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### Smile, its anatomy, types, components and cosmetics in orthodontics: A review

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#### Abstract

An attractive smile is the centre of attraction of the face. The smile is the most dominant, bright, moving part of the face and hence noticed first. Currently there has been a shift from traditional treatment goals, such as ideal occlusion and cephalometric standards, to include goals embodying principles of micro esthetics and soft tissue harmony. Orthodontists have an important role to play in smile designing which involves the correction or modification of all the parts that comes in the smile frame, including the upper and lower lips, gingival exposure during smile, the size, color and shape of the teeth and the negative spaces between the tooth and the cheeks. Best esthetics in smile can only be designed by proper understanding of the structures contributing to smile and establishing a good harmony and balance between those structures.

**Keywords:** muscles of smile, smile esthetics, components of smile, types of smile, smile arc

#### Introduction

A simple smile can bring out all the positive emotions in you. The mouth is the center of communication in the face; the smile plays an important role in facial expression and appearance. This has been demonstrated in studies with photographs, where higher intellectual and social abilities were attributed to individuals with esthetic smiles. They were also judged to be more attractive than the same individuals on photographs with modified lower-level esthetic smiles<sup>[1, 2]</sup>.

Eyes are attracted first to a single location in the composition, most likely the most dominant, or bright, or moving part. In a face, the smile contains contracts of bright teeth against red lips and is active in speech and expression. Thus, it is dominant and attracts one's attention first. Dentists can plan these visual channels in his/her composition using line, contrast and size of objects by attending to the many details of a smile, including tooth position and the development of the smile to establish self. Currently there has been a shift from traditional treatment goals, such as ideal occlusion and cephalometric standards, to include goals embodying principles of micro esthetics and soft tissue harmony. This has caused the orthodontic profession to place a greater emphasis on gingival esthetics, tooth form, and on interdisciplinary care in general. Today's society not only endorses good looks and the attendant impression of good health, but advocates it as a measure of self-respect.

#### Anatomy of Smile

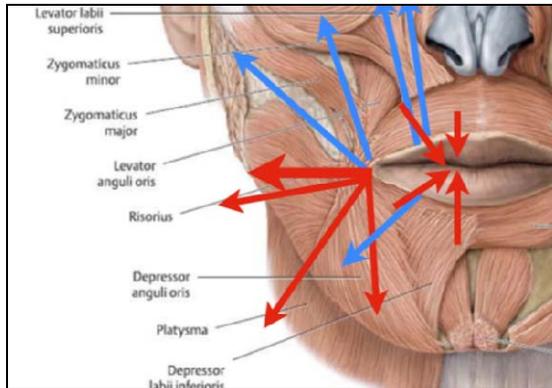
The smile expresses itself mainly in the oral region and eyes. The oral region includes the upper and lower lips, the corner of the mouth and anterior portions of the cheeks. The nasolabial grooves, if present, pass through the oral region from the nose toward the angles of the mouth and may extend inferiorly. The philtrum, usually present, is a vertical depression of the upper lip extending from the septum of the nose to the red zone<sup>[4]</sup>.

There are five groups that contribute to the anatomy of a smile (figure 1). These groups are as follows:

1. The elevators of the upper lips- quadrants labii superioris and caninus. The most important muscle in this group is the levator labii superioris.
2. The elevators of the corner of the mouth- zygomaticus major and portions of the buccinators.

3. The depressors of the corner of the mouth- triangularis risorius and portions of the buccinators.
4. The depressors of the lower lip quadrates labii inferioris and the mentalis.
5. The orbicularis oris has anterior fibers which purse the lips, pull them tightly against the teeth in a “clench smile” or roll the lower lips out into a “chimpanzee like smile”

There are striking variations in the amount of movement that exists in the normal smile from one person to another. A maximum spontaneous smile results in movement of the commissure from 7 to 22 mm. Likewise, the average direction of movement of the commissure is 40 degree from the horizontal, the direction of movement of most smiles is to helix scalp junction.



### Types of smile

There are five variations in which dental and/or periodontal tissues are displayed in the smile zone [5]:

- Type 1: Maxillary only
- Type 2: Maxillary and over 3mm gingival
- Type 3: Mandibular only
- Type 4: Maxillary and Mandibular
- Type 5: Neither Maxillary or Mandibular

Types of smiles were also classified as [6]:

1. Convex smile
2. Concave smile
3. Straight smile

### The Social Smile and the Enjoyment Smile

The social smile is a voluntary smile a person uses in social settings or when posing for a photograph. When you are introduced to someone, your smile indicates that you are friendly and “pleased to meet” that person. The enjoyment smile (or Duchenne smile) is an involuntary smile and represents the emotion you are experiencing at that moment [7] (Figure 2). What differentiates the social smile from the enjoyment smile is not the activity of the orbicularis oris musculature, but instead the participation of the orbicularis oculi. In the enjoyment smile there is a crinkling around the eyes that cannot be duplicated with a social smile [6].

Smiles can also be classified as either *posed* or *spontaneous*. Peck and Peck [7] classified smiles as stages I and II, and Ackerman *et al.* [8] designated the stage I smile as the posed smile and stage II as the unposed (spontaneous) smile. The posed smile is voluntary and need not be elicited or accompanied by emotion. A posed smile is static in the sense that it can be sustained. The lip animation is fairly reproducible, similar to the smile that may be rehearsed for photographs or school pictures (Figure 3).

The unposed smile is involuntary and is induced by joy or mirth. It is dynamic in the sense that it bursts forth but is not sustained. An unposed smile is natural in that it expresses authentic human emotion. Lip elevation in the unposed smile is often more animated, as seen in the laughing smile.



Fig 2: Social Smile and enjoyment smile



Fig 3: Posed and Unposed smile

### The Eight Components of a Balanced Smile

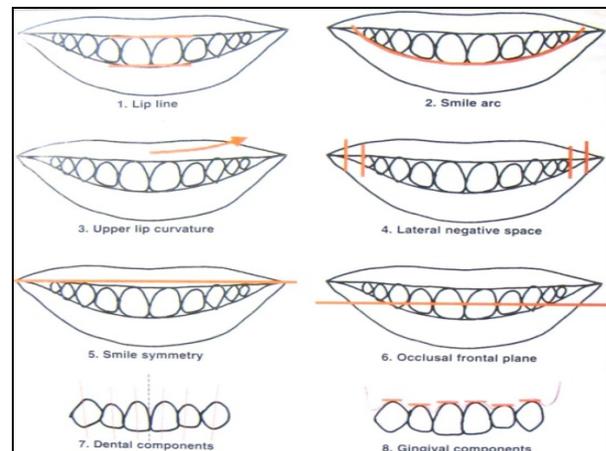


Fig 4: 8 components of balanced smile

#### 1. Lip line

The lip line is the amount of vertical tooth exposure in smiling i.e - the height of the upper lip relative to the maxillary central incisors.

As a general guideline, the lip line is optimal when the upper lip reaches the gingival margin, displaying the total cervico incisal length of the maxillary central incisors, along with the interproximal gingivae.

With aging, there is a gradual decrease in exposure of the maxillary incisors at rest and, to a much lesser degree, in smiling. This steady decline in maxillary tooth exposure at rest is accompanied by an increase in mandibular incisor display.

The amount of vertical exposure in smiling depends on the following six factors [9].

- **Upper Lip Length.** The average lip length at rest, as measured from subnasale to the most inferior portion of the upper lip at the midline, is about 23mm in males and

20mm in females<sup>[10]</sup>. Lip length should be roughly equal to the commissure height, which is the vertical distance between the commissure and a horizontal line from subnasale.

- **Lip Elevation.** According to Zachrisson *et al*<sup>[11]</sup> in smiling, the upper lip is elevated by about 80% of its original length, displaying 10mm of the maxillary incisors. Women have 3.5% more lip elevation than men. Actually, there is considerable individual variability in upper lip elevation from rest position to the full smile, ranging from 2-12mm, with an average of 7-8mm. If a gingival smile is caused by a hypermobile lip, it would be a mistake to correct it with aggressive incisor intrusion or maxillary impaction surgery, because that would result in little or no incisor display at rest and thus make the patient look older.
- **Vertical Maxillary Height.** The importance of the vertical position of the maxilla in tooth display has been demonstrated in both prosthetic dentistry and orthognathic surgery. When upper lip length and mobility are normal, a gingival smile with excessive incisor display at rest can be attributed to vertical maxillary excess. Zachrisson<sup>[11]</sup> states that the full smile does not make a good reference, partly because of the individual variation in lip mobility. A short upper lip should not be treated by shortening the maxilla unless the facial outline can accommodate such a change. According to Sarver *et al*<sup>[12]</sup> it should also be noted that in maxillary impaction, the upper lip shortens by as much as 50% of the surgical skeletal intrusion.
- **Crown Height;** The average vertical height of the maxillary central incisor is 10.6mm in males and 9.8mm in females<sup>[13]</sup>. A short crown can be due to attrition or excessive gingival encroachment. If there is little or no incisor display at rest, but the lip line is normal in smiling, the crown height can be increased incisally with cosmetic dentistry. A gingivectomy or a crown-lengthening procedure with crestal bone removal is recommended when short clinical crowns are associated with a gingival smile and a normal incisor display at rest.
- **Vertical Dental Height;** The incisor exposure at rest, rather than the overbite, determines the vertical position of the incisal edge, all other factors being equal. Therefore, a deep bite should be corrected by maxillary incisor intrusion in a patient with excessive incisor display at rest, but with posterior extrusion and/or lower incisor intrusion in a patient with a normal lip line at rest. The opposite applies to an open bite, which should be corrected by maxillary incisor extrusion if there is inadequate incisor display at rest, but with posterior intrusion and/or lower incisor extrusion if the lip line is normal at rest.
- **Incisor Inclination;** Peck *et al*<sup>[7]</sup> stated that proclined

maxillary incisors, whether in a Class II division 1 malocclusion or in a Class III compensation, tend to reduce the incisor display at rest and in smiling. On the other hand, uprighted or retroclined maxillary incisors, as seen in Class II, division 2 malocclusion or after orthodontic retraction without torque control, tend to increase the incisor display. According to Sarver *et al*.<sup>[12]</sup>, maxillary incisor inclination can best be assessed on profile and oblique smiling photographs, which should become standard orthodontic records.

## 2. Smile Arc

The smile arc is the relationship between a hypothetical curve drawn along the edges of the maxillary anterior teeth and the inner contour of the lower lip in the posed smile. According to Miller<sup>[14]</sup> the curvature of the incisal edges appears to be more pronounced for women than for men, and tends to flatten with age. Sarver *et al*.<sup>[13]</sup> stated that an optimal smile arc described as "consonant" the curvature of the maxillary incisal edges coincides with or parallels the border of the lower lip in smiling. The lower lip can either touch, not touch, or slightly cover the upper incisal edges. In a "nonconsonant" smile arc, the maxillary incisal edges are either flat or reversed relative to the curvature of the lower lip. The smile arc can be unintentionally flattened during orthodontic treatment like over intrusion of Maxillary Incisors., Bracket Positioning and canting of the Occlusal Plane. (Figure 5)



Fig 5: Patient with flat smile arc after orthodontic treatment

## 2. Upper Lip Curvature

The upper lip curvature is assessed from the central position to the corner of the mouth in smiling.

Upward -when the corner of the mouth is higher than the central position, Straight -when the corner of the mouth and the central position are at the same level and Downward - when the corner of the mouth is lower than the central position (figure 6).

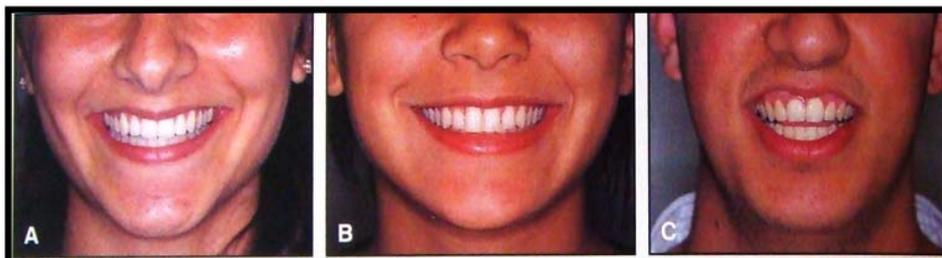


Fig 6: Upper lip curvature A: Upward B: Straight C: Downward

### 3. Lateral Negative Space

The transverse dimension of the smile is also referred to as "transverse dental projection". Lateral negative space is the buccal corridor between, the posterior teeth and the corner of the mouth in smiling. Orthodontists refer to buccal corridors as "negative" spaces to be eliminated by transverse maxillary expansion. A first- molar-to-first-molar smile is often advocated in orthodontics, but is considered evidence of a poorly constructed denture in prosthodontics.

### 4. Smile Symmetry

Smile symmetry, the relative positioning of the corners of the mouth in the vertical plane, can be assessed by the parallelism of the commissural and pupillary lines. Although the commissures move up and laterally in smiling, there is a difference in the amount and direction of movement between the right and left sides. A large differential elevation of the upper lip in an asymmetrical smile may be due to a deficiency of muscular tonus on one side of the face (figure 7)



**Fig 7:** Patient with asymmetrical smile due to deficiency of muscle tonus on side of face

Myofunctional exercises have been recommended to help overcome this deficiency and restore smile symmetry. An oblique commissural line in an asymmetrical smile can give the illusion of a transverse cant of the maxilla or a skeletal asymmetry.

### 6. Frontal Occlusal Plane

The frontal occlusal plane is represented by a line running from the tip of the right canine to the tip of the left canine. A transverse cant can be caused by differential eruption of the maxillary anterior teeth or a skeletal asymmetry of the mandible. This relationship of the maxilla to the smile cannot be seen on intraoral images or study casts, and smile photographs can also be misleading. Therefore, clinical examination and digital video documentation are essential in making a differential diagnosis between smile asymmetry, a canted occlusal plane, and facial asymmetry.



**Fig 8:** Pre treatment and post treatment photograph of a patient showing increased esthetics after correction of occlusal plane

### 7. Dental Components

A pleasant smile also depends on the quality and beauty of the

dental elements it contains and their harmonious integration. According to Moskowitz<sup>[15]</sup> dental components of the smile include- Size, shape, color, alignment of the teeth, Crown angulations (tip) of the teeth, Midline, and Arch symmetry.

### 8. Gingival Components

The gingival components of the smile are the color, contour, texture, and height of the gingivae. Inflammation, blunted papillae, open gingival embrasures, and uneven gingival margins detract from the esthetic quality of the smile.

The space created by a missing papilla above the central incisor contact point, referred to as a "black triangle", may be caused by root divergence, triangular teeth, or advanced periodontal disease. Orthodontic root paralleling and flattening of the mesial surfaces of the central incisors, followed by space closure, will lengthen this contact area and move it apically toward the papilla.

The gingival margins of the central incisors are normally at the same level or slightly lower than those of the canines, while the gingival margins of the lateral incisors are lower than those of the central incisors.

Gingival margin discrepancies may be caused by attrition of the incisal edges, ankylosis due to trauma in a growing patient, severe crowding, or delayed migration of the gingival tissue<sup>4</sup>. The gingival margins can be leveled by orthodontic intrusion or extrusion or by periodontal surgery, depending on the lip line, the crown heights, and the gingival levels of the adjacent teeth<sup>[16]</sup>.

### Cosmetic Dentistry in Orthodontics

The literature on cosmetic dentistry contains excellent definitions of desirable characteristics of tooth shape and proportions, gingival esthetic characteristics, and what constitutes esthetic teeth and gingival relationships. These characteristics include (1) tooth proportionality, (2) contacts, connectors, and embrasures, and (3) gingival characteristics.

#### 1. Tooth proportionality- height and width

The ideal maxillary central incisor should be approximately 80% width compared with height, but it has been reported to vary between 66% and 80%. A higher width/height ratio means a squarer tooth, and a lower ratio indicates a longer appearance. The corresponding solutions to the tooth height problem are all different, including bonding or laminates to increase the length of the tooth, awaiting completion of passive eruption, or periodontal crown lengthening. The most commonly reported maxillary incisor height width relationships are illustrated in (Figure 8). A higher width/height ratio means a squarer tooth, and a lower ratio indicates a longer appearance. Many smiles exhibit disproportionality, so that these measurements should not be taken as an absolute rule. The ranges of height and width are important to note<sup>[17-20]</sup>, because the disproportionality of a tooth can then be evaluated with regard to what parameter is at fault and in need of improvement. This concept is illustrated in (Figure 9) which shows a tooth that is virtually square

#### 2. Contacts, connectors, and embrasures

Contacts (interdental contact points) are defined as the exact place that the teeth touch (what makes floss snap). The connector (also referred to as the interdental contact area) is where the incisors and canines "appear" to touch<sup>[10]</sup>. (Figure 10).

The contact points progress apically as the teeth proceed from

the midline to the posterior. The connector height is greatest between the central incisors and diminishes from the central to the posterior teeth. The embrasures ideally are larger as the teeth progress posteriorly.

- Appropriate ratio for connector between central incisors is 50% of tooth height;
- Ratio for central and lateral incisor connector is 40% of central incisor height;
- Ratio for lateral incisor and canine connector is 30% of central incisor height

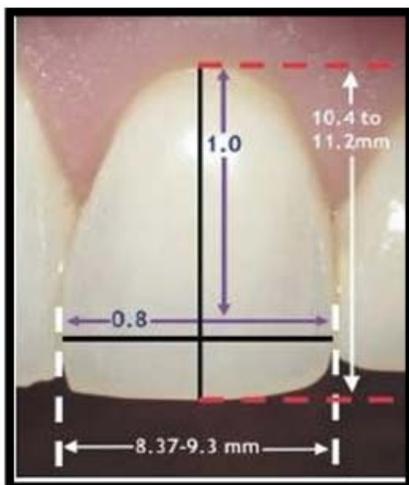
### 3. Gingival esthetics

Gingival shape refers to curvature of the gingival margin of the tooth, determined by the cemento-enamel junction and the osseous crest. According to the American Academy of Cosmetic Dentistry [21], The gingival shape of the mandibular incisors and the maxillary laterals should exhibit a symmetrical half-oval or half-circular shape. The maxillary centrals and canines should exhibit a gingival shape that is more elliptical. Thus, the gingival zenith (the most apical point of the gingival tissue) is located distal to the longitudinal axis of the maxillary centrals and canines. The gingival zenith of the maxillary laterals and mandibular incisors should coincide with their longitudinal axis. (figure 12).

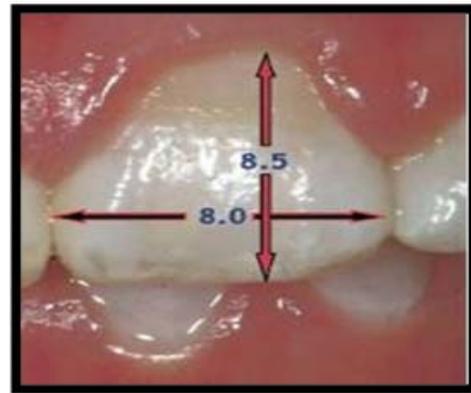
The gingival esthetic line [22] (GAL) is a line connecting the apices of the gingival scallop. The most apical part of the gingival scallop should reflect the angle of the long axis of the tooth, and there should be an interdental papilla of 4.5 to 5.0 mm from tip of the papilla to the depth of the marginal scallop [23].

The papillae will fill embrasure when the distance between alveolar crest and contact are less than 5mm<sup>24</sup>. This decreases to 56 % of the time when the distance is 6mm and 27% at 7mm. When the interradicular distance between central incisors is greater than 2.4mm the distance from contact to alveolar crest loses its influence [17].

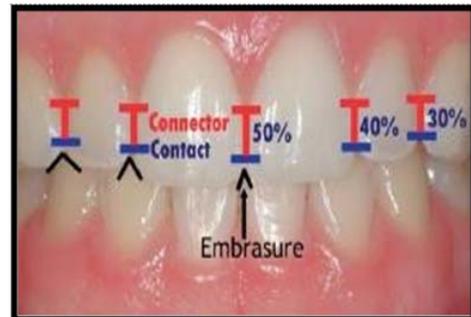
Recently, the uses of soft tissue lasers in orthodontic practice has become popular to enhance smile esthetics and improve finishing of orthodontic patients, use of soft tissue lasers broadly fall into the following categories: (1) improving gingival shape and contour, (2) lengthening crowns, (3) idealizing tooth proportionality, and (4) resolving crown/height asymmetries [25].



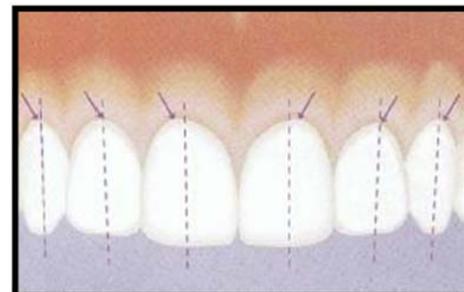
**Fig 8:** Ideal maxillary central incisor Proportion is approximately 80% width compared with height, with ranges as show



**Fig 9:** In this incisor is too short. Crown width is 8.0 mm, within normal range, but height is 8.5 mm, significantly shorter than acceptable range



**Fig 10:** Contact between anterior teeth



**Fig 11:** Gingival zenith (most apical point of gingival tissue) is distal to longitudinal axis of maxillary central incisors and canines

### Conclusion

A smile is a gesture unique to our race, that is unlike the grimace of lower primates and adds the human touch. People are concerned with their smile, the way they feel about it and its effect on other people too. A pleasing smile enriches, not only yourself but also the world around you.

Having a dentist actually craft a new smile for a patient is very much becoming an art form and it should be since each persons smile is a unique as its owner.

The orthodontist responsibility lies in preserving, creating and enhancing an existing smile without impairing function. The key to successful treatment lies in establishing harmony within the orofacial complex. The joy of its blending into engaging smile is shared by the patient, viewer and the dentist.

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