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The esthetic zone of Smile

Abstract:

Timeless human esthetics implies a sense of beauty, a pleasing impulse, naturalness, and a youthful appearance relative to one's age. The goal for esthetic treatment should be an enhanced but natural appearance that imparts a vibrant and believable appearance to the patient. This should be our goal in dental esthetics: a result that would be considered "bright, beautiful, but believable." Nowadays increasing, patients seeking treatment present with the primary concern of an esthetic enhancement of their smile.

This article will focus on the various smile design concepts and present smile parameters that will help the reader to design their esthetic treatments. The smile design concepts have been presented in various forms of tooth morphology, shade, shape and related to other structures scaffolding the smile. It is important to understand that when planning smile designing it is a broad aspect to be covered as esthetics is finite. Therefore planning treatment it is important to consider the esthetic zone of smile. Here I would suggest the various smile design zone parameters that are to be taken into account for planning any smile design procedure in orthodontics.

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Introduction

The smile is one of the most important facial expressions and is essential in expressing emotions. The subject of smile and facial attractiveness as they relate to communication and expression of emotion is of great interest to orthodontist. An attractive or pleasing smile enhances the acceptance of an individual in the society by improving the interpersonal relationships.¹ The importance of beauty and attractiveness in today society has been well established. Physically attractive people are perceived to be more kind, sensitive, interesting, strong, poised, modest, sociable, outgoing, exciting and responsive.

Webster² defines the smile as “ a change of facial expression involving a brightening of the eyes, an upward curving of the corners of the mouth with no sound and less muscular distortion of the features than in a laugh that may express amusement, pleasure, tender affection, approval, restrained mirth, irony, derision or any of various other emotions.”

There are two forms of smiles - the enjoyment or Duchenne smile and the posed or social smile. The Posed smile is voluntary and not elicited by an emotion. In other words it is reliably reproducible and can be sustained ^{3,4}. Posed smiles, therefore have importance

in Orthodontic diagnosis and treatment planning. The unposed or social smile however, is involuntary and is induced by joy or mirth. It is a natural response as it expresses authentic human emotion. Unlike the posed smiles, these smiles are not sustained.

Measuring smile is an era of objective or subjective assessment. Objective assessment of smile represents goals which are to be accomplished at the end of the treatment while the subjective assessment involves personal preferences of patients and clinicians .For example, the degree of mesiodistal tip on the maxillary anterior teeth can be varied to a certain degree, with a difference in the aesthetic outcome .There could be a wide range of possible axial inclinations for the maxillary anterior teeth that would result in aesthetic appearance that could be pleasing to the patient or the clinician without having any impact on dental health and masticatory system .There could be other details that are subjective and impossible to quantify as for example the practitioners who adhere to tweed school of philosophy or the other side contrary to this practitioners who believe in Bioprogressive school of thought . The anterior torque values varies significantly among the two techniques with a difference in the esthetics and the

function outcomes. The first measurable assessment was made by Andrews by his 'Six keys to normal occlusion' which could measure the final outcome of the treatment and which became a future foundation for developing preadjusted appliance systems with varying degrees of tip and torque values³. It must be understood that there is no universal "ideal" smile. The most important esthetic goal in orthodontics is to achieve a "balanced" smile, which can best be described as an appropriate positioning of the teeth and gingival scaffold within the dynamic display zone⁴.

As mentioned above, this includes lateral, vertical, and anteroposterior aspects, as well as the cant of the maxillary anterior transverse occlusal plane and the sagittal cant of the maxillary occlusal plane. Smile design and mechanotherapy must be built around this esthetic plane of occlusion, which is often different from the natural plane of occlusion. The first consideration in obtaining a consonant smile arc, or preserving an already consonant smile arc, is bracket positioning. Smile design also necessitates changes in overall treatment mechanics. In cases with high labial ectopic maxillary canines, for instance, levelling with a continuous archwire will intrude the maxillary central and lateral incisors and thus flatten the smile arc. For such cases segmented-arch technique using cantilever

springs offers better control of levelling and of the aesthetic plane of occlusion. Creating an attractive smile depends upon factors like whether the problem is dental or skeletal, any periodontal disease, missing teeth, etc. During this course of action an orthodontist may spend much time in detailing as was spent for major corrections like skeletal discrepancy, severe crowding, space closure and rotations. Frequently the patients become impatient because of the requirement of the second and third order changes in buccal segment³. For this role of bracket selection and placement plays a very important role³. People with a normal dental appearance are judged more socially attractive over many personal characteristics than those with malocclusions. Those with poor dental esthetics have been linked to lack of self-confidence and are thought to be disadvantaged in social, educational, and occupational settings⁴. Though, various authors have written extensively in the literature regarding the importance of various factors to be considered in aspect to smile designing. This article reviews concepts and principles of smile esthetics in orthodontic treatment that should lend esthetics to the entire orofacial complex involving unity, form, colour, function and display of dentition.

Clinical Evaluation

The most important aspect of the clinical assessment is for the clinician to know what to evaluate

clinically. Every face has disproportions and asymmetries, as so does the smile and its associated dentition. Therefore, it requires a clinician's educated eye for the correct diagnosis to be made for the future treatment protocol.

Natural head position

In order to assess smile proportions patient must be examined in natural head position (NHP). NHP is a standardized and reproducible position of the head in space when the subject is focusing on a distant point at eye level. In NHP, the visual axis is horizontal. This allows an extra-cranial vertical, and a horizontal perpendicular to that vertical, to be used as reference lines for facial aesthetic analysis⁵. This is important as the cant or inclination of all other reference lines, such as the Frankfort plane, is subject to biologic variation. The procedure to obtain a clinical facial photograph in NHP is with the subject standing upright and looking straight ahead into the image of his/her own eyes in a small mirror located at a distance, at the level of the eyes^{4,5}.

Smile Capture Method

Capturing patient smile images with conventional photography has two major drawbacks. First, it is

extremely difficult to standardize photographs due to differences in camera angles, distances to the patient, head positions, and discrepancies between intraoral and extraoral photographic techniques. Standardized digital videography allows the clinician to capture a patient's speech, oral and pharyngeal function, and smile at the same time. The patient is seated in a cephalostat and placed in natural head position or the patient is asked to hold two scales in cross configuration. The digital video camera is mounted on a microphone stand and set at a fixed distance in the records room. The lens is positioned parallel to the true perpendicular of the face in natural head position, and the camera is raised to the level of the patient's lower facial third⁴. The patient is asked to say the sentence "Chelsea eats cheesecake on the Chesapeake", relax, and then smile. Anterior tooth display is not the same during speech as in smiling⁴. By taking a video clip of both, we can evaluate all aspects of anterior tooth display. The video camera captures roughly 30 frames per second; this method usually produces a five-second clip, for a total of 150⁴.



Fig 1 - Video camera set on a tripod at 4 feet distance from the subject in sitting position

Standardization of image

The frames can be edited in a video editing software (DVD video soft studio) This converts the video into JPEG. Then, each JPEG file of the selected subjects can be opened in Adobe Photoshop CS2 (Adobe Systems, San Jose, California) and then adjusted by using the ruler option in the frame. The method used to standardize the image was as described by Desai et al⁷ First, the resolution was changed to 300 pixels per inch by going to “image > image size.” Then, the ruler function was chosen and set to millimeter which can measure a minimum of 0.1mm length. On the parallel end of the ruler, a 10-mm area, close to the smile, was measured. That number was divided into 10 (10/ measurement on JPEG file) and multiplied by the width value found in image size screen (image >

image size). The resulting number was copied and pasted in place of the width reading, and the changes were applied to the JPEG file.

Evaluation of smile design is to be considered under following clinical evaluation;

1) Dento-facial analysis

2) Dental analysis

Tooth analysis

Tooth and lip analysis

Tooth and gingival analysis

DENTO-FACIAL ANALYSIS

Midline Discrepancy

Ideally, the dental midline should be in align with the facial midline but usually it does not. As long as the midline is parallel with the long axis of the face, midline discrepancies of up to 4 mm will generally not be perceived as unesthetic. Slight corrections of midlines can be accomplished with restorative dentistry as long as the maxillary centrals are made relatively symmetric and correct intertooth relationships are maintained. If the individual teeth do not require restoration and there is a large midline discrepancy, the ideal treatment is orthodontic treatment. One should also check the soft tissue attachment hindering the closure of midline diastema⁶(fig2)



Fig 2- Midline diastema greater than 4mm requires orthodontic treatment

DENTAL ANALYSIS

Tooth analysis

The next step is to evaluate the relationship of the lips to the teeth, ie, visual tooth display both statically and dynamically⁷.

Intratooth evaluation

The average length for maxillary central incisors has been measured at between 10 mm to 11 mm. Patients who seek esthetics as a primary reason for treatment want to have a full smile with “above average” looking teeth. According to Edward Larren⁸ the esthetic zone for the central incisor to be between 10.5 mm and 12 mm. A good length to start the design is 11 mm, as it can be modified based on the many other treatment planning parameters. The width to-length esthetic relationship has

been discussed in the literature to be between 70% to 80%⁸. Smiles with these values were most often deemed “esthetic to highly esthetic.” The most esthetically pleasing ratio was 80%. It is extremely important to note that the esthetic perception of width-to-length ratios is significantly affected by the outline form and the reflective surface of the tooth. The lateral incisors are between 1 mm to a maximum of 2.5 mm shorter than the central⁸. For a more petite smile, more toward the 2 mm to 2.5 mm length is recommended. The canine is slightly shorter than the central between 0.5 to 1 mm⁸.

Contacts, connectors, and Embrasure Morphology

The elements of tooth contacts, connectors, and embrasures can be of real significance in planning the treatment of the smile. Contacts (interdental contact points) are defined as the exact place that the teeth and touch (what makes floss snap). The connector (also referred to as the interdental contact area) is where the incisors and canines “appear” to touch. 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 (the triangular space incisal to the contact) ideally are larger as the teeth progress posteriorly. The shape of the space between your teeth called the embrasure These should be consider before finishing the contacts as they can be to wide or narrow¹⁰.(fig 3 and 4)



Fig 3-embasures can be too wide or narrow giving unesthetic appearance

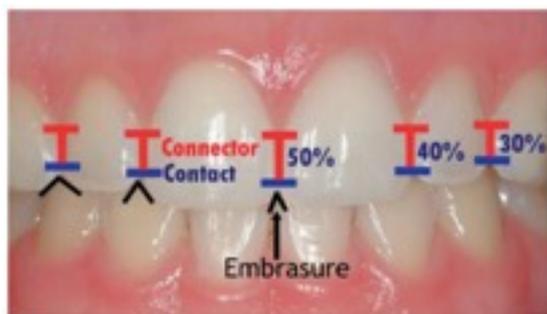


Fig 4- Contact between anterior teeth is where teeth actually touch; connector is where teeth appear to touch. Embrasures are smallest between central incisors and grow larger as they progress posteriorly in dentition

Intertooth evaluation

Tooth proportionality and Golden ratio

When a person smiles and the teeth are displayed, there is an intertooth relationship that needs to be maintained for the composition to be considered esthetic. The maxillary central

incisors should be relatively but not perfectly symmetrical. They should dominate but not overwhelm the smile⁸. This is obviously very subjective, but research has shown that in smiles determined to be esthetic, there was a clear dominance of the maxillary central incisor. Minoo et al⁹ had suggested that the golden proportion was not the same perceived maxillary anterior teeth widths of individuals with an esthetic smile and concluded that due to variety in nature, esthetics in dentistry cannot be justified mathematically; individuals should not be standardized in the same way. Though many authors recommend using the golden proportion to define the optical width of the maxillary teeth as they go posteriorly many studies has demonstrated that the actual measurements of most people's anterior teeth do not in fact follow the golden proportion. It has not been determined that if a person's optical tooth display followed the golden proportion that this be considered more esthetic than other arrangements. Acc to Edward Larren⁸ experience, the relationship of the maxillary lateral to central incisor comes very close to the golden proportion in an esthetic smile, and can be used as a guide in shaping teeth⁹. A good guide is to make the optical width of the lateral incisor about 65% of the central incisor (or a little less than two thirds). The canine does not follow the golden proportion optically and is generally about 75% to 80% or about three fourths to four fifths of the optical width of

the lateral incisor in smiles that were considered highly esthetic, with an esthetically acceptable zone from 70% to 85% (fig 5 and 6)

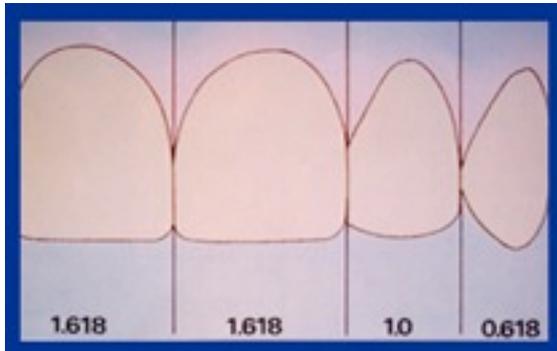


Fig 5- The golden proportion must be maintained so as to get the best esthetics



Fig 6- Width to length ratio is not the same and esthetic percentages is does not follows the golden proportion⁸

Tooth and lip analysis

Incisor exposure and Smile Line

Published reports have shown that the average 30-year-old woman displays about 3.5 mm of

maxillary central incisor tooth structure when the lips are at rest. The prosthodontic literature has generally recommended setting denture teeth so that 2 mm of tooth structure is displayed at rest. In the author's experience, the 2 mm exposed at rest is generally less than desired by esthetically driven patients, for most patients who have improved esthetics as their primary treatment goal, between 3 mm and 4 mm displayed at rest will be esthetically ideal. Another guide for evaluating the esthetic position of the maxillary anterior incisal edges applies when the patient smiles; in an esthetic composition, the tips of the maxillary anterior teeth come very close to touch the lower lip up to a maximum of 3 mm away. The esthetic treatment would be to reposition the incisal edges of the maxillary anterior teeth within these two dentolabial esthetic zones. The modality of treatment would be determined in conjunction with the evaluation of all the other smile design and treatment goal parameters. If patients display less than 4 mm of the maxillary central at rest and the teeth need to be lengthened, the length will generally be achieved by adding to the incisal edge. In an esthetic smile, the edges of the maxillary anterior teeth follow a convex or gull-wing course matching the curvature of the lower lip and are generally radially parallel to the horizon. From a frontal view, the maxillary arch from central to molar appears to curve upward, but not always. If it does, this apparent curve may be

a result of a slight posterior cant to the maxilla or the frequent appearance of the Curve of Spee in the intact dentition. Slight to moderate deviations to this pattern can be effectively treated with esthetic recontouring or conservative restorative dentistry. In situations where there is ideal tooth form and color but there are discrepancies to the smile line or visual tooth display, restorative dentistry is not indicated, as this would cause unnecessary mutilation of otherwise healthy tooth structure. In these clinical situations, and when there is moderate to severe distortion of the smile line, orthodontics would be the more appropriate treatment¹⁰.(fig 7)

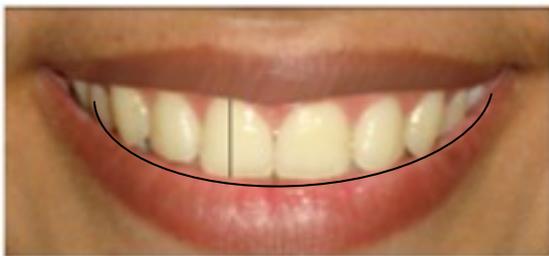


Fig 7- Incisors exposure and smile line

Dark Buccal Corridor

In an esthetic smile there is what has been termed negative space, which is a small space between the maxillary posterior teeth and the inside of the cheek¹³. The presence of dark buccal corridors may be due to:

- ☑ Transverse narrowing of the maxilla, especially in the premolar region. Expansion of the maxillary arch is required in order to fill the corners of the smile.

- ☑ Palatal angulation of the maxillary posterior dentition. Increased palatal root torque and/or expansion of the posterior maxillary dentition, primarily the premolar region, are required. In cosmetic dentistry, an increase in the thickness of the buccal aspect of ceramic restorations on the premolar teeth may help to fill out the smile.

- ☑ Retro-positioned maxilla. Maxillary advancement is the treatment of choice

A broad smile with a minimal buccal corridor is deemed most esthetic by lay people; however, a broad smile without a buccal corridor could also be perceived as fake. If the space appears excessive when the patient is smiling, a small amount of the contours of the maxillary posterior restorations—assuming restorations need to be placed for restorative reasons. If conservative additive or subtractive (ie, esthetic contouring) techniques will not work esthetically, then orthodontics should be considered¹⁴.(fg 8)



Fig 8- Right and left buccal corridors must be considered

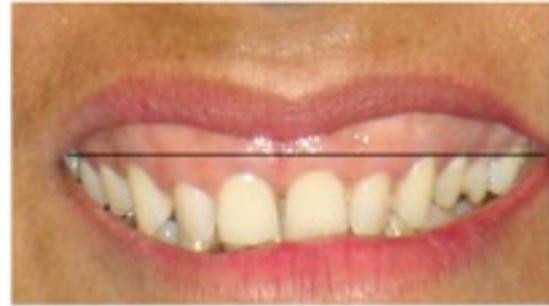
The vertical exposure of the maxillary incisors in relation to the upper lip at rest should be 2–4 mm, and on smiling the entire crown of the maxillary incisors should be exposed, with up to 1–2 mm of associated gingiva. A spontaneous smile, which is involuntary and expresses joyous emotion, tends to raise the upper lip slightly more than a posed smile, which is voluntary .

DENTO-GINGIVAL ANALYSIS

The lips frame the teeth and gingiva. The gingiva frames the teeth. The ratio of tooth structure to the amount of gingival and labial tissue should be harmonized to prevent an over-dominance of any one element. The vertical aspects of smile anatomy are the degree of maxillary anterior tooth display (Morley ratio), upper lip drape, and gingival display. In a youthful smile, 75–100% of the maxillary central incisors should be positioned below an imaginary line drawn between the commissures. (fig 9)



a



b

**Fig 9 - a; acceptable morley ratio
b; excessive display of incisors**

Other factors to consider in designing esthetic gingival relationships are: gingival line (the relationships of free gingival margins of the maxillary teeth), gingival scalloping and contour, papillary tip positioning, and gingival color

Gingival Line and its Zenith

The key esthetic issue is that the gingival line for the anterior teeth should be relatively horizontal to the horizon and relatively symmetric on both sides of the midline. It may radiate up slightly as it goes posterior. It is not critical that the lateral incisor gingival line fall incisal to the central as this is not obvious when a person is smiling. Positioning the lateral to the central incisor within 0.5 mm gingivally and 1 mm incisally is generally perceived as esthetic as long as horizontal symmetry is maintained. The contour of the gingival (ie, gingival scallop) to the tip of the papilla should be between 4 mm or 5mm and the tips of the papillae should have the

same radiating symmetry as the incisal edges and the free gingival margins. In an esthetic smile, the volume of the gingiva from the apical aspect of the free gingival margin to the tip of the papilla is about 40% to 50% of the length of the maxillary anterior tooth and fully fills the gingival embrasure. In situations where this condition does not exist, periodontal and orthodontic procedures are the treatments of choice to create the correct gingival architecture. Orthodontics not only positions the teeth but also can reposition gingiva and bone. Gingival color should appear pink and healthy or consistent with the healthy color of individual race variations^{15,16}.(fig 10)

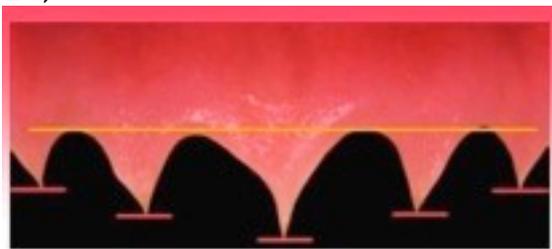


Fig 10 –Ideal gingival scallop⁸

Two concepts of cosmetic dentistry that are important to the final esthetic outcome of orthodontic patients are gingival shape and gingival contour. In cosmetic dentistry, care is taken in the assessment of the gingival architecture for the anterior teeth to have certain characteristics. 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 accreditation criteria for the American Academy of Cosmetic Dentistry, “The gingival shape of the mandibular incisors and the maxillary laterals should exhibit a symmetrical halfoval 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 (Fig 11). The gingival zenith of the maxillary laterals and mandibular incisors should coincide with their longitudinal axis¹⁶.

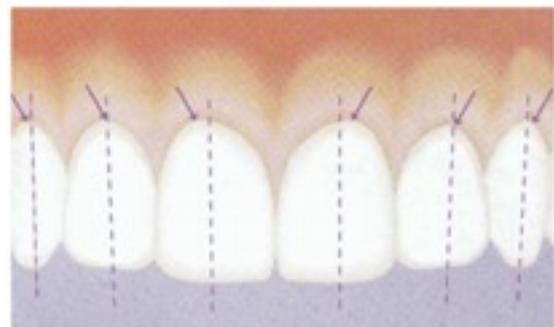


Fig 11– Gingival shape refers to curvature of gingival margin of tooth. Gingival zenith (most apical point of gingival tissue) is distal to longitudinal axis of maxillary central incisors and canines. Gingival zenith of maxillary lateral incisors should coincide with their longitudinal axis.

Conclusion

Today, various protocols of smile design are available. However, most clinicians wish to use the simplest protocol with the most predictable results. It is to be noted that smile design should always be a multifactorial decision-making process that allows the clinician to treat patients with an individualised and interdisciplinary approach. The Esthetic zone of smile presented in this article clearly indicates the most important components of smile design, their clinical significance during the smile design procedure. I believe that the maintain the esthetic zone through these parameters is a simple and practical that can help the clinician to easily comprehend the 'complex' smile design procedures of orthodontics.

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