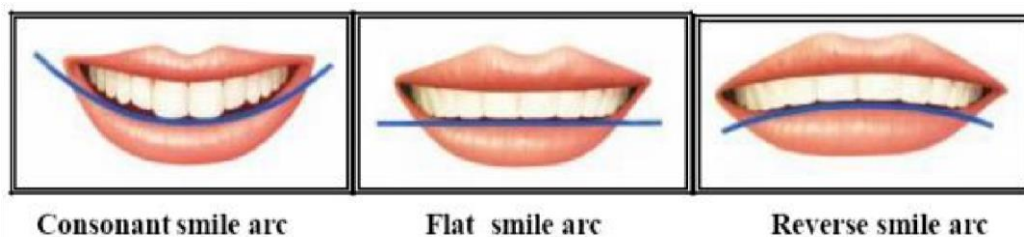


Figure 7: Smile Arc Classification (from Goldstein, 1997).

Smile arc include:

- a. **The cervical or gingival line** is formed from the union of the apexes of the canines, maxillary lateral and central incisors. As the most apical point of

the gingival contour, the apex in maxillary teeth is usually located distal to the long axis of the tooth. However, this rule does not always apply to the maxillary lateral incisors. (**Sarver DM, 2001**)

b. Incisal Line:

The incisal line follows the edges of anterior maxillary teeth. The ideal is that in young patients the incisal edges of the central incisors be below the edges of the lateral incisors and canines in a frontal view. In that configuration, the form of the incisal line resembles the outline of a “deep plate”. (**Chiche and Pinault, 1994; Magne et al, 2003**)

c. Contact Points Line:

The contact between anterior maxillary teeth is done in a descending fashion, starting from the canine. The contact between the canine and lateral incisor is positioned higher than the contact between the lateral and central incisors; the contact between the central incisors is even lower. The contact points should be narrow, unless there is a discrepancy in the mesio-distal diameter of the crown(**Andrews, 1989**). The position of the contact between teeth is related to tooth position and form (**Magne et al, 2003**).

d. Papillary Line:

The papillary line is formed by the tips of the gingival papillae located between the canines and lateral incisors, and between the maxillary lateral incisors and central incisors. It can be presumed that an ideal line would be parallel to the line formed by the contact points. According to the work of Kurt and Kokich (**Kurth and Kokich, 2001**).

e. Connector Band

The location where anterior teeth appear to touch is named a connecting space. Contact points are small areas in which teeth touch. Connecting spaces are larger, broader, and can be defined as zones in which two adjacent teeth appear to touch. The best aesthetic

relationship of anterior teeth is one that follows the 50-40-30 rule for the connecting space (**Morley and Eubank, 2001**).

f. Upper Lip Line:

Lip line indicates the position of the upper lip during smile formation and thereby determines the display of teeth or gingivae (**Goldstein , 1976**).

There are three types of lip lines: High, medium and low as follows:
(**Goldstein,1997**).

g. Lower Lip Line:

It is the shape of the lower lip and the incisal edges of maxillary and mandibular tips that create a pleasing or unpleasing smile ensemble (**Sarver DM, 2001**), there should be harmony between the curvature of the incisal edge of anterior maxillary teeth with the curvature of the upper edge of the lower lip during voluntary smiling (**Goldstein, 1976,**).

1.3.2.2 Lip Analysis:

Both the upper and lower lips have a marked effect on the beauty of the smile. The lip separation that occurs during smiling will permit the exposure of dental and gingival structures. This separation can be called “labial unveiling” (**Tarantili et al, 2005**)

1.3.2.3 Dark Buccal Corridors:

Matthews (1978); Sarver (2001) defined it as the dark space between the corner of the mouth and the buccal surface of the bicuspid teeth during smile (more commonly referred to by orthodontists as a negative space [NS]). And in many cases a more descriptive term would be the Tunnel syndrome (**Blitz, 1997**).

The presence of dark buccal corridors may be due to:

1. Transverse narrowing of the maxilla, especially in the premolar region.
2. Palatal angulation of the maxillary posterior dentition.
3. Retro-positioned maxilla.

Gracco et al. (2006) classified the buccal corridor into three types: minimal, moderate and large (evident) buccal corridor, as shown in figure 8

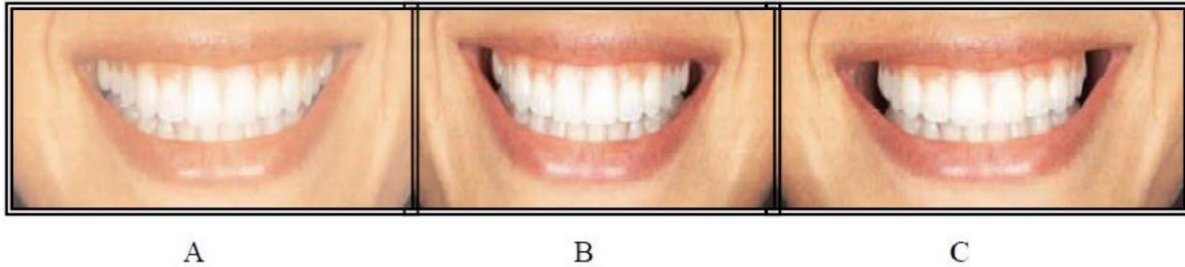


Figure 8. Types of buccal corridor according to(Gracco *et al.*, 2006) (A) minimal BC (B) moderate BC (C) evident BC.

A

1.3.3 Micro-Aesthetics:

The dentolabial gingival relationship, which is considered oral esthetics, has traditionally been where treatment planning is initiated. This process begins by determining ideal maxillary incisal edge placement. This is accomplished by understanding the incisal edge position relative to several different landmarks.

(Rufenacht, 1990).

1.3.3.1 Gingival height, shape and contour:

As gingival heights are measured, heights relative to the central, lateral, and canine in an up/down/up relationship are considered esthetic. the gingival line of the four incisors is approximately the same line with the lateral perhaps being slightly incisal (**Fradeani, 2004**)

For ideal appearance, the contour of the gingiva over the maxillary central incisors and canines is a halfellipse, with the zenith (the height of contour) distal to the midline of the tooth. The maxillary lateral incisor, in contrast, has a gingival contour of a half-circle, with the zenith at the mid-line of the tooth. (**Sarver and Yanosky, 2005**) as shown in figure 9.

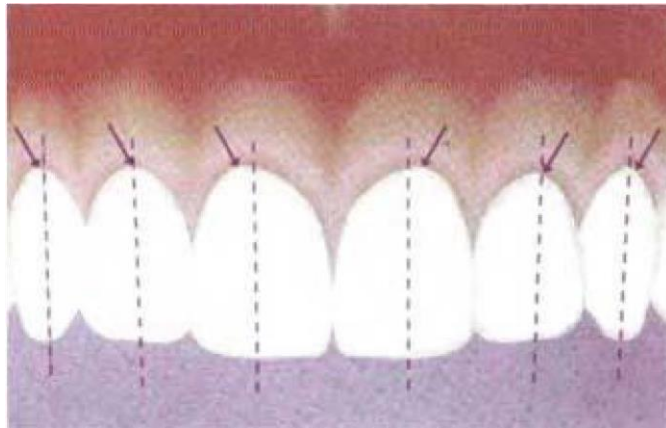


Figure 9: contour of the gingiva (**Sarver and Yanosky, 2005**).

1.3.3.2 Tooth Proportions:

The inter-tooth relationship, or arch form, involves the golden proportion and position of tooth width. Levin was one of the first people who applied the golden proportion to the smile (**Levin, 1978; Proffit et al., 2013**)

Ideal tooth width proportions when viewed from the front are one of many illustrations of the "golden proportion," 1.0:0.62:0.38:0.24, etc. In this close-up view of attractive teeth on smile, it can be seen that the width of the lateral incisor is 62% of the width of the central incisor; the (apparent) width of the canine is 62% of the width of the lateral incisor; and the (apparent) width of the first premolar is 62% of the width of the canine. (**Proffit et al , 2013**)

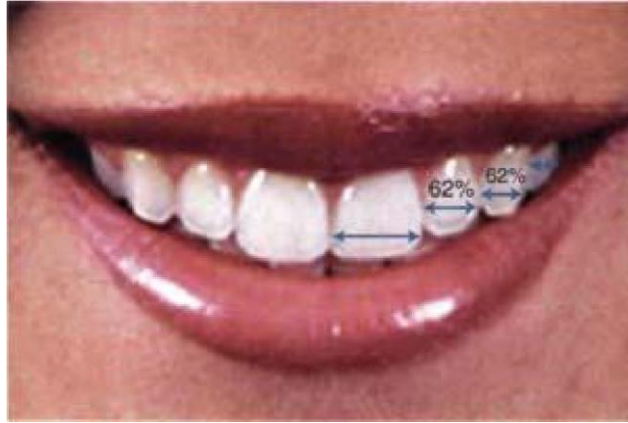


Figure 10: Tooth width proportions. (Proffit et al, 2013).

2. Discussion

In the past, the cephalometric analysis represented an important tool in orthodontic treatment planning, but today, the focus is mainly on facial soft tissue and dental assessment by using photographs. The patients and parents focused mainly on appearance, the orthodontic diagnosis and treatment planning should have a broader scope, include the occlusion, tooth shape and appearance of the face to have both excellent occlusion and excellent aesthetics, although this is quite difficult but it is the goal that all orthodontists should pursue to. Although orthodontists do not perform the dental procedures that related to cosmetics such as composite bonding, but there are principles in cosmetic dentistry that orthodontists can use to enhance the aesthetic outcomes of the finished cases. **(Mohammed, 2017).**

Facial type is related mainly to the craniofacial complex growth which is a major contributing factor for malocclusion. Different variations could be present in facial form due to age. Many researchers found a great difference between the faces of gender **(Baum 1964, Enlow 1982).**

One of the most important issues in orthodontics is how to gain space (for example: by interproximal reduction) or get rid of excess space (for example: by composite bonding or veneers), additionally, existence of tooth size discrepancy (TSD) which means disproportion or lack of harmony of mesiodistal dimension of teeth when related to those within the same arch or the opposing arch, represents one of the major problems in orthodontics, these problems could be overcome by considering anterior teeth dimensions and proportions. **(Mohammed, 2017).**

Although the concerns and actions of orthodontists are measured in millimeters, they can improve and make a difference in patient's life, therefore; the micro-aesthetics should not be seen in isolation but, as a key to provide a pleasant smile "mini-aesthetics" and harmonious face "macro-aesthetics". **(Dana Mohammed, 2017).**

Finding the correct relation between the facial types and the dental arch form will help us to determine the proper treatment plan and the prognosis of the case, for example, using a narrow arch wire has poor prognosis in a patient with Euryprosopic facial type.

3. Conclusion and Suggestion Conclusion:

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

And since 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

The achievement of stable, functional, and esthetic arch forms has long been one of the prime objectives of orthodontics.

Change due to various treatment mechanics are different for each individual because of his morphology and facial type so it is necessary to understand the individual patient by describing his basic facial type, skeletal and dental structure to draw up effective treatment design for his malocclusion.

Suggestion:

- 1) Pre- and post-orthodontic facial and arch measurements for the patients and estimate the soft tissue changes after the treatment.
- 2) Further studies to determine the difference between the skeletal facial type and the soft tissue facial type.
- 3) Further studies to determine the relationship between the maxillary and mandibular dental arch forms
- 4) Analyzing the mini-aesthetic appearance to find out the correlation between three divisions of aesthetics in orthodontics.

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