

**Republic of Iraq  
Ministry of Higher Education  
and Scientific Research  
University of Baghdad  
College of Dentistry**



# **Smile Refinement and Orthodontics**

A Project Submitted to  
The College of Dentistry, University of Baghdad, Department of  
Orthodontics in Partial Fulfillment for the Bachelor of Dental  
Surgery

**By**

**Noor Al Huda Faaiz Abd\_Alhameed**

Supervised by

Assistant Professor

**Dr. Noor Muhammed Hasan Garma**

B.D.S., M.Sc. (Orthodontics)

**April, 2022**

## **Certification of the Supervisor**

I certify that this project entitled “Smile refinement and orthodontics” was prepared by Noor Alhuda Faaiz Abd\_Alhameed under my Supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor’s name: Assist. Prof. Noor Muhammed Hasan Garma

Date:

## **Dedication**

I would like to dedicate this project to my family especially my dear mother who was with me in every step in this long journey, I also dedicate this project to my best friends and all the people I love for helping, supporting and standing by my side all the time.

## **Acknowledgement**

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

I would like to extend my deepest respect and gratitude to the Dean of College of Dentistry, University of Baghdad, Prof. **Dr. Raghad Al-Hashimi**.

My sincere thanks to Assist. Prof. **Dr. Yassir A. Yassir**, Head of Orthodontics Department, and all professors and seniors in the department for their pleasant cooperation.

I would like to show my deep and sincere gratitude to my research supervisor, Prof. Dr. **Noor Muhammad Hasan Garma** for her advice, encouragement, and guidance in planning and conducting this project.

# Table of Content

<b>Subject</b>	<b>Page.No</b>
<b>Declaration</b>	<b>I</b>
<b>Certification of the Supervisor</b>	<b>II</b>
<b>Dedication</b>	<b>III</b>
<b>Acknowledgement</b>	<b>IV</b>
<b>Table of contents</b>	<b>V</b>
<b>List of Figures</b>	<b>VI</b>
<b>List of Tables</b>	<b>VI</b>
<b>List of Abbreviations</b>	<b>VI</b>
<b>Introduction</b>	<b>1</b>
<b>Aim of the study</b>	<b>2</b>
<b>Chapter One: Review of Literature</b>	<b>3</b>
<b>1.1 Smile Concept</b>	<b>3</b>
<b>1.2 Macro-aesthetics</b>	<b>3</b>
<b>1.3 Mini-aesthetics</b>	<b>4</b>
<b>1.5 Micro-aesthetics</b>	<b>8</b>
<b>1.6 Orthodontic Treatment options for smile refinement</b>	<b>10</b>
<b>1.6.1 Smile management during major orthodontic treatment mechanics</b>	<b>11</b>
<b>1.6.2 Smile refinement during orthodontic intervention</b>	<b>13</b>
<b>1.6.2.1 Bracket Positioning</b>	<b>13</b>
<b>1.6.2.2 Black Triangle</b>	<b>15</b>
<b>1.6.3 Smile refinement after orthodontic intervention</b>	<b>16</b>
<b>1.6.3.1 Crown lengthening procedures</b>	<b>16</b>
<b>1.6.3.2 Gingivectomy or Gingivoplasty</b>	<b>20</b>
<b>1.6.3.3 botulinum toxin type I</b>	<b>22</b>
<b>Chapter Two</b>	<b>23</b>
<b>Discussion</b>	<b>23</b>
<b>Chapter Three</b>	<b>24</b>

<b>Conclusion</b>	<b>24</b>
<b>References</b>	<b>25</b>

## List of Figures

<b>Figure No.</b>	<b>Subject</b>	<b>Page No.</b>
<b>Figure 1.1</b>	<b>Frontal Assessment</b>	<b>4</b>
<b>Figure 1.2</b>	<b>Tooth–Lip Relationship</b>	<b>6</b>
<b>Figure 1.3</b>	<b>Smile arcs</b>	<b>7</b>
<b>Figure 1.4</b>	<b>Micro-esthetics</b>	<b>10</b>
<b>Figure 1.5</b>	<b>Black Triangle</b>	<b>16</b>
<b>Figure 1.6</b>	<b>Chu’s Esthetic Gauges</b>	<b>18</b>
<b>Figure 1.7</b>	<b>Preoperative facial view of type I</b>	<b>19</b>
<b>Figure 1.8</b>	<b>Preoperative appearance of type II</b>	<b>19</b>
<b>Figure 1.9</b>	<b>Preoperative appearance of type III case.</b>	<b>20</b>
<b>Figure 1.10</b>	<b>Gummy smile</b>	<b>21</b>
<b>Figure 1.11</b>	<b>Gingivectomy</b>	<b>21</b>
<b>Figure 1.12</b>	<b>Gummy smile treated by Botox</b>	<b>22</b>

## List of Tables

<b>Table No.</b>	<b>Subject</b>	<b>Page. No</b>
<b>Table 1</b>	<b>Vari-Simplex bracket heights</b>	<b>14</b>
<b>Table 2</b>	<b>MBT™ Versatile+ Appliance Bracket placement guide</b>	<b>14</b>
<b>Table 3</b>	<b>TOM x TOM</b>	<b>15</b>

## List of Abbreviations

<b>Subject</b>	<b>Abbreviations</b>
<b>CL</b>	<b>Crown lengthening</b>
<b>Mm</b>	<b>Millimeter</b>
<b>GPS</b>	<b>Guide position Smile Arc</b>

## **Introduction**

Improving the appearance of the smile is one of the main reasons patients seek orthodontic treatment. Understanding the components of an esthetically attractive smile is essential to achieving patient satisfaction as well as successful treatment results (**Turley, 2015**). The orthodontic and dental literature include a range of information on both soft and hard tissue structures that are components of an esthetic smile. Balanced smile has been categorized into three major divisions. These divisions are the lip line, smile line, and dental components.

Lip line includes lip thickness, upper lip length, height of smile (overall or posteriorly), gingival display at smiling, inter-labial gap, and upper lip curvature/shape (**Sarver and Ackerman, 2000**). The second division includes smile arc, buccal corridors, cant of occlusal plane, upper incisor inclination, last posterior tooth visible, smile width/index ratio, smile symmetry, vertical maxillary height, and facial/dental midline ( **Littlewood and Mitchell, 2019**). The third division includes micro-esthetics of dental components of the smile, upper incisor ratio/size/symmetry, upper incisor inclination, upper incisor angulation, upper incisor vertical position, tooth color, and incisal embrasures (**Sarver and Ackerman, 2000**).

Modern orthodontics deals not only with the dental and skeletal aspects but also with facial proportions and the role of the dentition on facial appearance ( **Singh and Sharma, 2011**). Giving a greater emphasis on esthetic elements of smile, a balanced beautiful smile can be achieved by orthodontic treatment. Thus, it is prudent to consider smile analysis as an important tool for diagnosis and orthodontic treatment planning (**Kadhim et al., 2020**). The roles of orthodontic involve bracket positioning, black triangle removal, reduction the buccal corridor , extrusion and intrusion to refine the smile (**Proffit et al., 2019**).

## **Aim of the study:**

The aim of this study was to review the role of orthodontist in refining the smile of the patient which can be reflected on results optimization and patient satisfaction.



# Chapter One: Review of Literature

## 1.1 Smile Concept

The smile concept includes a complicated interaction between skeletal and dental structures on the one hand, with the overlying soft tissue envelope on the other hand. The appropriate positioning of lips, gingiva, specifically the marginal regions, and teeth within the dynamic display zone results in a balanced smile (Singh and Sharma, 2011).

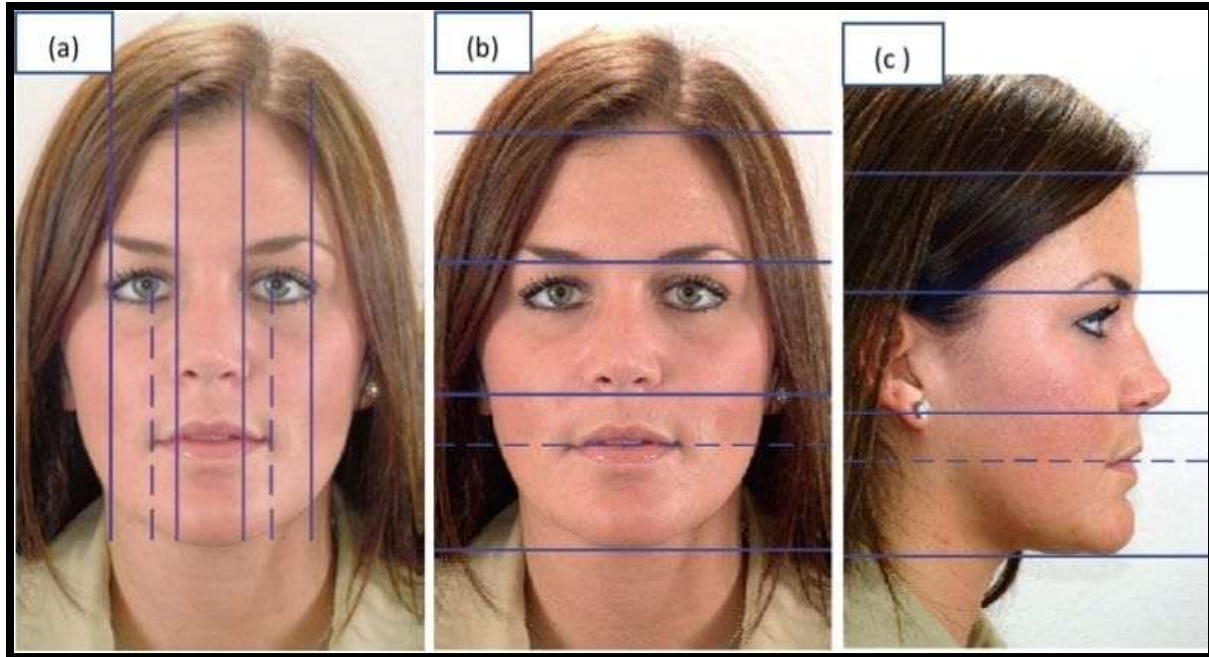
Balanced smile has been classified into three major domains which should be carefully examined for successful orthodontic treatment ( Littlewood and Mitchell, 2019):

- 1- Facial proportions in all three planes of space (macro-aesthetics).
- 2- The dentition in relation to the face (mini-aesthetics)
- 3- The teeth in relation to one another (micro-aesthetics)

## 1.2 Macro-aesthetics

Macro-aesthetics deals with the overall structure of the face and its relation to the smile (Singh *et al.*, 2021). In clinical practice the assessment of the macro aesthetic components is done using various facial photographs with geometric and mathematical appraisals, using reference points and their interrelation in smile design, the following macro-aesthetic guidelines are considered fundamental (Koirala, 2009):

- facial midline
- facial thirds (fig1.1)
- interpupillary line
- naso-labial angle



**Figure 1.1** Frontal Assessment (a) Facial proportions and symmetry in the frontal plane. Vertical facial proportions in the frontal (b) and lateral (c) views are best evaluated in the context of the facial thirds, the lower facial third often is slightly longer than the central third. The lower third also includes thirds: The mouth should be one-third of the way between the base of the nose and the chin (**Proffit et al., 2019**).

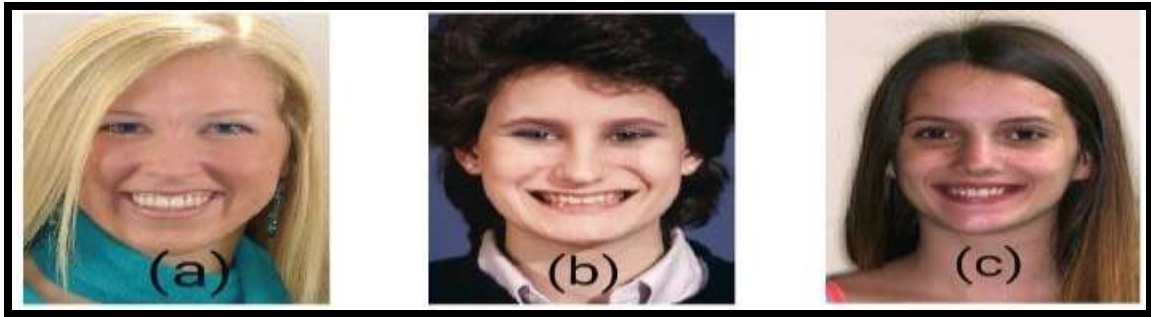
### 1.3 Mini-aesthetics

Mini-aesthetics deals with the aesthetic correlation of the lips, teeth and gums at rest and in smile position. The visual mini-aesthetics distance is similar to the across-the-table distance, which is normally within 2 to 5 feet, there are various guidelines in aesthetics based on the relationship and ratio between lips, teeth and gingival tissue. These can be assessment using frontal, vertical and transverse characteristics of the smile (**Koirala, 2009**).

- 1- Evaluation of midline in which it is particularly important to note the relationship of the dental midline of each arch to the skeletal. Midline of that jaw (i.e., the lower incisor midline relative to the midline of the mandible, and the upper incisor midline relative to the midline of the maxilla) (**Proffit et al.,**

**2019**). The maxillary midline should at least be ideally vertical and parallel to the facial midline if not coincident, which is ideal (**Tubelius and Zachrisson, 2005**). However, when the maxillary midline is angulated even a 2 mm (10 degrees), deviation will be perceptibly unattractive. Even though coinciding maxilla-mandibular midlines are ideal but is not that grave an esthetic concern (**Janson *et al.*, 2011**).

**2-** Evaluation of Tooth–Lip Relationship For an esthetically pleasing social smile, at least 75% of the maxillary crown should be visible, but up to 4 mm display of gingiva 4 mm lip coverage of the incisor crown is acceptable. The most attractive smiles have the upper lip at the height of the gingival margin of the upper central incisor (**Turley, 2015**) but it is important to note the amount of incisor display. For patients with excessive incisor display, the usual cause is a long lower third of the face, but that is not the only possibility; a short upper lip could produce the same thing. however, this tends to decrease with advancing age, so what looks like a problem at a younger age may not be as the patient gets older (fig1.2) (**Naini and Gill, 2008**).



**Figure 1.2** Tooth–Lip Relationship (A) Display of all the maxillary incisors and some gingiva on smiling is a youthful and appealing characteristic. (B) No gingival display is less attractive, although it is not considered objectionable at this level by lay persons. (C) There is agreement among laypersons regarding the acceptable range of gingival and tooth display during a posed smile. This girl shows 1 to 2 mm of gingiva, which is the maximum acceptable amount on a social smile. (D) Overlap by the lip of the cervical margin of the tooth by 1 to 2 mm is ideal. (E) Tooth coverage by the lip of 4 mm is considered to be the maximum acceptable amount (Proffit et al., 2019).

**3-** Evaluation of Smile Arc which is defined as the relationship of the curvature of the incisal edges of the maxillary incisors and canines to the curvature of the lower lip in a posed smile (fig.1.3) (Munjal et al., 2017). Three types of smile arcs are seen: parallel (consonant), straight, and reverse smile arc, with the goal being a parallel smile arc. In the parallel arc, the incisal curve follows the lower lip while it is flatter in the straight arc. In the reverse arc, the canines are lower and the arc is reverse to the curve of the lower lip (Singh et al., 2021). The curvature of the incisal edges appears to be more pronounced for women than for men, and tends to flatten with age (Munjal et al., 2017).



**Figure 1.3** Smile arcs: (A) Parallel (consonant) smile arc, (B) straight smile arc, and (C) reverse smile arc (**Singh et al., 2021**).

- 4- Evaluation of Transverse cant and symmetry which is a transverse cant of the occlusal, whether it is an up–down transverse rotation of the dentition is revealed when the patient smiles or the lips are separated at rest (**Singh et al., 2021**). Dentists detect a transverse roll at 1 mm from side to side, whereas laypersons are more forgiving and see it at 2 to 3 mm—but at that point, it is a problem (**Proffit et al., 2019**). Discrepancy in the maxillary anterior incisal plane depends on the interaction between posterior occlusal plane, incisal plane, interpupillary line, and crown length of the maxillary incisors (**Singh et al., 2021**). Smile asymmetry may also result due to asymmetric smile curtain. In preadolescents, the occlusal plane can be corrected by growth modification appliances but in the adolescent and adult patients surgery is often indicated (**Sarver and Ackerman, 2003**).
- 5- Evaluation of Lateral Negative Space which 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 (**Munjaj et al., 2017**). In studies measuring the number of teeth displayed in the smiles of young subjects with normal occlusions, those displaying the first molars were ranked the highest esthetically (**Sabri, 2005**).

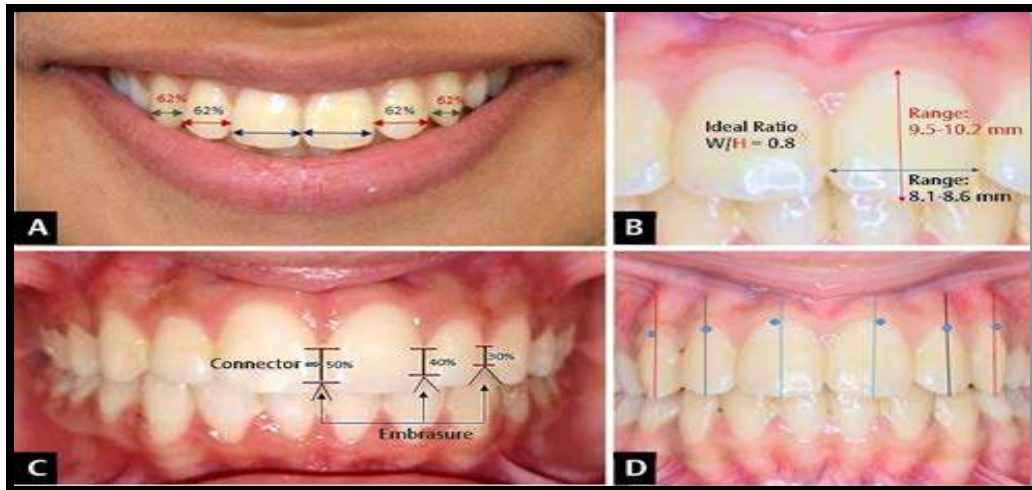
## 1.5 Micro-aesthetics

This domain represents the focus part of this literature review. It deals with the fine structure of dental and gingival aesthetics, for the clinical assessment of micro-aesthetic components of the teeth and gingival tissue, appropriate illumination and magnification tools are required for intra-oral examination. Necessary clinical intra-oral photographs should be taken for documentation and future reference (**Koirala, 2009**).

- 1- Evaluation of Tooth Proportions (fig1.4A) which for an esthetically pleasing smile according to the golden proportion, the apparent width of the lateral incisor should be 62% of the width of the central incisor, the apparent width of the canine should be 62% that of the lateral incisor and the apparent width of the first premolar should be 62% that of the canine (**Singh et al., 2021**).
- 2- Evaluation of the Height–Width Relationships (fig1.4B), the width of a tooth should be 80% of the height. They have given an ideal range of 0.75 to 0.85. The central incisor may have a width of 8.1 to 8.6 mm and a length of 9.5 to 10.2 mm (**Sharma and Sharma, 2012**). Teeth appear tapered when height is excessive and square when it is deficient. Sulcular depth of the incisors, lip level, relative crown length and amount of incisal wear influence the treatment strategy in cases with disproportionate length (**Proffit et al., 2019**).
- 3- Evaluation of Connectors and Embrasures (fig1.4C). Connector area is defined as the interdental contact area. The connector height is greatest between the central incisors and diminishes from the central to the posterior teeth (**Sarver, 2004**). Ideally, the maxillary anterior teeth follow the 50–40–30 ratio with the ideal connector length between the two maxillary incisors being 50% of the crown length and so on (**Singh et al., 2021**). while

embrasures are defined as the triangular spaces that lie incisal to the contact, ideally the embrasures are larger in size than the connectors, and the gingival embrasures are filled by the interdental papillae, Short interdental papillae leave an open gingival embrasure above the connectors, and these “black triangles” can detract significantly from the appearance of the teeth on smile (**Proffit *et al.*, 2019**).

- 4- Evaluation of Gingival esthetics which are (shape, contour and color). Gingival shape refers to curvature of the gingival margin of the tooth, determined by the cementoenamel junction and the osseous crest. 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 (**Sarver, 2004**). Proportionate gingival height is indispensable for an esthetic dental appearance. Generally, the central incisor and canine gingival margin are at the same level, while the lateral incisor margin is 1.5 mm lower. When the canines replace the laterals, this fact should be kept in mind (**Singh *et al.*, 2021**). The gingival zenith (the most apical point of the gingival tissue) should be located distal to the longitudinal axis of the maxillary centrals and canines; the gingival zenith of the maxillary laterals should coincide with their longitudinal axis (fig.1.4D) (**Proffit *et al.*, 2019**).



**Figure 1.4** Microesthetics: (A) Tooth proportions, (B) height-width relationship, (C) connectors and embrasures, and (D) gingival zeniths (**Singh et al., 2021**).

## 1.6 Orthodontic Treatment Options for Smile Refinement

The attention of individuals towards facial esthetics is considerably increased in recent times. Most of the patients seek orthodontic treatment not only to gain well-aligned teeth but also to improve their facial esthetics (**Spear and Kokich, 2007**).

It is possible not only to obtain an excellent occlusion but to improve patient esthetics according to his/her expectations. Planning the treatment based on facial esthetics as a purpose to protect the smile arc is parallel to a strategy to achieve occlusal purposes (**Singh et al., 2021**). Smile is the common facial trait that significantly contributes to overall facial esthetics, and the facial attractiveness of an individual could noticeably be enhanced through improving the smile features (**Bhuvaneshwaran, 2010**). The identification of the characteristics is the starting point of any esthetic planning of the smile and among the teeth in the esthetic zone, the central incisors are the most important and we need to understand that vertical alterations in the upper centrals imply the alteration of three characteristics: 1) the



central-to-lateral incisal step, 2) the gingival design among the teeth in the esthetic zone, and 3) the amount of gingival exposure in the central incisor area. Among these aspects, the central-to-lateral step is the most important (**Oliveira *et al.*, 2018**).

### **1.6.1 Smile Management during Major Orthodontic Treatment Mechanics**

#### **1- Primary focus on correcting vertical orthodontic problems**

**Lindauer *et al* (2005)** investigated how intrusion arch by bite plate can correct a deep overbite, they found that accomplish satisfying correction of the overbite, but is likely to cause decrease the maxillary incisor exposure and some degree of flattening of the smile arc during treatment.

The authors suggested that the flat smile arc could be corrected to some degree using flat continuous arch wires in the later stages of orthodontic treatment. This action will bring the maxillary incisors closer to their initial vertical position and therefore create a more parallel smile arc (**Christou *et al.*, 2019**).

#### **2- Primary focus on correcting transverse orthodontic problems**

**Maulik and Nanda (2007)** evaluated the connection between expansion of the upper arch using a palatal expander and buccal corridor/smile esthetics. The authors used the percentage of represented buccal corridors in the total smile width as an indicator of a narrow smile, the authors also showed that rapid palatal expansion decreases the exposure of buccal corridors after treatment.

**Carvalho *et al* (2012)** also tested how palatal expanders affect the smile esthetics. The authors found that expanders seemed to increase the smile width and exposure of the maxillary central and lateral incisors but lip thickness remain

unchanged and the buccal corridors remain unchanged after rapid palatal expansion.

Another study in this category evaluated how self-ligating brackets affect the smile and its parameters compared to conventional brackets. The results showed that there is not significant difference for the smile esthetic outcome whether Damon self-ligating or conventional brackets **Shook et al., 2016** are used. Both increase the arch width and decrease buccal corridors .

**Akyalcin et al (2017)** compared long term changes (up to 17 years) between extraction vs non-extraction groups before and after orthodontic treatment. The authors concluded that extractions do not affect the transverse maxillary arch width or the buccal corridors.

### **3- Primary focus on correcting sagittal orthodontic problems**

**Mah et al (2003)** investigated how orthodontic correction of Class II Division I cases who were treated with maxillary first premolar extractions will affect the patients' smile arc in regard to the lower lip. This study showed that extraction of upper premolars to correct a maxillary sagittal discrepancy result in deepening of smile line curvature. This occurs due to clockwise rotation of the anterior occlusal plane and reduction of proclination of maxillary incisors.

**Tauheed et al (2013)** focused on the proportions of the smile and found that teeth ratios after extraction treatment of maxillary premolars will deviate more from the golden proportion ratios than in non-extraction cases. Hence, to them, it is of great importance to preserve the micro-esthetics in the finishing stages when extraction mechanics are used in orthodontic treatment.

## 1.6.2 Smile Refinement during simple Orthodontic mechanics

### 1.6.2.1 Bracket Positioning

Accurate bracket positioning is essential to finish treatment with an excellent occlusion and beautiful smile. Additionally, the most common reason for unnecessary delay of treatment and the discovery of difficulty in the final stage is the incorrect bonding of the appliances (**Pitts and Castellanos, 2014**).

For a long time, the specialty used an esthetic parameter without scientific evidence: “the ideal step between central and lateral incisors is 0.5 mm”. Due to this gap in the literature, several different vertical positions of the upper central incisors were tested and slightly extruded centrals were found to be more attractive than intruded centrals. The results of these studies indicated that the central-to-lateral ideal incisal step should be 1, 2 mm for female and male patients (**Simões *et al.*, 2019**).

The incisal design is the most important characteristic in a smile analysis and corresponds to the design formed by the incisal edges of the teeth in the esthetic zone (**Machado, 2014**). In fact, it is not mandatory that the incisal edges of the teeth in the esthetic zone follow the contour of the lower lip, this anatomical area is simply a reference guide. On the other hand, the incisal edges in the esthetic zone must form a gentle and upward curve bilaterally. In addition, it is mandatory that the incisal edges of the central incisors be parallel to the ground or the interpupillary line (**Machado, 2020**).

If we don't accomplish an ideal incisal design (a gentle and upward curve bilaterally), the smile could be perceived as unattractive. Therefore, it is mandatory to incorporate smile characteristics into orthodontic diagnosis and, then use this information to properly position maxillary anterior brackets: upper central incisors

should appear more extruded than intruded in order to guarantee an ideal incisal design (Simões *et al.*, 2019). Also, there's Alexander technique uses the premolar height (X in the Vari-Simplex table for bracket heights) for bracket positions in the entire arch (Alexander, 2008).

**Table 1:** Table of Vari-Simplex bracket heights (Pitts and Castellanos, 2014)

Bracket Height	
<b>Maxillary Arch</b>	
Centrals	X
Laterals	X - 0.5 mm
Cuspids	X + 0.5 mm
Bicuspid	X
1st Molars	X - 0.5 mm
2nd Molars	X - 1.0 mm
<b>Mandibular Arch</b>	
Centrals	X - 0.5 mm
Laterals	X - 0.5 mm
Cuspids	X + 0.5 mm
Bicuspid	X
1st Molars	X - 0.5 mm

The MBT™ table, another commonly used bracket positioning guide. It suggests average positions for brackets in the maxillary arch of 4.5 mm for the first premolar (X - 0.5 mm.), 5.0 mm for canine (X), 4.5 mm for lateral (X - 0.5 mm), and 5.0 mm for central (X). Unfortunately, bracket placements with these height discrepancies typically flatten the smile curve (McLaughlin *et al.*, 2001).

**Table 2:** MBT™ Versatile+ Appliance Bracket placement guide (Pitts and Castellanos, 2014).

MBT™ Versatile Appliance Bracket Placement Guide							
7	6	5	4	3	2	1	High
2.0	4.0	5.0	5.5	6.0	5.5	6.0	+ 1.0 mm
2.0	3.5	4.5	5.0	5.5	5.0	5.5	+ 0.5 mm
<b>2.0</b>	<b>3.0</b>	<b>4.0</b>	<b>4.5</b>	<b>5.0</b>	<b>4.5</b>	<b>5.0</b>	<b>Average</b>
2.0	2.5	3.5	4.0	4.5	4.0	4.5	- 0.5 mm
2.0	2.0	3.0	3.5	4.0	3.5	4.0	- 1.0 mm
7	6	5	4	3	2	1	Low
3.5	3.5	4.5	5.0	5.5	5.0	5.0	+ 1.0 mm
3.0	3.0	4.0	4.5	5.0	4.5	4.5	+ 0.5 mm
<b>2.5</b>	<b>2.5</b>	<b>3.5</b>	<b>4.0</b>	<b>4.5</b>	<b>4.0</b>	<b>4.0</b>	<b>Average</b>
2.0	2.0	3.0	3.5	4.0	3.5	3.5	- 0.5 mm
2.0	2.0	2.5	3.0	3.5	3.0	3.0	- 1.0 mm

Dr. Tom Pitts has developed a protocol for Smile Arc Protection (SAP) bracket positions that consistently produces beautiful Smile Arcs. Dr. Tomás Castellanos has quantified this esthetic positioning by measuring the length on the teeth. Hence, this is a “Tom-Tom” production. The table facilitates the vertical placement of brackets in positions that result in adequate smile curves, as well as mutually protected occlusions (**Pitts and Castellanos, 2014**).

**Table 3:** TOM x TOM is a table that studied and designed by Dr. Tomas Castellanos, based in “Smile Arc Protection”. A, lower arch values. B, upper arch values (**Pitts and Castellanos, 2014**).

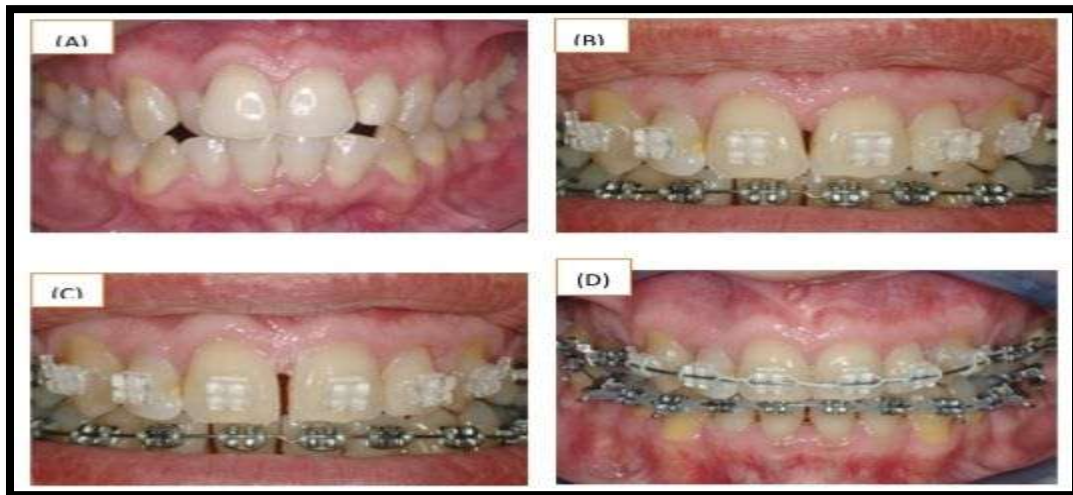
A GUIDE TO POSITION SMILE-ARC							
TOM X TOM - LOWER							
GPS-A	7	6	5	4	3	2	1
11 mm	4,5	4,5	5,5	6,0	6,0	5,0	5,0
10 mm	4,0	4,0	5,0	5,5	5,5	5,0	5,0
9 mm	3,5	3,5	4,5	5,0	5,0	4,5	4,5
8 mm	3,0	3,0	4,0	4,5	4,5	4,0	4,0

B GUIDE TO POSITION SMILE-ARC							
TOM X TOM - UPPER							
GPS-A	7	6	5	4	3	2	1
12 mm	2,5	4,0	5,0	5,5	6,0	6,0	7,0
11 mm	2,5	3,5	4,5	5,0	5,5	5,5	6,5
10 mm	2,0	3,0	4,0	4,5	5,0	5,0	5,5
9 mm	2,0	2,5	3,5	4,0	4,5	4,5	5,0

### 1.6.2.2 Black Triangles

Short interdental papillae leave an open gingival embrasure above the connectors, and these “black triangles” can detract significantly from the appearance of the teeth on smile. Black triangles in adults usually arise from loss of gingival tissue related to periodontal disease, but when crowded and rotated maxillary incisors are corrected orthodontically in adults, the connector moves incisally and black triangles may appear, especially if severe crowding was present. For that reason, both and potential black triangles should be noted during the

orthodontic examination, and the patient should be prepared for reshaping of the teeth to minimize this esthetic problem (Fig 1.5) (Proffit *et al.*, 2019).



**Figure 1.5** black triangle (A) Crowded and rotated maxillary incisors at the beginning of orthodontic treatment in an adult. (B) After alignment of the incisors, a black triangle was present between the central incisors. (C) With the orthodontic appliance still in place, the incisors were reshaped so that when the contact point would be moved apically the midline connector would be lengthened. (D) After the space was closed the black triangle was no longer apparent (Proffit *et al.*, 2019).

### 1.6.3 Smile refinement After Orthodontic Intervention

#### 1.6.3.1 Crown lengthening Procedures

Clinical crown of the tooth is the distance from gingival margin to incisal edge or occlusal surface of the tooth (Park, 2010). One of the processes to obtain appropriate size of clinical crown is crown lengthening (CL). According to the definition of the American Academy of Periodontology, CL is “ a surgical procedure designed to increase the extent of the supragingival tooth structure for restorative or esthetic purposes by apically positioning the gingival margin, removing supporting bone or both” (Ardakani *et al.*, 2016).

CL aimed at increasing the clinical crown height of a tooth either for the esthetic or restorative needs. The same is accomplished usually by surgical,

orthodontic, or a combination of surgical and orthodontic procedures (**Baghele, 2021**). Crown-lengthening surgery is a resective procedure used to induce recession surgically. The clinician either excises or apically positions soft tissues. In addition, the underlying osseous structure plays a critical role in the final wound healing (**Hempton and Dominici, 2010**).

### **Esthetic Crown Lengthening**

After a proper diagnosis, the first step in esthetic CL must include an understanding of the patient's concerns. Esthetic perceptions between dentists and laypeople can vary. The use of a well-made diagnostic wax-up cast can provide valuable information to the dentist, laboratory, and patient which can be otherwise difficult to communicate (**Malik and Tabiat-Pour, 2010**).

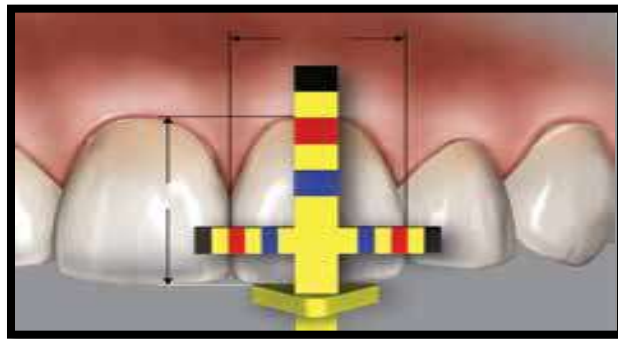
It is a well-known fact that practitioners tend to underestimate the amount of tooth structure that must be exposed during a crown lengthening procedure, leading to biologic width violation, Chu aesthetic gauges are a series of innovatively designed, color coded measurement gauges that provide a biologically based, step by-step approach to periodontal aesthetic crown lengthening (**Nautiyal et al., 2016**).

Chu's Aesthetic Gauges (fig 1.6 ), which define ranges of individual tooth size, was used to create the proper individual tooth proportion based upon width once the incisal edge position was established (**Codes, 2014**). Chu's Esthetic Gauges for crown lengthening procedure has provided the operator with additional clinical benefits such as proper visualization of the biologic width while performing the procedure, determining the final placement of the interdental papilla, and accordingly reducing the crest of the bone interdentally to maintain the

biologic width at the same time and maintaining the Golden proportion in the prosthesis which would lead to superior esthetic outcomes (**Patil, 2021**).

### **Precise color-coded measurements (Codes, 2014):**

- Provides quick, accurate diagnosis of tooth proportion
- Provides accurate results and reduces chairside adjustment time
- Easy to read — reduces visual fatigue



**Figure 1. 6** Chu’s Esthetic Gauges. The T-bar tip has a vertical and horizontal arm. This measures length and width at the same time (**Codes, 2014**).

### **The Aesthetic Crown Lengthening Classification**

Which is an assessment of the alveolar crest position, four distinct clinical scenarios may be identified (**Chu and Hochman, 2007**).

- 1- Type I aesthetic crown lengthening is characterized by sufficient gingival tissue coronal to the alveolar crest, allowing the surgical alteration of the gingival margin levels without need for osseous recontouring (Fig.1.7) (**Chu and Hochman, 2007**).





**Figure 1.7** Preoperative facial view of type I case diagnosed through bone sounding. Crown lengthening of teeth #8(11) and #9(21) may be achieved without the need for osseous contouring (**Chu and Hochman, 2007**).

2- Type II aesthetic crown lengthening is characterized by soft tissue dimensions that allow the surgical repositioning of the gingival margin without exposure of the osseous crest, but nevertheless in violation of the biologic width (Fig.1.8) (**Lee and Jun., 2000**).



**Figure 1.8** Preoperative appearance of type II case. Treatment objectives are improved dental proportions as well as a decrease in the amount of gingival display (**Chu and Hochman, 2007**).

3- type III aesthetic crown lengthening, bone sounding may reveal a scenario where repositioning the gingival margin will result in exposure of the osseous crest. This is an unacceptable complication that precludes the completion of any gingivectomy procedures prior to surgical bone contouring (Fig. 1.9) (**Lee and Jun., 2000**).



**Figure 1.9** Preoperative appearance of type III case. Gingival excision to achieve the desired clinical crown length will result in exposure of the alveolar crest (**Chu and Hochman, 2007**).

4- Type IV aesthetic crown lengthening is reserved for scenarios where the degree of gingival excision is compromised by an insufficient amount of attached gingiva. Ideal margin position, therefore, can only be achieved through the use of an apically positioned mucoperiosteal flap, regardless of the need for osseous contouring (**Chu and Hochman, 2007**).

### **1.6.3.2 Gingivectomy or Gingivoplasty**

Important factors in finishing orthodontics cases for optimal smile aesthetics now include concepts that are important in cosmetic dentistry: gingival shape and contours, tooth proportionality, and crown heights (**Ismullah and Kurnia, 2020**). Resective gingival surgery to lengthen the clinical crown (gingivectomy or gingivoplasty). Resective bone surgery to lengthen the clinical crown and selecting the best option to correct the problem depends on several factors: Sulcus depth on probing, location of CEJ relative to the bone level, crown-root relationship between the teeth involved, root form and degree of gingival display on smiling (Fig 1.10) (**Lione et al., 2020**).

Treatment now can be carried out effectively with the use of a diode laser (Fig.11). A laser of this type, in comparison to the carbon dioxide (CO) or erbium-

doped yttrium aluminium garnet (Er-YAG) lasers also used now in dentistry, has two primary advantages (**Chu and Hochman, 2007**).

It does not cut hard tissue, so there is no risk of damage to the teeth or alveolar bone if it is used for gingival contouring, and it creates a "biologic dressing" because it coagulates, sterilizes, and seals the soft tissue as it is used. There is no bleeding, no other dressing is required, and there is no waiting period for healing of a Soft Tissue (**Proffit *et al.*, 2019**).



**Figure 1.10** Gummy smile. Patient had disproportionality of width and height of maxillary incisors, with gingival encroachment. Appropriate bracket placement is difficult because entire crown is not visible. B Through laser gingivectomy, excess tissue was removed and crown visualized. C, Four weeks after gingivectomy. Properties of laser prevent bleeding; thus brackets can be placed immediately, and healing occurs quickly (**Lione *et al.*, 2020**).



**Figure 1.11** Gingivectomy A, Patient had excessive gingival display, but smile arc was consonant. Intrusion of maxillary incisors would reduce gummy smile but would also flatten smile arc. B, Digital image modification demonstrated effect of crown lengthening on reducing gingival display while maintaining smile arc. C, After canines were brought down and leveling completed, patient was referred to dentist for laser gingivectomy. D, After appliances were removed, excellent crown proportionality, gingival shapes, and contours were present (**Lione *et al.*, 2020**).

### 1.6.3.3 Botulinum Toxin Type I:

Botox or Botulinum toxin type I is used as a temporary treatment for gummy smile (Fig 1.12). The effect of Botox will appear after 2 weeks and persists between 4 and 6 months depending on the muscle thickness and anatomy (*Janson et al.,2011*).

The injection of botulinum toxin, despite being a simple and safe procedure, may be associated with some adverse events such as pain at the injection site, bruising, infection, edema, dysphonia, dysphagia, ptosis, or lengthening of the upper lip and asymmetry of the smile (*Mazzuco et al.,2010*).

The operator should be attentive in relation to dosage, precision of technique and location of the puncture (*Janson et al.,2011*).

Contraindications to the use of botulinum toxin are pregnancy; lactation; hypersensitivity (allergy) to botulinum toxin itself; lactose and albumin; muscle and neurodegenerative diseases (myasthenia gravis and Charcot's disease), and concurrent use of aminoglycoside antibiotic that enhances the action of the toxin (*Niamtu et al.,2008*).



**Figure 1.12** Gummy smile treated by Botox. Pre (A) and post (B) photos for a case with gummy smile treated by Botox (*Mazzuco et al.,2010*).

## Chapter Two

### Discussion

Smile forms an important aspect of facial analysis, as it contributes to overall facial esthetics. Many orthodontists pay more attention to cephalometric radiograph; and profile assessment to improve their patients' esthetics; however, the facial attractiveness of the individuals is obviously improved through enhancing their smiles. A systematic review done by **Christou *et al* (2019)** concluded how different types of orthodontic interventions affect the esthetics of the smile and concluded that the orthodontic treatment affects the esthetics of the smile in three dimensions. There was slight evidence that extractions do not affect the smile width and buccal corridors area. Whereas evidence on palatal expansion was controversial. In addition.

An analysis of smile esthetics in American Board of Orthodontic patients done by **Akyalcin *et al* (2014)** revealed that an esthetically pleasing smile is considered crucial to consider cases as successfully treated upon the submission to American Board Orthodontics (ABO) clinical examination, including harmonious smile arc relationship and less gingival display.

A study done by **Kadhim *et al* (2020)** showed the impact of analyzing certain smile esthetic parameters on diagnosis and treatment plan for individuals seeking orthodontic treatment. Use of facial photograph can be a reliable tool for a less time-consuming and detailed evaluation of smile features. Accurate bonding of orthodontic brackets can participate in shortening the time demanded for better finalization of patient smile.

# Chapter Three

## Conclusion

Smile refinement impact on the final facial and smile appearance can be quite dramatic. Modern orthodontics deals not only with the dental and skeletal aspects but also with dental proportions and the role of the dentition on facial appearance. Smile refinement need accurate smile planning performed with major mechanics or accurate bonding. Therefore, finishing a case begins the moment brackets are placed.

The roles of orthodontic for smile management can be summarized in the following tasks:

- 1) Arch intrusion to correct the excessive gingival display.
- 2) Arch expansion to reduce the buccal corridor.
- 3) Bracket positioning to draw the incisal edges in the esthetic zone in a gentle and upward curve bilaterally (smile arc protection or creation).
- 4) Reshaping of tooth either to eliminate the black triangle or to correct height-width tooth proportions.
- 5) Also, the Crown lengthening procedures, gingivectomy and Botox that done by orthodontist or other dental specialty to improve the smile of the patient.

## References

### -A-

Alexander W. Build treatment into bracket placement. In: *The 20 Principles of the Alexander Discipline*. Chicago, IL: Quintessence; 2008:59.

Akyalcin, S., Frels, L.K., English, J.D. and Laman, S. (2014) Analysis of smile esthetics in American Board of Orthodontic patients. *Angle Orthodontist*, 84(3), 486–491.

Akyalcin, S. , Misner, K., English, J. D., Alexander, W. G., Alexander, J. M. and Gallerano, R. (2017) Smile esthetics: Evaluation of long-term changes in the transverse dimension. *Korean Journal of Orthodontics*, 47(2), 100–107.

Yuns Amin, F., Priya, R., Devaki Vijayalakshmi, R. and Karthik, L. (2020) The Influence of Smile Arc by Bracket Position Modification: A Prospective Clinical Study. *Journal of Indian Orthodontic Society*, 54(1), 49–57.

Ardakani, M. R. T., Khalilian, F., Nateghi, Z., Esmaeilnejad, A. and Janbakhsh, N. (2016) A Review of the Crown Lengthening Surgery; The Basic Concepts. *British Journal of Medicine and Medical Research*, 13(3), 1–7.

### -B -

Baghele, O. N. (2021). A comprehensive update on crown-lengthening procedures with new concepts and inputs. *Journal of the International Clinical Dental Research Organization*, 13(1), 17.

Bhuvaneshwaran, M. (2010) Principles of smile design. *Journal of Conservative Dentistry*, 13(4), 225.

**-C-**

Carvalho, F. A., Koren, O., Goodrich, J. K., Johansson, M. E., Nalbantoglu, I., Aitken, J. D., ... & Gewirtz, A. T. (2012). Transient inability to manage proteobacteria promotes chronic gut inflammation in TLR5-deficient mice. *Cell host & microbe*, 12(2), 139-152.

Christou, T., Betlej, A., Aswad, N., Ogdon, D. and Kau, C. H. (2019) Clinical effectiveness of orthodontic treatment on smile esthetics: A systematic review. *Clinical, Cosmetic and Investigational Dentistry*, 11, 89–101.

Chu, S. J. and Hochman, M. N. (2007) A BIOMETRIC APPROACH TO AN ESTHETIC CROWN LENGTHENING : Learning Objectives. *Pract proced aesthet dent*, 19(10).

Codes, P. (2014) ‘Chu’s aesthetic gauges™’.

**-H-**

Hempton, T. J. and Dominici, J. T. (2010) Contemporary crown-lengthening therapy: A review. *Journal of the American Dental Association*, 141(6), 647–655.

**-I-**

Ismullah, Y. and Kurnia, S. (2020) Gingivectomy and Gingival Depigmentation After Orthodontic Treatment. *Dentino : Jurnal Kedokteran Gigi*, 5(2), 217.

**-J-**

Janson, G., Branco, N. C., Fernandes, T. M. F., Sathler, R., Garib, D. and Lauris, J. R. P. (2011) Influence of orthodontic treatment, midline position, buccal corridor and smile arc on smile attractiveness. *Angle Orthodontist*, 81(1), 155–163.



**-K-**

Kadhim, H. A , Al Toma, R. R. and Saloom, H. F. (2020) Impact of assessing smile parameters as part of orthodontic treatment planning - a survey based analysis. *Journal of the World Federation of Orthodontists*, 9(3), 117–122.

Koirala, S., Jin, Z., Piao, X., & Corfas, G. (2009). GPR56-regulated granule cell adhesion is essential for rostral cerebellar development. *Journal of Neuroscience*, 29(23), 7439-7449.

**-L-**

Lindauer, R. J., Vlieger, E. J., Jalink, M., Olf, M., Carlier, I. V., Majoie, C. B., ... & Gersons, B. P. (2005). Effects of psychotherapy on hippocampal volume in out-patients with post-traumatic stress disorder: a MRI investigation. *Psychological medicine*, 35(10), 1421-1431.

Littlewood, S. J., & Mitchell, L. (2019). *An introduction to orthodontics*. Oxford university press.

Lione, R., Pavoni, C., Noviello, A., Clementini, M., Danesi, C., & Cozza, P. (2020) Conventional versus laser gingivectomy in the management of gingival enlargement during orthodontic treatment: A randomized controlled trial. *European Journal of Orthodontics*, 42(1), 78–85.

**-M-**

Machado, A. W. (2014) 10 Commandments of Smile Esthetics. *Dental Press Journal of Orthodontics*, 19(4), 136–157.

Machado, A. W. (2020) Mechanics to Enhance Facial and Smile Esthetics. *Seminars in Orthodontics*, 26(3), 117–125.

Mah, T. F., Pitts, B., Pellock, B., Walker, G. C., Stewart, P. S., & O'Toole, G. A. (2003). A genetic basis for *Pseudomonas aeruginosa* biofilm antibiotic resistance. *Nature*, 426(6964), 306-310.

Malik, K. and Tabiat-Pour, S. (2010) The use of a diagnostic wax set-up in aesthetic cases involving crown lengthening--a case report. *Dental update*, 37(5).

Mazzuco, R., & Hexsel, D. (2010). Gummy smile and botulinum toxin: a new approach based on the gingival exposure area. *Journal of the American Academy of Dermatology*, 63(6), 1042-1051.

McLaughlin, M. W., & Talbert, J. E. (2001). Professional communities and the work of high school teaching. University of Chicago Press.

Munjal, S., & Kundu, S. (2017). Exploring the connection between human capital and innovation in the globalising world. In *Human Capital and Innovation* (pp. 1-11). Palgrave Macmillan, London.

Maulik, C., & Nanda, R. (2007). Dynamic smile analysis in young adults. *American journal of orthodontics and dentofacial orthopedics*, 132(3), 307-315.

-N-

Naini, F. B. and Gill, D. S. (2008) Facial aesthetics: 2. Clinical assessment. *Dental update*, 35(3).

Nautiyal, A., Gujjari, S. and Kumar, V. (2016) Aesthetic crown lengthening using Chu aesthetic gauges and evaluation of biologic width healing. *Journal of Clinical and Diagnostic Research*, 10(1), ZC51–ZC55.

Niamtu, J. (2008). Botox injections for gummy smiles. *American Journal of Orthodontics and Dentofacial Orthopedics*, 133(6), 782-783.

**-O-**

Oliveira, P. L. E., Motta, A., Pithon, M. and Mucha, J. (2018) Details of pleasing smiles. *The international journal of esthetic dentistry*, 13(4), 494–514.

**-P-**

Park, J.-B. (2010) Restoration of the Severely Decayed Tooth Using Crown - Lengthening with Simultaneous Tooth-Preparation. *European Journal of Dentistry*, 04(02), 197–201.

Patil, D. Y. (2021) A Clinical Evaluation Of Chu ' s Esthetic Gauges In Crown Lengthening Procedures In The Maxillary Anterior Region-A Randomised Study. 20(1), 5498–5507.

Pitts, T. and Castellanos, T. (2014) A new table to guide bracket placement based on the concept of “smile arc protection”, *Orthodontic Practice US*, 5(5), 12–16.

Proffit, W. R., Fields Jr, H. W., & Sarver, D. M. (2019). Contemporary orthodontics. Elsevier Health Sciences.

**-S-**

Sabri, R. (2005). The eight components of a balanced smile. *J Clin Orthod*, 39(3), 155-67.

Sarver, D. M. (2004) Principles of cosmetic dentistry in orthodontics: Part 1. Shape and proportionality of anterior teeth. *American Journal of Orthodontics and Dentofacial Orthopedics*, 126(6), 749–753.

Sarver, D. M. and Ackerman, J. L. (2000) Orthodontics about face : The re-emergence of. *American Journal of Orthodontics and Dentofacial Orthopedics*, 575–576.

Sarver, D. M. and Ackerman, M. B. (2003) Dynamic smile visualization and quantification: Part 2. Smile analysis and treatment strategies. *American Journal of Orthodontics and Dentofacial Orthopedics*, 124(2), 116–127.

Sharma, P. K. and Sharma, P. (2012) Dental Smile Esthetics: The Assessment and Creation of the Ideal Smile. *Seminars in Orthodontics*, 18(3), 193–201.

Shook, J. R., & Giordano, J. (2016). Moral enhancement? Acknowledging limitations of neurotechnology and morality. *AJOB Neuroscience*, 7(2), 118-120.

Simões, D., de Brito, G. M., Cangussu, M. C. T. and Machado, A. W. (2019) Does the vertical position of maxillary central incisors in men influence smile esthetics perception?. *American Journal of Orthodontics and Dentofacial Orthopedics*, 156(4), 485–492.

Singh, S., Singla, L. and Anand, T. (2021) Esthetic Considerations in Orthodontics: An Overview. *Dental Journal of Advance Studies*, 9(02), 55–60.

Singh, V. P. and Sharma, J. (2011) Principles of Smile Analysis in Orthodontics- A Clinical Overview. *Health Renaissance*, 9(1), 35–40.

Spear, F. M. and Kokich, V. G. (2007) A Multidisciplinary Approach to Esthetic Dentistry. *Dental Clinics of North America*, 51(2), 487–505.

#### -T-

Turley, P. K. (2015) Evolution of esthetic considerations in orthodontics. *American Journal of Orthodontics and Dentofacial Orthopedics*, 148(3), 374–379.

Tubelius, P., Stan, V., & Zachrisson, A. (2005). Increasing work-place healthiness with the probiotic *Lactobacillus reuteri*: a randomised, double-blind placebo-controlled study. *Environmental Health*, 4(1), 1-5.

