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Smile design: A review

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Abstract

Dentistry has evolved from a curative to a creative science in a very short span of time. Esthetic dentistry has emerged as one of the most lucrative, progressive, and challenging branches of this field. It is the aim of this review to acquaint the reader to the various principles and the science behind designing a smile that is holistic and does not compromise with function.

Keywords: smile, design, esthetic, smile designing

1. Introduction

"Peace begins with a smile" - Mother Teresa.

In this tumultuous, barbarious world that we occupy, we could do with a lot more smiles. The Oxford Dictionary has defined Smile as "A pleased, kind, or amused facial expression, typically with the corners of the mouth turned up and the front teeth exposed"^[1] A smile can often determine how well a person can function in society. A charming smile can open doors and knock down barriers that stand between one and a fuller, richer life. An attractive or pleasing smile clearly enhances the acceptance of the individual in society and the character of the smile influences to a great extent the attractiveness and the personality of the individual.

Beauty with health is the mantra for today's times. Newer technologies are being harnessed & advance research is being undertaken in the field of esthetic dentistry. The focus of dentistry in the present times is not only the prevention and treatment of disease but on meeting the demands for better esthetics.

Thus, dentistry has evolved from a curative to a creative science in a very short span of time. Esthetic dentistry has emerged as one of the most lucrative, progressive, and challenging branches of this field.

The principles of smile design require an integration of esthetic concepts that harmonize facial esthetics with the dental facial composition and the dental composition. The dental facial composition includes the lips and the smile as they relate to the face. The dental composition relates more specifically to the size, shape, and positions of the teeth and their relationship to the alveolar bone and gingival tissues.

It is very important that when planning treatment for cases of compromised esthetics, to not isolate smile design from a comprehensive and holistic approach to patient care. Achieving a successful, healthy and functional result requires an understanding of the interrelationship among all the supporting oral structures, including the muscles, bones, joints, gingival tissues and occlusion^[2]

Vital elements of smile designing

I. Tooth components

- a. Dental midline
- b. Incisal length
- c. Tooth dimensions
- d. Axial inclination
- e. Incisal embrasures
- f. Interproximal contact area and Interproximal contact points
- g. Sex, personality and age

Table 1: History

Time Period	Remarks
900-800 B.C.	Both the Phoenicians (approximately 800 B.C.) and Etruscans (approximately 900 B.C.) carefully carved animal tusks to simulate the shape, form, and hue of natural teeth for use as pontics
490-265 B.C.	Age of the Greek civilization. Prominent Greek philosophers such as Aristotle and Plato philosophized about the existence of the Golden Ratio which is seen in nature and according to which the human mind interprets beauty. Euclid, the famous Greek mathematician, first defined the Golden Ratio in his book "Elements" in the same era.
31 B.C.-476 A.D.	During the Roman Empire dental cosmetic treatment was available only to the affluent classes. Oral hygiene was practiced primarily by women for reasons of beauty rather than dental health. Mouthwashes, dentifrices, and toothpicks were common in Roman boudoirs, and when teeth were lost, they were replaced with substitutes of bone or ivory carved to the likeness of the missing ones.
1000 A.D.	The Central and South American Mayas (approximately 1000 A.D.) beautified themselves by filing the incisal edges of their anterior teeth into various shapes and designs. They also placed plugs of iron pyrites, obsidian, and jade into the facial surfaces of the maxillary anterior teeth. This practice was common among both sexes, and tooth mutilation is still practiced in some societies.
Middle Ages	Interest in dental esthetics was virtually absent during the Middle Ages.
18 th Century	Pierre Fauchard (1678-1761) of France, together with several colleagues, advocated such esthetic practices as proper oral hygiene and the use of gold shell crowns with enamel "veneers." They also introduced a technique for the manufacture of mineral (as opposed to ivory or bone) "incorruptible" teeth for use in dentures.
1880's	The first porcelain crown systems, which preceded early direct tooth-coloured filling materials, were developed by Drs M. Richmond and M. Logan. Although these crown systems were a technological breakthrough at the time, they were ill-fitting and lacking in esthetic qualities.
1890's	There was the first known description of porcelain veneers, fixed in place with zinc phosphate cement. The esthetic qualities of these veneers, in common with the first porcelain crowns, were, at best, limited.
1950's and 1960's	1960s two major developments heralded a new era in esthetic dentistry: the introduction of enamel etching and bonding by Michael Buonocore in 1955, and the development of acrylic resins for use in dentistry. Relatively quickly thereafter, resin composite systems were introduced for the esthetic restoration of teeth.
Current Era	The profession now takes for granted a plethora of systems that may find application in the provision of esthetic dentistry such as, to single out from numerous recent advances, the advent of Digital smile designing and Photoshop Smile Designing, introduction of the Bioclear Matrix. In this digital era more and more of artificial intelligence is being used to improve treatment modalities thus benefiting the <i>raison d'être</i> of the dental profession-the patient. ^[3, 4]

II. Soft tissue components

- a. Gingival health
- b. Gingival level
- c. Smile line
- d. Interdental embrasure

I. Tooth components

a. Dental Midline

The midline refers to the vertical contact interface between two maxillary centrals. It should be perpendicular to the incisal plane and parallel to the midline of the face. Minor discrepancies between facial and dental midlines are acceptable and, in many instances, not noticeable.

However, a canted midline would be more obvious, and therefore, less acceptable. The maximum allowed discrepancy can be 2 mm and sometimes greater than 2 mm discrepancy is esthetically acceptable so long as the dental midline is perpendicular to the interpupillary line.

Various anatomical landmarks such as midline of the nose, forehead, chin, philtrum, interpupillary plane can be used as guides to the midline assessment.

The philtrum of the lip is one of the most accurate of these anatomical guide posts. It is always in the centre of the face except in surgical, accident or cleft cases.

To evaluate the midline, one must always consider

1. Location and
2. Alignment.

Midline should be

- a. parallel to the long axis of the face: the line angle that
- b. forms the contact between the centrals should be
- c. Parallel to the long axis of the face;
- d. Perpendicular to the incisal plane: the line angle that
- e. Forms the contact between the centrals should be

- f. Perpendicular to the incisal plane and over the papilla: the midline should drop straight down from the papilla.

A face bow transfer or even a reference stick aligned parallel to the interpupillary plane provides useful information in laboratory communication regarding midline inclination and the possible presence of a canted incisal plane.

Maxillary and mandibular midlines do not coincide in 75% of cases. Therefore, it is not advisable to use the mandibular midline as a reference point for establishing the maxillary midline. Mismatch between maxillary and mandibular midline does not affect esthetics since mandibular teeth are not usually visible while smiling ^[5-7].

B. Incisal Length

Maxillary incisal edge position is the most important determinant in smile creation because once set, it serves as a reference point to decide the proper tooth proportion and gingival levels. The parameters used to help establish the maxillary incisal edge position are: degree of tooth display, phonetics and patient input.

When the mouth is relaxed and slightly open, 3.5 mm of the incisal third of the maxillary central incisor should be visible in a young individual. As age increases, the decline in the muscle tonus results in less tooth display.

Correct incisal edge position is crucial because it is related to the pitch of the anterior teeth, labial contours, lip support, anterior guidance, lingual contours and tooth display. The pitch of each anterior tooth is determined by the combination of correct lip support and the lingual labial position of the incisal edge. This location influences anterior guidance and the labial and lingual contours. In short, all

these factors play a dominant role in both esthetics and function.

The prosthodontic literature has generally recommended setting denture teeth so that 2 mm of tooth structure is displayed at rest. A decrease in incisal visibility is associated with aging whereas an increase in incisal visibility is associated with youthfulness [8].

C. Tooth Dimensions

Correct dental proportion is related to facial morphology and is essential in creating an esthetically pleasing smile.

Central dominance dictates that the centrals must be the dominant teeth in the smile and they must display pleasing proportions. They are the key to the smile. The proportions of the centrals must be esthetically and mathematically correct. The width to length ratio of the centrals should be approximately 4:5 (0.8–1.0); a range for their width of 75–80% of their length is most acceptable (Figure 1).

The shape and location of the centrals influences or determines the appearance and placement of the laterals and canines.

Various guidelines for establishing correct proportions in an esthetically pleasing smile are

1. Golden proportion (Lombardi),
2. Recurring esthetic dental proportions (Ward),
3. M proportions (Methot) and
4. Chu's esthetic gauges.

The important point to be noted here is that it is not the actual size, but instead the perceived size, that these proportions are based on when viewed from the facial aspect (in short, it is the distance between proximal line angles of the teeth).

These principles are used as a guide rather than a rigid mathematical formula. Most authors recommend creating harmony and balance by eye via proper adjustment and evaluation of provisionals rather than any formula.

Ultimately, there is no formula for anterior esthetics; instead, the final esthetics is a combination of

1. Tooth proportion guide lines,
2. Patient's own perception,
3. Cultural and social influences,
4. Dentist artistic influences and
5. Effective communication with laboratory [9, 10].



Fig 1: Teeth arranged in Golden Proportion

D. Axial inclinations

Axial inclination compares the vertical alignment of maxillary teeth, visible in the smile line, to central vertical midline. From the central to the canine, there should be a natural, progressive increase in the mesial inclination of each subsequent anterior tooth. It should be least noticeable with the centrals and more pronounced with the laterals and slightly more so with the canines. If the incisal plane is canted, the axial inclination of the anterior teeth and the

midline itself, if it is at right angle to the incisal plane, will be correspondingly incorrect.

The evaluation of axial inclination can be done on a photograph of the anterior teeth in a frontal view. A line is sketched on each tooth from the middle of the incisal edge through the midline of the tooth at its gingival interface. Axial inclination can also refer to the degree of tipping in any plane of reference. The guide for labiolingual inclination is as follows:

1. Maxillary central incisor: Positioned vertically or slightly labial
2. Maxillary lateral incisor: Cervical is tucked in, incisal edge inclined slightly labially
3. Maxillary canine: Cervical area positioned labially, cusp tip lingually angulated. [11]

E. Incisal embrasures

The incisal embrasures should display a natural, progressive increase in size or depth from the central to the canine. This is a function of the anatomy of these teeth and as a result, the contact point moves apically as we proceed from central to canine. The contact points in their apical progression should mimic the smile line [16]. Failure to provide adequate depth and variation to the incisal embrasure will

1. Make the teeth appear too uniform and
2. Make the contact areas too long and impart to the dentition a box like appearance. The individuality of the incisors will be lost if their incisal embrasures are not properly developed.

Also, if the incisal embrasures are too deep, it will tend to make the teeth look unnaturally pointed. As a rule, in a tooth the disto-incisal corner is more rounded than its mesio-incisal corner. [12]

F. Interproximal contact area and Interproximal contact points

1. Interproximal contact area (ICA)

- It is defined as the broad zone in which two adjacent teeth touch.
- It follows the 50:40:30 rule in reference to the maxillary central incisor.
- The increasing ICA helps to create the illusion of longer teeth by wider and also extend apically to eliminate black triangles.

2. Interproximal contact point (ICP)

- It is the most incisal aspect of the ICA.
- As a general rule, the ICP moves apically, the further posterior one moves from the midline.

G. Sex, age and personality

Minor differences in the length, shape and positioning of the maxillary teeth allow for dramatic characterization.

- **Age:** Maxillary central incisor Youthful teeth: unworn incisal edge, defined incisal embrasure, low chroma and high value Aged teeth: shorter; so less smile display, minimal incisal embrasure, high chroma and low value
- **Sex:** Maxillary incisors Female form: round smooth, soft delicate Male form: cuboidal, hard vigorous
- **Personality:** Maxillary canine Aggressive, hostile angry: pointed long "fangy" cusp form Passive, soft: blunt, rounded, short cusp form [13].

II. Soft tissue components

A. Gingival health

The gingiva frame the teeth and add to the symmetry of the smile. The health, colour and texture of the gingival tissues are paramount for long term success and the esthetic value of the treatment.

Healthy gingiva is usually pale pink in colour, stippled, firm and should exhibit a matte surface. A normal healthy gingival sulcus should not exceed 3 mm in depth.

B. Gingival Level

Establishing the correct gingival levels for each individual tooth is the key in the creation of harmonious smile. The cervical gingival height (position or level) of the centrals should be symmetrical. It can also match that of the canines. It is acceptable for the laterals to display the same gingival level. However, the resultant smile may be too uniform and it is preferable to exhibit a rise and fall in the soft tissue by having the gingival contour over the laterals located toward the incisal compared to the tissue level of the centrals and canines [14-16].

C. Smile Line

Smile line refers to an imaginary line along the incisal edges of the maxillary anterior teeth which should mimic the curvature of the superior border of the lower lip while smiling. Another frame of reference for the smile line suggests that the centrals should appear slightly longer or, at least, not any shorter than the canines along the incisal plane.

Smile lines, depending on the amount of maxillary teeth displayed, can be classified as high, medium and low (Figure 2).

Reverse smile line or inverse smile line occurs when the centrals appear shorter than the canines along the incisal plane [17].

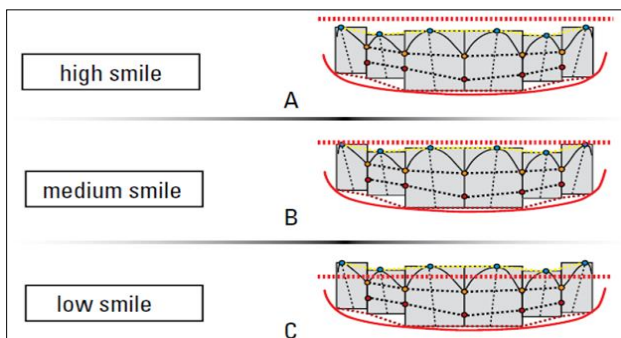


Fig 2: Smile Lines

D. Interproximal embrasures

The darkness of the oral cavity should not be visible in the interproximal triangle between the gingiva and the contact area. If the most apical point of the restoration is 5 mm or less from the crest of the bone, then black triangles will be avoided. At times, this will require long contact area that will be extended toward the cervical.

This will encourage the formation of a healthy, pointed papilla instead of the blunted tissue form that often accomplishes a black triangle. Conversely, an improperly developed cervical embrasure that involves overextended, bulky restorations will result in an improper emergence profile and swollen and inflamed gingival tissues [15, 16].

Conclusion

The change in dentistry from need based dentistry to elective dentistry has made a significant impact on the profession and the public perception of dentists. Anecdotal evidence suggests that up to one half of the dentistry accomplished at this time is elective. Much of this treatment is what could be considered to be esthetic dentistry including bleaching, bonding, veneers, tooth colored inlays and onlays, non-metallic crowns and fixed prosthesis, orthodontics and surgical procedures, and many other procedures.

Proper computerized smile designing as well as communication with the laboratory technician has made the diagnostic wax-up easier as well helped in further education of the patients. Use of all ceramic laminates and veneers enhanced the overall esthetic outcome. Recent advances such as the technique of Digital Smile Designing is an extremely useful tool for patient motivation and interdisciplinary as well as laboratory communication.

In my humble opinion a Prosthodontist is probably the best person to identify the quality of a smile. Furthermore, he is best suited to change the quality of the smile and keep the teeth and tissues in harmony with the muscles, skeletal structures and joints. It is imperative to maintain a balance between esthetics and function in order to develop a peaceful and stable masticatory system.

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