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Facial esthetics in orthodontics

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Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled “**Facial esthetic in orthodontics**” was prepared by **Nouri Zubair Nouri** 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's name: Lecturer Dr. Ihsan Sadiq Mohammed

Dedication

I would like to dedicate my humble effort to:

My sweet and lovely father and mother their affection, love, encouragement and prays of day and night make me able to get success and honor.

Nouri Zubair Nouri

Acknowledgment

First and foremost, praises and thanks to **Allah** Almighty for helping me fulfill my dream, for his blessings throughout my work to complete it successfully.

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Introduction

The importance of esthetics in the orthodontic sense can hardly be overemphasized, yet, it has often been considered secondary to achieving an ideal functional occlusion. Edward H. Angle based his ideal of harmony on the Greek facial Type of Apollo Belverde and believed that a “full complement of teeth” was indispensable for achieving perfect harmony and this belief predominated in the orthodontic world for a few decades. Angle’s belief was challenged by practitioners who were dissatisfied by the instability and lack of esthetics following the overzealous adherence to the nonextraction philosophy and started advocating need-based extractions so as to achieve esthetic harmony (**Turley, 2015; Sarver and Ackerman, 2000**).

The emphasis on dentoalveolar esthetics has increased among both dental professionals and patients in recent years (**Edler, 2014; Turley, 2015**). Moreover, although an ideal occlusion remains a primary goal of treatment, the esthetic outcome is critical for a patient's satisfaction. Many of those seeking orthodontic treatment are keen to improve dental esthetics and, potentially, their quality of life regarding both functional aspects and appearance.

Esthetics has become imperative so as to achieve a satisfactory outcome and is now an indispensable part of the idealized treatment goal. As the perception of esthetics is different for the orthodontist from that of a layperson, the patient’s perception of the face must be acknowledged prior to commencing treatment (**Câmara, 2012**). Moreover, the treatment goals should aim for a balanced and harmonious facial profile over rigid adherence to standard average skeletal and dental norms (**Turley, 2015**).

Chapter one: Review of literature

1.1 Effect of Facial Background on Perception of Dental Esthetics

Although it is now widely recognized that the background facial appearance plays a role in the perception of the appearance of the teeth, it has been difficult to quantify these relationships. The discovery that the length of time an individual looks at features of the face (or anything else) is proportional to its importance to them provides a way to determine how the teeth and the face affect each other in quantitative terms. In recent studies, the movements of the eyes of a sample of young adults were tracked while they were looking at images of faces of young adults that were digitally combined with teeth that had different levels of facial attractiveness (quantified with the Aesthetic Component of the Index of Orthodontic Treatment Need [IOTN]—see Fig. 1), and the frequency and duration of gazes were recorded. This was accomplished for both sexes (Proffit *et al.*, 2019).



Figure (1): The stimulus photographs of the Index of Treatment Need (IOTN) esthetic index. The score is derived from the patient’s answer to “Here is a set of photographs showing a range of dental attractiveness. Number 1 is the most attractive and number 10 the least attractive arrangement. Where would you put your teeth on this scale?” Grades 8 to 10 indicate definite need for orthodontic treatment; 5 to 7, moderate or borderline need; 1 to 4, no or slight need.

In general, eye tracking for facial images shows that the most attention is paid to the eyes. The data from these studies showed that for attractive and average females, unattractive teeth (high borderline esthetic dental need at IOTN level 7) became a focus for the viewers sooner when the female image they were observing had moderate or high background attractiveness than it did for images with unattractive background esthetics (**Richards *et al.*, 2015**). This attention rivaled looking at the eyes. For men, the most attention was directed at the mouth when the males were unattractive or of average attractiveness and the dental esthetics need was severe (esthetic dental need at IOTN level 10). Then it surpassed the eyes.

These studies demonstrated that overall facial attractiveness influences how people look at teeth and that they tolerate different levels of dental attractiveness based on this. So, malalignment is more noticeable in average and attractive women and average and unattractive men. We also know that people make judgments regarding intelligence and interpersonal temperament for children and young adults based on the appearance of the teeth. This information can be helpful when advising patients regarding their need for treatment and helps explain how important it is to assess the facial as well as the dental attractiveness of the patient (**Bansal *et al.*, 2015**).

1.2 Systematic Examination of Facial and Dental Appearance (Proffit *et al.*, 2019)

A systematic examination of facial and dental appearance should be done in the following three steps:

1. Facial proportions in all three planes of space (macro-esthetics). Examples of problems that would be noted in this first step would be asymmetry, excessive or deficient face height, mandibular or maxillary deficiency or excess, and so on. In performing this evaluation, keep in mind that both the evolutionary and prenatal development of the face can provide additional insight into the origin and significance of unusual facial morphology.

2. The dentition in relation to the face (mini-esthetics). This includes the display of the teeth at rest, during speech, and on smiling. It includes such assessments as excessive gingival display, inadequate anterior tooth display, inappropriate gingival heights, and the extent of the buccal corridors (the dark spaces in the corners of the mouth beyond the teeth).

3. The teeth in relation to one another (micro-esthetics). This includes assessment of tooth proportions in height and width, gingival shape and contour, connectors and embrasures, black triangular holes, and tooth shade.

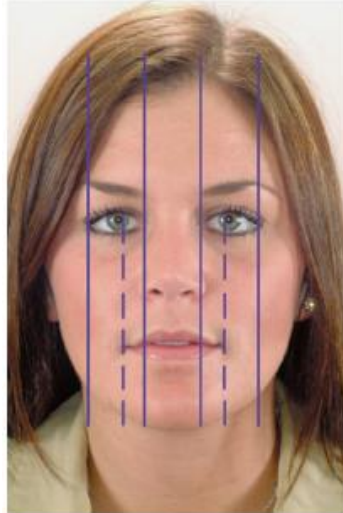
1.3 Macroesthetics: Facial Proportions

The first step in evaluating facial proportions is to take a good look at the patient, examining him or her for developmental characteristics and a general impression. Humans are very adept at evaluating faces and in fact have a dedicated neural system for that purpose (**Rossion *et al.*, 2012**). Even so, with faces as with everything else, looking too quickly at the details carries the risk of missing the big picture. It is a mistake for any dentist to focus on just the teeth after a cursory look at the face. It is a disastrous mistake for an orthodontist not to evaluate the face carefully.

1.3.1 Frontal Examination.

The first step in analyzing facial proportions is to examine the face in frontal view. Low-set ears or eyes that are unusually far apart (hypertelorism) may indicate either the presence of a syndrome or a microform of a craniofacial anomaly. If a syndrome is suspected, the patient's hands should be examined for syndactyly, because there are several dental–digital syndromes. In the frontal view, one looks for bilateral symmetry in the fifths of the face and for proportionality of the widths of the eyes, nose, and mouth (Fig. 2). A small degree of bilateral facial asymmetry exists in essentially all normal individuals. This can be appreciated most readily by comparing the real full-face photograph with composites consisting of two right or two left sides (Fig. 3). This “normal asymmetry,” which usually results from a small size difference between the

two sides, should be distinguished from a chin or nose that deviates to one side, which can produce severe disproportion and esthetic problems (see Fig. 4) (Proffit *et al.*, 2019).



• **Figure (2): Facial proportions and symmetry in the frontal plane. An ideally proportional face can be divided into central, medial, and lateral equal fifths. The separation of the eyes and the width of the eyes, which should be equal, determine the central and medial fifths.**

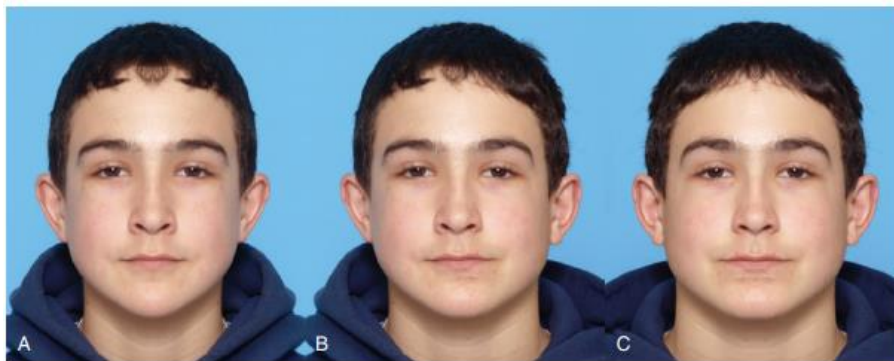


Figure (3): Composite photographs are the best way to illustrate normal facial asymmetry. For this boy, whose mild asymmetry rarely would be noticed and is not a problem, the true photograph is in the center (B). On the patient's right, (A) is a composite of the two right sides; on the left, (C) is a composite of the two left sides. This dramatically illustrates the difference in the two sides of a normal face, in which mild asymmetry is the rule rather than the exception. Usually, the right side of the face is a little larger than the left, rather than the reverse as in this individual.

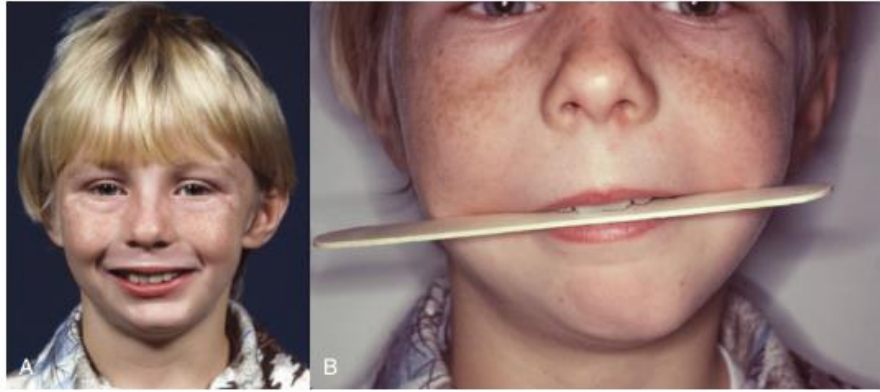


Figure (4): (A) Facial asymmetry developed in this boy after fracture of the left mandibular condylar process at age 5 because scarring in the fracture area prevented normal translation of the mandible on that side during growth.

When trying to define an attractive face, some features such as symmetry, average appearance, and secondary sexual characteristics influence the judgment. An attractive face could be partly a composition of several attractive components. Significant correlations were found between the parts, such as the chin and the skin, and the skin and the smile. Although facial elements were isolated as much as possible, some overlap occurred; when the skin was shown, the chin was also visible, which could explain this correlation. Significant values can also be attributed to chance. Correlations between some components were not significant, which is not surprising because a beautiful face could have some less attractive components. In addition, small elements such as the eyebrows can be challenging to evaluate, leading lay evaluators to ascribe a mean value to them (**Dario *et al.*, 2006; Little & Anthony, 2014**).

Before the advent of cephalometric radiography, dentists and orthodontists often used anthropometric measurements (i.e., measurements made directly during the clinical examination) to help establish facial proportions (Fig. 5). Although this method was largely replaced by cephalometric analysis for many years, the recent emphasis on soft tissue proportions has brought soft tissue evaluation back into prominence. (**Proffit *et al.*, 2019**).



Figure (5): Facial measurements for anthropometric analysis are made with either (A) bow calipers or (B) straight calipers. (C) to (E) Frequently used facial anthropometric measurements

Assessment is done for any asymmetry in the frontal plane. An ideally proportioned face can transversely be divided into equal central, medial, and lateral fifths. The separation of the eyes and the width of the eyes, determined by the central and medial fifths, should be equal. The nose and chin should be contained within the central fifth, with the width of the nose equal to or slightly wider than the central fifth. Ideally, the interpupillary distance should be same as the width of the mouth. Vertical facial proportions in the frontal and lateral views are best assessed in relation to the facial thirds, which should ideally be equal in height in well-proportioned faces (Fig. 6) (Jibin and Anilkumar, 2020). Ricketts advocated the used of golden proportion for the analysis of a physically beautiful face (Fig. 7) (Singh *et al.*, 2021).

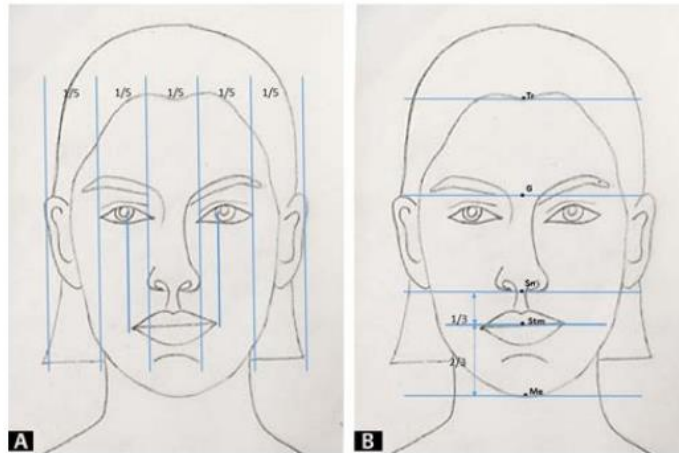


Figure (6): Frontal proportions: (A) Transverse and (B) vertical (original).

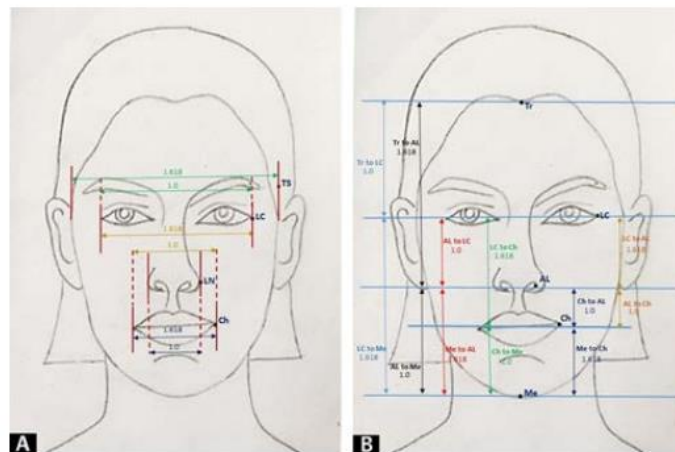


Figure (7): Golden proportions of face: (A) Transverse proportions and (B) vertical proportions (original).

1.3.2 Profile Assessment

It involves the following parameters: Anteroposterior position of jaws: The estimation of the profile, that is, convex, concave, and straight, serves as a guide to determine the underlying skeletal relationship and whether the jaws are proportionately positioned in the anteroposterior plane (**Singh *et al.*, 2021**).

The treatment modalities for dentoskeletal corrections range from growth modification (through dentofacial orthopaedic and functional therapy), camouflage treatment (through extraction and non-extraction therapy), and orthognathic surgery in severe discrepancies. Advancements in computer imaging have enabled the orthodontist

to plan and execute the treatment of an orthognathic patient effectively along with establishing realistic goals. Depending on the severity of the dentofacial deformity and esthetic demands, a variety of surgical options like maxillary advancement, maxillary alveolar setback, maxillary superior repositioning, mandibular advancement, mandibular setback, and adjuvant soft tissue surgical procedures (genioplasty, rhinoplasty, and cheiloplasty) can be used to achieve optimal dentoskeletal as well as facial esthetics (**Siqueira *et al.*, 2009**).

Vertical proportions and mandibular plane: Assessment of the vertical facial thirds and the mandibular plane in the lateral view helps in unmasking the vertical growth tendencies. A steep mandibular plane angle is associated with long anterior facial height and a skeletal open bite tendency, whereas a flat mandibular plane angle usually accompanies a short anterior facial height and deep bite malocclusion (**Singh *et al.*, 2021**).

Assessment of the incisor prominence and lip posture: Relationship between incisor prominence and lip posture aids in the formulation of a treatment plan. The ideal position of the incisors to their supporting bone is determined by components like the relationship of the jaws, soft tissue contours, and the relationship of the incisors to the supporting bone (**Bansal *et al.*, 2015**).

Excessive protrusion of incisors is determined by prominent lips, separated by more than 3 to 4 mm in relaxed position, that have to be strained to achieve closure. Retraction of teeth in such a patient will aid in improving lip function as well as facial esthetics and hence extractions should be considered in cases having bimaxillary protrusion (or protrusion) with/without crowding. Retraction of maxillary incisors reduces upper lip prominence but should not be done to an extent that the inclination of the upper lip becomes negative in relation to the true vertical line (an imaginary plum line at the intersection of the philtrum of the lip to the subnasale) (**Mejia-Maidl and Evans, 2000**). The profile is flattened by ~2 mm by premolar extraction and the dishing

in of the profile can be attributed to faulty diagnosis and planning. Burstone has stated that a decrease in lip prominence following retraction occurs only till lips close at rest without strain. However, when prominent lips close without strain, then the dentition is not at fault and retraction in such cases would provide no benefit apart from making the nasolabial angle more obtuse (**Songkongka, 2017**).

The relative prominence of the nose and chin in relation to the lips and face is important in treatment planning. In patients with a large nose and/or a large chin, a greater degree of lip prominence (achieved by incisor protraction) would still be considered esthetic (**Parrini et al., 2016**).

Surgical intervention is required sometimes for achieving optimal esthetic results in cases with mandibular retrusion/ protrusion. In Class II Div. 1 cases having lower lip trap with an increased overjet, proclined upper lip, and acute nasolabial angle, retraction of maxillary incisors improves lip seal and esthetics. However, when the upper lip is aesthetically positioned and the nasolabial angle is obtuse, mandibular advancement needs to be considered. In Class II camouflage cases with everted lower lip due to excessive proclination of mandibular incisors relative to the chin, the ideal treatment option would be incisor retraction by premolar extraction or genioplasty (**Machado and Andre, 2014**).

In cases with mandibular prognathism, having an increased lower facial height with protruded teeth, lack of a well-defined labiomental sulcus can be corrected by retraction of incisors. In patients having a Class III profile and thin lips, proclining the incisors tend to improve the profile by creating fuller lips (**Turley, 2015**).

1.4 Miniesthetics

1.4.1 Smile Type and Vertical Tooth–Lip Relationship

For an esthetically pleasing social smile, at least 75% of the maxillary crown should be visible, but up to 4 mm display of gingiva/4 mm lip coverage of the incisor crown is acceptable (**Proffit *et al.*, 2012**). The most attractive smiles have the upper lip at the height of the gingival margin of the upper central incisor. Three smile types have been described based on amount of incisor and gingival display: low, average, and high (Fig. 8). The average smile displays 75 to 100% of the maxillary crown length, the low smile shows less than 75% crown, while the high smile or the “gummy smile” is categorized by the display of the entire crown length in addition to a contiguous band of gingiva (**Zachrisson, 2005**).



Figure (8): Smile types: (A) Average smile, (B) high smile, and (C) low smile (original).

In cases of low smile types, elongating the upper teeth can be achieved by arch wires, anterior vertical elastics, judicious use of Class II elastics (which can rotate the occlusal plane down anteriorly), and the help of orthognathic surgery. In some cases, a combination of orthodontics and prosthetic crown lengthening with porcelain laminate veneers may be suggested (**Zachrisson, 2005**).

In cases of a high smile type, the underlying cause might be anterior vertical excess, increased muscular capacity to raise the upper lip, excessive overjet and overbite, and excessive interlabial gap at rest. Treatment modalities for correction of a high smile type include segmented arch mechanics for intrusion of maxillary incisors, intrusion using temporary anchorage devices, and orthognathic surgery (Lefort I

Osteotomy) (**Proffit *et al.*, 2012**). Orthognathic surgery needs to be considered in cases having vertical maxillary excess without excessive exposure of maxillary teeth in repose, as orthodontic treatment may accentuate the problem by over retraction of maxillary incisors or anterior tilting of the occlusal plane. In cases with adequate incisor display and deep bite with a deep curve of Spee, active intrusion of mandibular incisors is desirable, while molar extrusion may be considered in normal and low angle cases (**Zachrisson, 2005**). Incisor display at rest and during smile reduces with flaring, while increased display is seen with uprighting of incisors (**Sarver and Ackerman, 2003**).

However, overzealous maxillary intrusion can lead to an older appearance and a gummy smile is considered more youthful than diminished tooth display (**Zachrisson, 2005**). Between the third to seventh decades of life, maxillary incisor exposure decreases by 3.4mm and mandibular incisor exposure increases by 2.4mm. As a person ages, smile becomes narrower vertically and wider transversely (**Sarver and Ackerman, 2000**).

1.4.2 Transverse Dimension of Smile

Buccal corridor and arch form: The buccal corridor is a space created between the buccal surface of the posterior teeth and the corner of the lips when the patient smiles. The presence of buccal corridors is considered to give a natural appearance. The transverse width of the arch should be esthetically related to the facial width. Pretreatment mandibular intercanine width and mandibular arch form should serve as the optimal guide to future dental arch form and stability. A narrow collapsed arch form presents inadequate transverse dimension characteristics and dramatic improvements in aesthetics are seen after orthodontic treatment (**Sarver and Ackerman, 2003**). Noticeably constricted maxillary arch with or without cross bites requires expansion. Smile fullness can be added intentionally by adding buccal crown torque to palatally inclined canines and premolars in case the maxillary arch is satisfactory in regard to shape and width (**Zachrisson, 2005**). However, patients having buccally flared

posteriors should not undergo expansion. Excessive intentional expansion results in obliteration of the buccal corridor leading to a denture like smile, flattening of the smile arc, and disequilibrium and long-term relapse (**Zachrisson, 2005**). Studies have suggested that large buccal corridors give rise to less attractive smiles (**Janson *et al.*, 2011**). Measurement of buccal corridors in extraction and nonextraction cases has yielded no significant differences (**Christou *et al.*, 2019**).

1.4.3 Transverse cant and symmetry

Discrepancy in the maxillary anterior incisal plane depends on the interaction between posterior occlusal plane, incisal plane, interpupillary line, and crown length of the maxillary incisors. If the maxillary incisal plane deviates from the interpupillary line but coincides with the occlusal plane, the entire maxilla is developed asymmetrically and maxillary surgery is advised to intrude the maxilla on the over erupted side. When the maxillary incisal plane deviates from the interpupillary line and the occlusal plane, orthodontic extrusion/intrusion is performed. Smile asymmetry may also result due to asymmetric smile curtain (**Sarver and Ackerman, 2003**). In preadolescents, the occlusal plane can be corrected by growth modification appliances but in the adolescent and adult patients surgery is often indicated (**Sarver and Ackerman, 2003**). Individualized, esthetic, symmetric labiolingual crown inclinations are to be the treatment goal for every patient (**Zachrisson, 2005**).

1.4.4 Smile Arc

It is defined as the relationship of the curvature of the incisal edges of the maxillary incisors and canines to the curvature of the lower lip in a posed smile (**Sarver, 2001**). Three types of smile arcs are seen: parallel (consonant), straight, and reverse smile arc, with the goal being a parallel smile arc (**Zachrisson, 2005**). In the parallel arc, the incisal curve follows the lower lip while it is flatter in the straight arc. In the reverse arc, the canines are lower and the arc is reverse to the curve of the lower lip (Fig. 9). Ideally a distance of 1 to 1.5 mm between the central and lateral incisal

edges/bracket slots is ideal, while the traditional 0.5 mm difference in the bracket slot between the central and lateral incisor leads to a flat smile (**Sarver and Ackerman, 2003**). Step bends in the archwire can also be used to achieve this goal.



Figure (9): Smile arcs: (A) Parallel (consonant) smile arc, (B) straight smile arc, and (C) reverse smile arc (Singh *et al.*, 2021).

1.5 Microesthetics

1.5.1 Tooth Proportions

For an esthetically pleasing smile according to the golden proportion, the apparent width of the lateral incisor should be 62% of the width of the central incisor, the apparent width of the canine should be 62% that of the lateral incisor and the apparent width of the first premolar should be 62% that of the canine (Fig. 10.A). This ratio serves as a guide to determine the post-treatment size of a lateral size in case of disproportionately small lateral incisors, or when canines are reduced to replace the lateral incisors in case of congenitally missing laterals (**Proffit *et al.*, 2012**). As smile after extraction treatment has been shown to deviate from the golden proportion ratios more than nonextraction treatment, microesthetics need to be duly preserved in such treatment (**Edler, 2014**).

1.5.2 Height–Width Relationships

The width of a tooth should be 80% of the height. Sterrett have given an ideal range of 0.75 to 0.85. The central incisor may have a width of 8.1 to 8.6 mm and a length of 9.5 to 10.2 mm (Fig. 10.B) (**Sharma and Sharma, 2012**). Teeth appear tapered when height is excessive and square when it is deficient. Sulcular depth of the incisors, lip

level, relative crown length and amount of incisal wear influence the treatment strategy in cases with disproportionate length. In case of reduced crown height, the restoration of the missing part of the crown is done through laminates or bonding, while facial laminates are used in cases of distorted crowns and periodontal crown lengthening is performed in cases with vertical gingival encroachment (Chu, 2007).

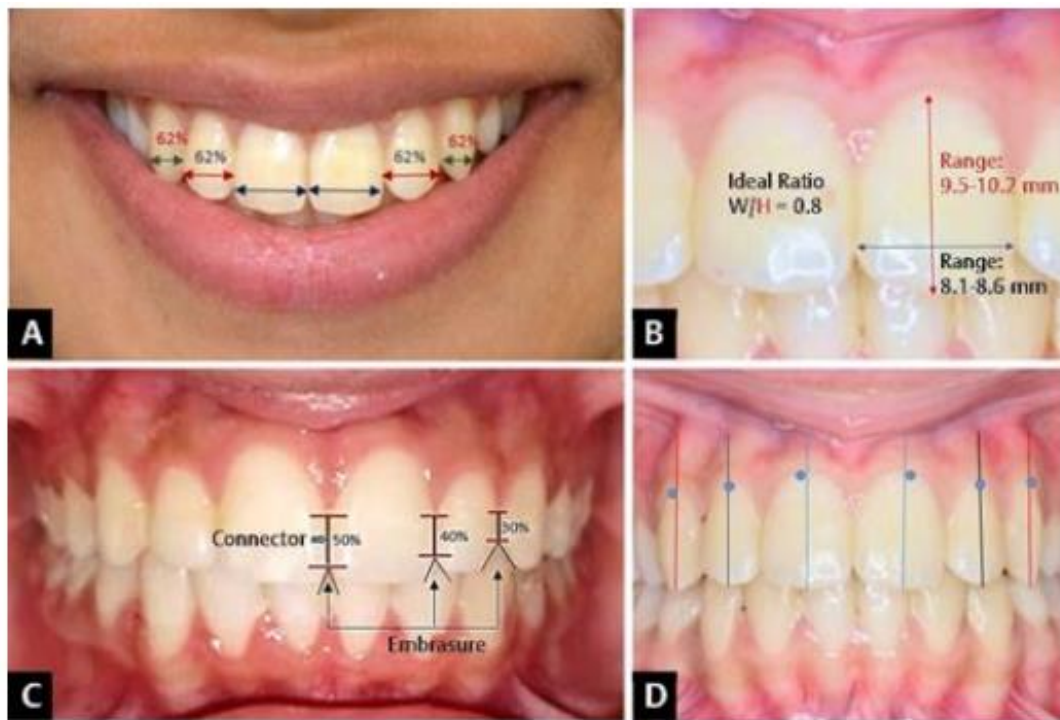


Figure (10): Microesthetics: (A) Tooth proportions, (B) height-width relationship, (C) connectors and embrasures, and (D) gingival zeniths (Singh *et al.*, 2021).

1.5.3 Connectors and Embrasures

Connector area is defined as the interdental contact area, while embrasures are defined as the triangular spaces that lie incisal to the contact (Sarver, 2005). The contact points move gingivally from the central incisors to the premolars, leading to a progressively larger incisal embrasure. Ideally, the maxillary anterior teeth follow the 50–40–30 ratio with the ideal connector length between the two maxillary incisors being 50% of the crown length and so on (Fig. 10.C) (Morley and Eubank, 2001). The embrasures are generally larger in size to the connectors and the interdental papilla fills the gingival embrasure. When the interdental papillae are short, open gingival

embrasures are present above the connectors forming unaesthetic black triangles. Orthodontic treatment of adults with severely crowded/rotated maxillary incisors as well as periodontal disease may cause black triangles. Reshaping the teeth by interproximal stripping and orthodontic root paralleling followed by space closure is the treatment of choice (**Proffit *et al.*, 2019**). Patients having a potential for black triangles have to be briefed about the need of reshaping of teeth to correct the same.

1.5.4 Gingival Height, Shape, and Contour

Proportionate gingival height is indispensable for an esthetic dental appearance. Generally, the central incisor and canine gingival margin are at the same level, while the lateral incisor margin is 1.5 mm lower. When the canines replace the laterals, this fact should be kept in mind. The gingival shape of the maxillary central incisors and canines is elliptical and the gingival zenith is oriented distal to the long axis of the respective tooth. The gingival shape of the maxillary lateral incisors and mandibular incisors should be symmetric half oval/half circle with the gingival zenith coinciding with the long axis of the tooth (Fig. 10.D) (**Gurel, 2003**). Gingival contouring by removal of excess gingiva is accomplished through periodontal surgeries like gingivectomy or crown lengthening, while gingival recession is routinely treated with tissue grafts or guided tissue regeneration and in some cases by nonsurgical orthodontic extrusion (**Sharma and Sharma, 2012**).

1.5.5 Tooth Shade and Color

A progression of shade from the midline posteriorly leads to an esthetically pleasing smile. The maxillary central incisors are the lightest and brightest and the teeth become gradually less bright. The hue (color) of maxillary laterals is similar to the central incisors but they are less bright. The canines are the least bright teeth with the highest chroma (color saturation). The first and second premolars are however closer to the laterals in color and hence are brighter than the canines (**Sharma and Sharma,**

2012). The teeth become dull and dark with age due to the formation of secondary dentin and wearing away of the facial enamel (**Proffit *et al.*, 2012**).

1.6 Laypeople's perceptions of frontal smile esthetics

Lay perceptions of smile esthetics are important to better understand the treatment goals from a patient's viewpoint. The results of this review permitted the identification of several smile features that should be well addressed during the definition of an orthodontic treatment plan. the most important aspect of facial animation is the smile, which is a critically important part of social interactions. Various characteristics may contribute to smile esthetics including smile arc, maxillary central incisor ratio and symmetry, anterosuperior teeth ratio, anterosuperior space, gingival design, level of gingival exposure, buccal corridors, midline and tooth angulations, tooth color and anatomic shape, and lip volume (**Machado and Andre, 2014**)

Maxillary incisors seem to be the most important teeth in defining smile esthetics, followed by maxillary canines (**Thomas *et al.*, 2011; Rosa *et al.*, 2013**). Key factors appear to be the widths of the visible teeth and shape irregularity of the central incisors, whereas slight alterations of symmetry and inclination do not seem to affect significantly smile esthetics (**Machado *et al.*, 2013; Ma *et al.*, 2014**). **Ong *et al.*, (2006)** stated that golden proportions were not decisive for attractiveness, and that overall dental attractiveness did not depend on any particular feature of the dentition. The ideal maxillary central incisor should be approximately 80% in width compared with height, but with variability between 66% and 80%. A greater width/height ratio results in a squarer tooth, and a lower ratio indicates a longer appearance. However, from our results, crown-length discrepancies between 2 and 4 mm seem to be considered esthetically acceptable (**Moore *et al.*, 2005; Kumar *et al.*, 2010**).

The vertical position of the maxillary incisors is the first feature analyzed by **Machado, (2014)** in planning smile rehabilitation treatment: a range between 0.5 and 1.5 mm of difference between the central and lateral incisors represents the gold standard.

Furthermore, vertical positioning of the central incisors was considered the key factor for smile arc design. The ideal position of the incisal edge of the lateral incisors was observed to be between 1 and 2 mm above the plane of the central incisor (**Anderson et al., 2005**).

Furthermore, the ideal distance between the smile arc and the lower lip was reported to be 2 mm, with an esthetic threshold up to 4 mm. Smile arcs with excessive curvature or flattening or reverse curvature have a negative effect on laypeople's perceptions (**Parekh et al., 2007; Badran et al., 2013**).

Results from the article by **Machado et al. (2013)** indicate that the gingival margins of the lateral incisors should be positioned slightly inferior to the adjacent teeth. However, only discrepancies between teeth of the same kind were considered in the articles in this review, with differences between 1.5 and 2 mm linked to a poorer smile score (**Ker et al., 2008; Correa et al., 2012**). Gingival display perception as an esthetic problem is considerably influenced by personal choice. According to Sarver and Jacobson (**Sarver and Jacobson, 2007**), orthodontists and oral and maxillofacial surgeons tend to see a gummy smile as an unesthetic characteristic, whereas laypersons consider it a problem only in more extreme cases. Machado reported a 3-mm limit of gingival exposure for an esthetically acceptable smile. Among our sample, laypeople judged as nonesthetic a gingival exposure of more than 4 mm and less than 1.5 mm, with a mean ideal value of 2.5 mm (**Machado et al., 2013; An et al., 2014**). However, even if this agreement in stating a threshold for gummy smiles may represent a guideline for treatment, several authors reported discordant results regarding laypeople's judgments of gingival exposure (**De-Marchi et al., 2012; Kaya et al., 2013**).

According to **Chang et al. (2011)** gingival display, as other smile variables, affects attractiveness only when considered in a facial context. Furthermore, when comparing average models with unattractive and attractive ones, an increase of gingival exposure was preferred. Thus, there remains disagreement regarding the need for orthodontic

treatment associated with gummy smiles; also, beyond adolescence, incisal and gingival display tends to reduce with advancing years.

In the past, it was claimed that when the arch forms are narrow or collapsed, the smile may cause inadequate esthetics (**Sarver and Jacobson, 2007**). Certainly, orthodontic expansion and widening of a collapsed arch form can dramatically improve the smile by decreasing the size of the buccal corridors and improving the transverse smile dimension in certain instances (**Sarver and Ackerman, 2003**). Furthermore, **Machado, (2014)** highlighted a preference for buccal corridors of medium width but did not define a numeric value for this feature. The majority of analyzed articles concluded that wider buccal corridors generally result in worse judgments, even if no significant correlation between scores and buccal corridors was found in the sample (**Martin et al., 2007; Nascimento et al., 2012**), except for the study by **De-Marchi et al. (2012)** Thus, lay tolerance for buccal corridors was reported to be between 5 and 16 mm, whereas the ideal buccal corridor amounts were discordant, ranging 6 to 11.6 mm (**McLeod et al., 2011**). **Parekh et al, (2006)** observed that less attractive smiles have excessive buccal corridors and flat smile arcs. Furthermore, flat smile arcs appear to decrease attractiveness ratings regardless of the buccal corridors. From an esthetic perspective, a diastema is an obstacle in reaching an ideal smile (**Machado et al., 2013**). Furthermore, according to **Rodrigues et al, (2009)** and **Thomas et al, (2011)** a diastema has a great impact on esthetic perceptions, even when full-face esthetics are evaluated. However, laypeople's acceptance of a diastema is characterized by an esthetic threshold of approximately 2 mm.

According to a previous review, a maxillary to mandibular midline discrepancy is considered acceptable up to a threshold of 2 mm, even if it was stated to be less relevant than changes in tooth angulation (**Machado, 2014**). According to **Parrini et al. (2016)**, a 2-mm deviation was also identified as the acceptance threshold. As expected, smile attractiveness decreased along with an increasing midline discrepancy, both for maxillary to facial midline and for maxillary to mandibular midline deviations (**Pinho**

et al., 2007; Saunders *et al.*, 2011). Furthermore, Zhang *et al* (2011) stated that similar degrees of deviation were most noticeable in male subjects with a tapered face type and least noticeable in female subjects with a square face type. Thus, on the basis of our evidence, the influence of facial patterns on midline deviation perceptions requires more investigation. On the frontal plane, an important issue to consider for smile esthetics is the cant of the maxillary occlusal plane (Sarver *et al.*, 2003).

Little evidence exists in relation to the effect of lip thickness on smile judgments. Machado (2014) suggested that lip support at the end of treatment is important, advising against maxillary incisor retraction and evaluating the adoption of lip filling in association with orthodontic treatment. Regarding lip thickness and distance from incisors, threshold values are not available. However, all authors concluded that these features seem to have some impact on perceptions (De-Marchi *et al.*, 2012; Ioi *et al.*, 2014). There is therefore a need for further research in this field.

Chapter two: Discussion

Obtaining a beautiful smile is always the main objective of any aesthetic dental treatment. After all, it is the beauty of the smile that will make the difference between an acceptable or pleasing aesthetic result for any given treatment. Nevertheless, in spite of its importance, the intrinsic characteristics of the smile are little discussed. Much is said of the clinical consequences of dental procedures on the smile, but its intrinsic characteristics are not widely evaluated. These characteristics can sometimes be altered and sometimes not, as they are integral parts of the individual. As such, the field of dentistry has no reach over these characteristics, and can only make evaluations of them.

Evaluating beauty is always subjective. However, we need adequate tools to overcome the challenge of this subjectivity. In orthodontics, it is not enough only to recognize what is interfering with the smile—it requires a diagnosis of what is not normal, in order to establish a treatment plan. Just as in functional problems, in which we follow conducts that lead us to a diagnosis of the anomalies, aesthetic problems also require parameters so we can find the defects. When searching for the visualization of problems, several rules and assumptions are created, leading sometimes to an underestimation of defects or an overvaluing of rules, creating paradigms that are not supported by proven scientific data. The very essence of aesthetic dentistry, which involves artistic criteria, contributes to this fact. The use of simple and reliable mechanisms can improve the possibilities of success, if not eliminate performance errors.

Chapter three: Conclusion

Esthetics has been an ever-evolving concept and has gained considerable importance in the field of orthodontics in the last few decades. The re-emergence of the soft tissue paradigm has further catapulted the interest of the orthodontist. So much so that achieving a harmonious profile and an esthetically pleasing smile has become the ideal goal of treatment and is no longer secondary to achieving a functional dental occlusion and/or a rigid adherence to skeletal and dental norms. Esthetics in the orthodontic sense can be divided into three categories: macroesthetics, miniesthetics, and microesthetics. Macroesthetics includes the evaluation of the face and involves frontal assessment and profile analysis. The frontal assessment involves assessment of facial proportions, while the profile analysis involves evaluation of anterior–posterior position of jaws, mandibular plane, and incisor prominence and lip posture. Miniesthetics involves study of the smile framework involving the vertical tooth–lip relationship, smile type, transverse dimensions of smile, smile arc, and midline. Microesthetics involves the assessment of tooth proportions, height-width relationships, connectors and embrasures, gingival contours and heights, and tooth shade and color. The harmony between these factors enables an orthodontist to achieve the idealized esthetic result and hence these parameters deserve due consideration. The importance placed on a pleasing profile cannot be undermined and the orthodontist should aim for a harmonious facial profile over rigid adherence to standard average cephalometric norms.

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