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Sterilization and Infection Control in dentistry:

Practical infection control in the operatory dentistry is a multi-step process. Protocol should be updated to include:

- 1- Good identification of high-risk patient populations.
- 2- Good barrier technique, aseptic technique.
- 3- Good surface disinfection.
- 4- Good instrument sterilization.
- 5- Good equipment disinfection and sterilization.



Dental chair units contain integrated systems that provide the instruments and services for a wide range of dental procedures. Dental chair units use water to cool and irrigate Dental Chair Unit (D.C.U) -supplied instruments and tooth surfaces during dental treatment. Water is supplied to these instruments by a network of interconnected narrow-bore (2–3 mm) plastic tubes called dental unit waterlines. Many studies over the last 40 years demonstrated that DENTAL UNIT WATERLINE (D.U.W) output water is often contaminated with high densities of micro-organisms, predominantly Gram-negative aerobic heterotropic environmental bacteria, including *Legionella* and *Pseudomonas* species. Untreated Dental unit waterlines host biofilms that permit micro-organisms to multiply and disperse through the water network and which are aerosolized by (D.C.U) instrument use, thus exposing patients and staff to these micro-organisms, to fragments of biofilm and bacterial endotoxins. This review concentrates on how practical developments and innovations in specific areas can contribute to effective (D.U.W) biofilm control. These include the use of effective (D.U.W) treatment agents, improvements to (D.C.U) supply water quality, (D.C.U) design changes, development of automated (D.U.W) treatment procedures that are effective at controlling biofilm in the long-term and require minimal human intervention, are safe for patients and staff, and which do not cause deterioration of (D.C.U) components following prolonged use.



Dental Unit Waterline treatment agents:

Dental unit waterlines treatment agents are generally divided into two categories, including agents for intermittent (D.U.W) treatment (e.g. once weekly) and agents for continuous or residual (D.U.W) treatment. It

is important to note that many (D.U.W) treatment agents have not been developed or endorsed by dental chair unit manufacturers, but rather have been developed by other manufacturers in response to an evident market need. Thus, there is significant potential for incompatibility of (D.U.W) treatment agents with components of the (D.U.W) network as well as with instruments connected to this network ([Coleman et al. 2007](#)).



Adverse effects of Dental Unit Waterline (D.U.W) treatment agents:

A few studies have reported adverse effects associated with the application of (D.U.W) treatment agents, but, as mentioned previously, only a very few long-term studies of the effectiveness of (D.U.W) treatment agents have been reported thus far. Furthermore, in the case of residual (D.U.W) treatment agents, there is a lack of independent studies in the literature on potential interactions of such agents and their by-products on oral tissues and teeth. A number of recent studies reported that some (D.U.W) treatment agents (e.g. 3-ppm sodium hypochlorite; a 1 : 10 dilution of Listerine mouthrinse; bio 2000, a 0.12% chlorhexidine gluconate- and 12% ethyl alcohol-containing product; and 0.224% BioClear, a citric acid containing product) may adversely affect bonding of composite material to both enamel and dentine ([Roberts et al. 2000](#); [Taylor-Hardy et al. 2001](#)). With the extended and more widespread use of (D.U.W) treatment agents, it is likely that such adverse effects may become clinically relevant in the case of residual (D.U.W) treatments.

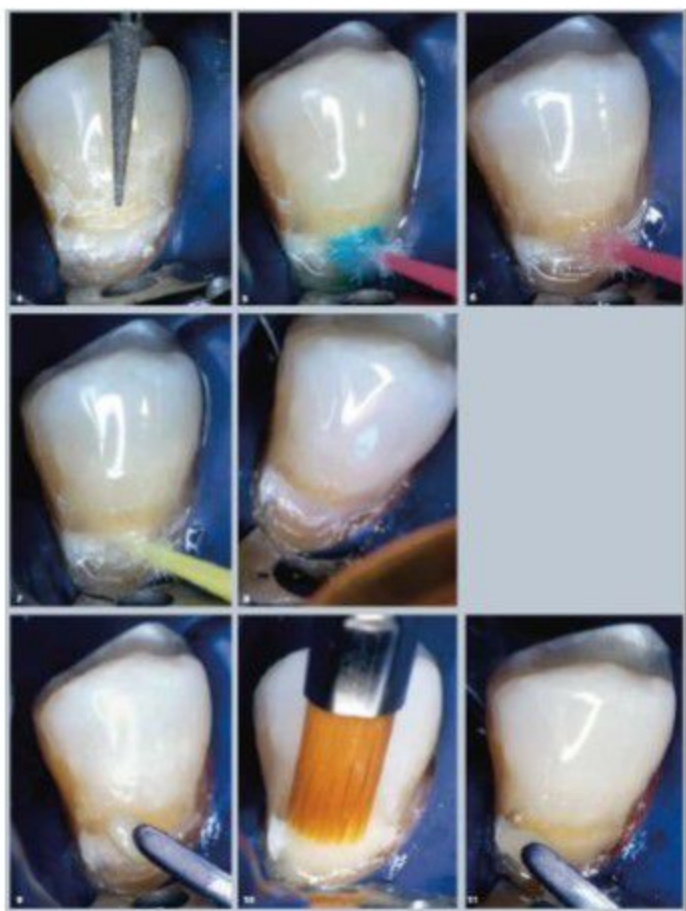


The problem of microbial biofilm formation in Dental Unit Waterlines and poor quality (D.U.W) output water has been recognized for more than four decades. In an age where inadequate infection control and prevention in healthcare facilities is seldom absent from the media, it is vital that dental healthcare professionals endeavour to maintain their dental chair unit output water quality at a level which would at least satisfy the ADA standard of ≤ 200 CFU ml⁻¹ of aerobic heterotrophs, or preferably, potable water standards. Achieving this objective has been difficult to meet consistently, mainly because of the absence of standards or legislation, but also because dental chair unit manufacturers have been slow to address this issue by dental chair unit engineering and design changes and by the provision of specific guidance on (D.U.W) disinfection. Fortunately, this situation has begun to change with some dental chair unit manufacturers developing and continuing to improve effective integrated and automated (D.U.W) disinfection systems for use with specified (D.U.W) treatment agents that are effective in the long-term and compatible with their dental chair units. Work described in this lecture has shown that (D.U.W) biofilm problems when studied in detail and in the longer term can have relatively simple solutions. It is clear that one cannot prescribe a single solution to improve (D.U.W) water quality for all circumstances as the dental chair units in dental clinics may be single, multiple, supplied by mains water, by large internal storage and distribution systems supplied with mains water or supplied by separate reservoir bottles. The dental chair units may be of different makes and models. The one factor that impacts on biofilm formation in all dental chair units and their Dental Unit Waterlines, regardless of make, is consistently high quality supply water. If dental chair unit supply water is of poor quality, (D.U.W) output water will be of poor quality. Practical approach's to providing this have been outlined, together with a centralized automated disinfection system suitable for individual or many dental chair units that can provide (D.U.W) output water of consistently better than potable

water in the long-term and has many economic advantages in terms of reduced maintenance and equipment down-time.

Aesthetic Restorative Dentistry.

Closed sandwich technique: Resin modified glass-ionomer/composite resin: Figure 1 shows the preoperative view of a wedge-shaped carious cervical lesion on the mandibular right second premolar. These lesions occur from tensile forces. The initial caries control procedure provided removal of the infected dentin and placement of a resin-modified glass ionomer to provide a seal of the lesion while demineralizing the affected dentin (Fig 2). A chamfer was placed along the occlusal margin (Fig 3). A 0.5-mm scalloped bevel was placed in enamel to interrupt the straight line of the chamfer and to reduce the potential for microleakage (Fig 4). The preparation was cleaned with a premixed slurry of pumice and 2% chlorhexidine (Fig 5). The preparation was rinsed and lightly air dried. A two-component self-etching system was used. The self-etching primer was applied to the preparation and allowed to set for 20 seconds and dried gently for 5 seconds (Fig 6), and the bonding agent was applied to the enamel and dentin surfaces and light cured for 10 seconds (Figs 7 and 8). The initial enamel layer of opacious A4-shaded composite resin was applied to the occlusal half of the preparation with a long-bladed composite instrument (Fig 9), contoured, and smoothed with a #2 sable brush (Fig 10). A second opacious increment was placed in the gingival half of the preparation (Fig 11), smoothed with a #2 sable brush, and light cured.



Ceramic materials:

Ceramics, derived from the Greek word *keramos*, was the ancient art of fabricating pottery. This word may have originated from a Sanskrit term meaning burnt earth because the main constituents were clays excavated from the earth, which were heated to form pottery. Although the methods of acquiring, purifying, and fabricating these raw materials into ceramic objects have significantly changed, some of the basic materials and techniques are still the same. Traditional ceramics uses clay as one of its primary components, in combination with other metal oxides including feldspar ($K_2O \text{ } Al_2O_3 \text{ } 6SiO_2$), alumina (Al_2O_3), potash (K_2O), and soda (Na_2O). Ceramic objects are still fabricated by pulverizing these raw materials into fine particles and powders and adding water to help keep the particles together during sculpting and shaping.

The “green” (unbaked) object is dried and placed into an oven (kiln) and heated to a specified temperature that allows the individual particles to coalesce into a solid mass. The process of coalescence of the particles is called sintering, and it usually results in shrinkage and strengthening of the solid mass. These traditional ceramics include stoneware (tile), earthenware (pottery), porcelain (tableware and china), electrical insulators, bricks, and sanitary ware (sinks and toilets).

1-Dental ceramics are chemical mixtures of nonmetallic and metallic elements that allow ionic and covalent bonding to form periodic crystalline structures.

2-The most common dental ceramics are composed of metal oxides (SiO_2 , Al_2O_3 , K_2O) and other traditional ceramic materials.

3-Most dental ceramics are semi crystalline, silicates, oxides, and derivative structures.

4-The simple structures are usually bonded ionically, whereas the complex structures generally involve ionic and covalent bonding.

5-In theory, the basic constituents for fabricating conventional dental ceramics are similar to those for traditional ceramics, and these compounds include feldspar, silica, and kaolin (refined as clay).

6-The major difference between the porcelain used in dental ceramics and other traditional ceramics is the proportion of the main ingredients. Dental ceramics are composed mainly of feldspar, while traditional ceramics are composed mainly of clay.

7-Feldspar is a gray, crystalline material, and its chemical composition is potassium aluminum silicate ($\text{K}_2\text{O Al}_2\text{O}_3 6\text{SiO}_2$). Other constituents found in feldspar include mica and iron, and these are removed mechanically by splitting the feldspar rock and during later stages by using strong magnets.

8-The pure feldspar pieces are ground and milled into a powder.

9-Quartz crystals are the main source of silica (SiO_2), and they are heated and quenched in cold water to split into smaller pieces, and these smaller quartz pieces are ground and milled into a fine powder, and any iron impurities are removed with magnets.

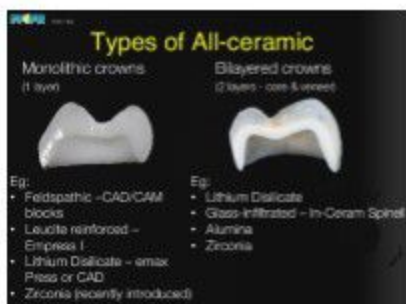
10-Dental porcelain is comprised of approximately 15% quartz powder. The quartz powder is infusible at the firing temperature of porcelain and is surrounded by fusible ingredients, and this crystalline layer of quartz that contributes to the dispersed phase and is surrounded by a continuous amorphous phase, this crystalline layer is responsible for the **translucent optical properties of porcelain and limits shrinkage during firing**.

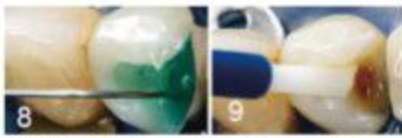
11-Kaolin is a natural form of clay obtained from riverbeds, and the clay is washed, dried, and screened into a pure, fine powder.

12-In dental porcelains, kaolin is used in small concentrations (ie, 4%) as a particle binder, and the kaolin coats the non-fusible particles and becomes sticky, holding the wet porcelain particles together, and this allows the technician to control the form of the restoration by manipulating the powder-liquid mass.

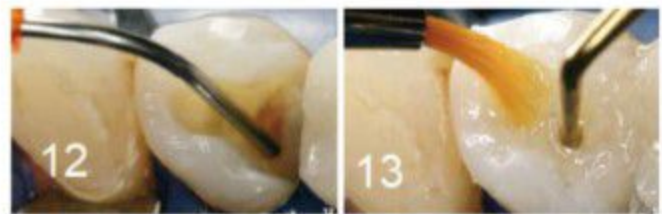
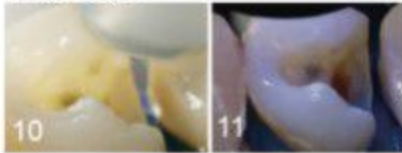
13-The porcelain restorations tooth colored, small quantities of coloring agents are added to porcelain powders. These pigments are derived from metallic oxides that are ground and mixed with feldspar powder, and this mixture is then fired, fused to glass, and then reground to a powder.

14-The coloring agents **metallic oxides include iron oxide for brown shading, copper oxide for green shading, and titanium oxide for yellow shading, manganese oxide for purple shading, cobalt oxide for blue shading, and tin oxide for opaquing, and the rare earth elements can be added in small quantities to provide fluorescence**.



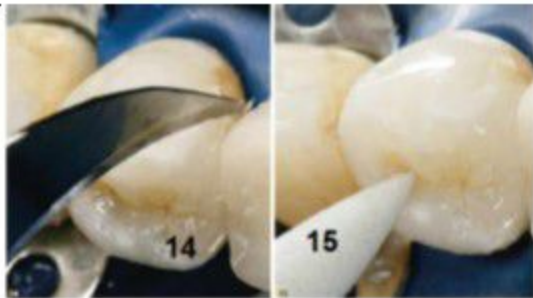


(Fig 8): After the preparation was cleaned with 2% chlorhexidine (Concepsis), the preparation was etched for 15 seconds with 32% phosphoric acid, rinsed with water for 5 seconds, and lightly air dried.
(Figs 9 to 11): An adhesive (All-Bond 3, Bisco) was applied, air thinned, and light cured for 45 seconds.



(Fig 12): The composite resin cement was injected into the preparation.

(Fig 13): The inlay was positioned and held firmly in place using a ball-tipped instrument. The excess resin cement was removed with a sable brush, leaving only a residual amount at the margin to compensate for polymerization shrinkage, and light cured for 40 seconds.



(Fig 14): The residual cement was removed with a scalpel blade (#12 BD Bard-Parker), and a thin application of glycerin was applied to all the margins to prevent the formation of an oxygen inhibition layer on the composite resin cement.

(Fig 15): The restoration was polymerized from all aspects buccal, occlusal, lingual, and proximal surfaces each for 40 seconds. Final polishing at the restorative interface was achieved with prepolishing and high-shine polishing points.



(Fig 16): The postrestorative occlusal view illustrates an optimal and durable interfacial adhesion between the tooth and ceramic biomaterial that can be attained from utilizing a thorough adhesive protocol

-Principles of aesthetic dentistry.

Smile, a person's ability to express a range of emotions with the structure and movement of the teeth and lips, can often determine how well a person can function in society. Of course, the importance given to a beautiful smile is not new. The search for beauty can be traced to the earliest civilizations; both the Phoenicians (app 800 BC) and Etruscians (app 900 BC) carefully carved animal tusks to simulate the shape, form and hue of natural teeth. It was not until the 18th century that dentistry was recognized as a separate discipline and its various branches were established. Pierre Fauchard (1678– 1761) of France, the leader of the movement, together with several colleagues modernized and promoted dentistry and also advocated esthetic practices.

The goal of an esthetic makeover is to develop a peaceful and stable masticatory system, where the teeth, tissues, muscles, skeletal structures and joints all function in harmony (Peter Dawson). It is very important that when planning treatment for esthetics cases, smile design cannot be isolated from a comprehensive 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.

Dentistry has seen a significant increase in the emphasis on elective treatment for better esthetics. Webster's Dictionary defines esthetics as "the branch of philosophy dealing with beauty and taste (emphasizing the evaluative criteria that are applied to art)." The success of a restoration depends on sound mechanical, biological and esthetic principles. An ideal restoration must satisfy these requirements. Irfan Ahmad has suggested the HFA triad. According to this, careful dental treatment must be directed to fulfil the Health, Function and Aesthetics for the patient. It is important to undertake the treatment in the sequence where health is first, followed by function and last esthetics. Health can be achieved without function and esthetics. However, to achieve optimal esthetics

the restoration must be in function and healthy. Hence esthetic treatment is a combination of both systematic principles and artistic skills.



The smile we create should be esthetically appealing and functionally sound too. It is our duty to carefully diagnose, analyze and deliver the best to our patients, taking into account all of the discussed factors. The smile designing done by us has to be as conservative as possible unlike the past. Our aim has to be less reduction of tooth structure and greater esthetics and durability. This simply means that cosmetic dentistry has to be a multispecialty branch, wherein all treatments like orthodontics, periodontics, surgical procedures have to be performed whenever deemed necessary.

Harmonizing an esthetics smile requires a perfect integration of facial composition and dental composition.

The facial composition includes the hard and soft tissues of the face. The dental composition relates more specifically to teeth and their relationship to gingival tissues. A smile design should always include the evaluation and analysis of both facial and dental composition.

Facial composition

Facial beauty is based on standard esthetic principles that involve proper alignment, symmetry and proportion of face. Analyzing, evaluating and treatment planning for facial esthetics often involve a multidisciplinary approach which could include orthodontics, orthognathic surgery, periodontal therapy, cosmetic dentistry and plastic surgery. Thus, esthetic approach to patient care produces the best dental and facial beauty. But in our clinical practice, unless and otherwise there is an obvious discrepancy in the face, we restrict our smile makeover to the dental composition only. There are two facial features which do play a major role in the smile design:

1. The inter pupillary line and
2. Lips.

The interpupillary line should be perpendicular to the midline of the face and parallel to the occlusal plane. Lips are important since they create the boundaries of smile design. If we come across major discrepancies in the abovementioned two factors, then we have to seriously consider the correction of the facial composition, before we venture into the correction of the dental composition.

In classical terms, the horizontal and vertical dimensions for an ideal face are as follows:

1. Horizontal:

- The width of the face should be the width of five “eyes”.
- The distance between the eyebrow and chin should be equal to the width of the face [Figure 1].

2. Vertical:

- The facial height is divided into three equal parts from the forehead to the eyebrow line, from the eyebrow line to the base of the nose and from the base of the nose to the base of the chin.
- The full face is divided into two parts, eyes being the midline.
- The lower part of the face from the base of the nose to the chin is divided into two parts, the upper lip forms one-third of it and the lower lip and the chin two-thirds of it [Figure 2].

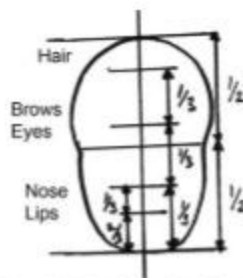


Figure 1: Horizontal dimensions of face.



Figure 2: Vertical dimensions of face



The basic shape of the face when viewed from the frontal aspect can be one of the following:

1. Square.
2. Tapering.
- 3 Square tapering.
4. Ovoid.

The lateral profile of an individual can be any one of the following:

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

These factors play a role in determining the tooth size, shape and the lateral profile; in short, the tooth morphology is dependent on the facial morphology.

Vital elements of smile designing (dental composition)

The vital elements of smile designing include the following:

1. 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. Mismatch between maxillary and mandibular midline does not affect esthetics since mandibular teeth are not usually visible while smiling.

b) Incisal lengths (incisal edge positions): 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:

1. Degree of tooth display: 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.

2. Phonetics: Is a major determinant of the tooth length. In order to determine proper lip, tongue and incisal support and tooth position, it is necessary that the patient sits either erect or stands during the phonetic exercises.

The various phonetics used are as follows:

• **M sound:** After pronunciation, the lips return to their normal rest position, allowing evaluation of the amount of the tooth display in rest position.

• **E sound:** The maxillary incisal edge position should be positioned halfway between the upper and lower lip during the "E" sound.

• **F and V sounds:** Fricative sounds are produced by the interaction of the maxillary incisal edge with the inner edge of the lower lips' vermillion border. Thus, fricative sounds help to determine the labiolingual position and length of the maxillary teeth.

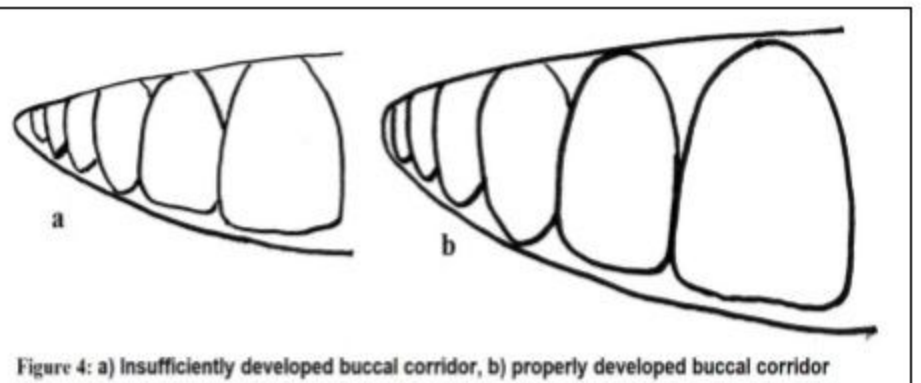
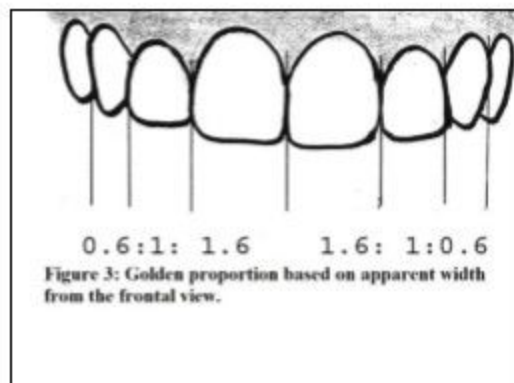
• **S sound:** During pronunciation, the mandibular central incisors are positioned 1 mm behind and 1 mm below the maxillary incisal edge.



3. Patient input: Intraoral cosmetic preview and provisional restorations help to confirm proper placement of the final incisal edge position. The patient desires must be met as best as possible, provided they do not interfere with the parameters previously discussed. 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. All these factors play a dominant role in both esthetics and function.

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

1. Golden proportion (Lombardi): When viewed from the facial, the width of each anterior tooth is 60% of the width of the adjacent tooth (mathematical ratio being 1.6:1:0.6) [Figure 3]. It is difficult to apply as patients have different arch form, lip anatomy and facial proportions. Strict adherence to golden proportion calculations limits creativity and this may lead to cosmetic failure. 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. The shape and location of the centrals influences or determines the appearance and placement of the laterals and canines.



Maxillary central incisor: Centrals are the focal point of an esthetic smile and create the central dominance as described earlier. Approximate length of the central should be 10–11 mm and the width is calculated accordingly so that the ratio falls between 75 and 80%.

Maxillary lateral incisor: These are the playful part of the smile. They provide individuality, are never symmetrical and influence gender characterization.

Maxillary canine: They play a critical point in creating a pleasing smile as they are:

- The junction between the anterior and posterior dental segments; hence, only the mesial half of the canine is visible from the frontal view when the patient smiles;
- support the frontal muscles – the size and characteristic of the buccal corridor is determined by the size, shape and position of the canine.
- canine depicts the personality characterization (masculine: vigorous and aggressive; feminine: delicate and soft).

Also, we have to keep in mind that:

- Central incisor is wider than the lateral by 2–3 mm and canine by 1–1.5 mm.
- Canine is wider than the lateral by 1–1.5 mm.
- Canine and central are longer than lateral by 1–1.5 mm.

Maxillary bicuspids: They play a very important role for arch design. They should fill the buccal corridor.

Buccal corridor refers to dark space (negative space) visible during smile formation between the corners of the mouth and the buccal surfaces of the maxillary teeth [Figure 4 a and b]. Its appearance is influenced by

1. The width of the smile and the maxillary arch.
2. The tone of the facial muscles.
3. The positioning of the labial surface of the upper premolars.
4. The prominence of the canines particularly at the distal facial line angle and
5. Any discrepancy between the value of the premolars and the six anterior teeth.

Arch form has a direct influence on the buccal corridor. The ideal arch is broad and conforms to a U shape. A narrow arch is generally unattractive. The unattractive, negative space should be kept to a minimum. This problem can be solved or minimized by restoring the premolars. The buccal corridor should not be completely eliminated because a hint of negative space imparts to the smile a suggestion of depth.

2. Recurring esthetic dental proportions (Ward).

3. M proportions (Methot).

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). **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.
5. Effective communication with laboratory.

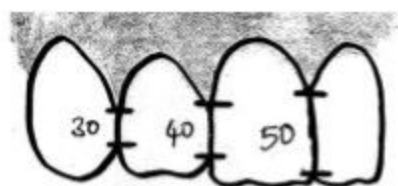
d) Zenith points: are the most apical position of the cervical tooth margin where the gingiva is most scalloped. It is located slightly distal to the vertical line drawn down the center of the tooth. **The lateral is an exception as its zenith point may be centrally located** [Figure 5]. Establishing the proper location of zenith points is a critical step in alteration of mesial and distal dimensions.

- Closure of diastema:

Move the zenith points to provide the illusion of bodily movement and reduce exaggerated triangular form, correction of tooth angulation.



Figure 5: Zenith points and its relation to midline.

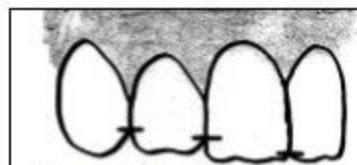


Figures 6: ICAs – 50:40:30 rule.

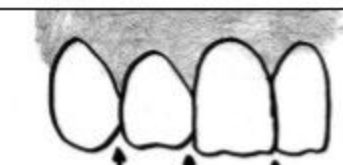
e) Axial inclinations: Compares the vertical alignment of maxillary teeth, visible in the smile line, to central vertical midline. From the central to the canine, there should be natural, progressive increase in the mesial inclination of each subsequent anterior tooth. It should be least noticeable with 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.[15] 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.



Figures 7: ICPs – moves apically as we move from central to canine.



Figures 8: Incisal embrasure – increase in size and depth from central to canine.

f) Interdental contact area (ICA) and point (ICP):

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 [Figure 6].
- 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 [Figure 7].

g) Incisal embrasure: 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 [Figure 8]. The contact points in their apical progression should mimic the smile line.

Failure to provide adequate depth and variation to the incisal embrasure will:

1. Make the teeth appear too uniform.

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, a tooth distal to incisal corner is more rounded than its mesio-incisal corner.

h) Sex, personality and age: 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.

i) Symmetry and balance: Symmetry is the harmonious arrangement of several elements with respect to each other. Symmetrical length and width is most crucial for the centrals. It becomes less absolute as we move further away from the midline.

- Static symmetry: Mirror image, maxillary central incisors.

- Dynamic symmetry: Two objects very similar but not identical. Playing with perfect imperfection in the laterals and canines allows for a more vital, dynamic, unique and natural smile.

Balance: is observed as the eyes move distally from the midline, so that both the right and left sides of the smile are well balanced.

2. Soft tissue components:

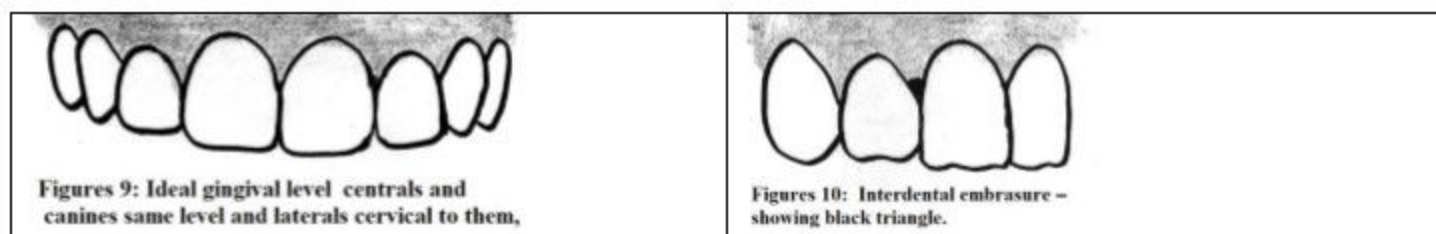
a) Gingival health: The gingiva acts as the frame for the teeth; thus, the final esthetic success of the case is greatly affected by the gingival health. It is of paramount importance that the gingival tissues are in a complete state of health prior to the initiation of any treatment. Healthy gingiva is usually:

1. Pale pink in color, stippled, firm and it should exhibit a matte surface.

2. Located facially (3 mm) above the alveolar crestal bone.

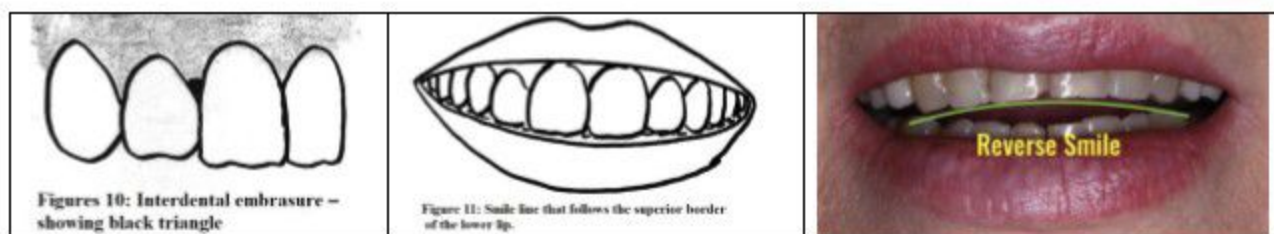
3. Located interdentally (5 mm) above the intercrestal bone papilla should be pointed and should fill the gingival embrasure right up to the contact area.

b) Gingival levels and harmony: 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 [Figure 9]. The gingival margin of the lateral incisor is 0.5–2.0 mm below that of the central incisors. The least desirable gingival placement over the laterals is for it to be apical to that of the centrals and or the canines.



The gingival shape on 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, as mentioned earlier, the gingival zenith is located distal to the long axis of the maxillary centrals and canines and coincides along the long axis of the maxillary lateral incisors.

c) Interdental embrasure (Cervical embrasure): 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 [Figure 10]. Conversely, an improperly developed cervical embrasure that involves overextended, bulky restorations will result in an improper emergence profile and swollen and inflamed gingival tissues.



d) 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. This approach is particularly useful in cases of lip symmetry or extreme lip curvature during smile formation [Figure 11]. Reverse smile line or inverse smile line occurs when the centrals appear shorter than the canines along the incisal plane. Lip line should not be confused with the smile line. Lip line refers to the position of the inferior border of the upper lip during smile formation and thereby determines the display of tooth or gingiva at this hard and soft tissue interface. Under ideal conditions, the gingival margin and the lip line should be identical or there can be a (1–2 mm) display of the gingival tissue. Showing 3–4 mm or more of the gingiva (gummy smile) often requires cosmetic periodontal re-contouring to achieve an ideal result.

Finally, the individual tooth morphology has to mimic nature, also, the appropriate shade selection has to be done to bring out all the hard work of our smile design. Shade selection must be customized for each individual. It should be natural and polychromatic. The body of the tooth can be fairly uniform in color but the gingival third should be noticeably richer in chroma. The chroma should also increase from central to the canine, canine having a higher chroma.

