



## Demystifying The Altered Passive Eruption – A Review

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### Abstract

The altered passive eruption(APE)is a developmental condition associated with a gummy smile.Presence of excessive gingival display with normal skeletal,dental and lip proportion suggests a diagnosis of APE.The altered passive eruption is defined as failure of the gingival margin to recede adequately during tooth eruption to a level apical to the cervical convexity of a crown.They are of two types based on gingival and anatomic crown relationship and two subtypes in correspondence with alveolar bone and Cementoenamel junction. It constitutes an esthetic concern and poses difficulty in maintaining periodontal health especially, during orthodontic and restorative treatment.In the current era of esthetic concern, it is essential for systematic diagnosis and appropriate management of APE.Treatment mainly depends on the type and subtype of altered passive eruption.The main aim of this review is to discuss in detail about the diagnosis of APE.

**Keywords:** Altered passive eruption, diagnosis, dentogingival junction

### INTRODUCTION

A smile can be true joy or a masquerade but it is a requisite for health. For a smile to be bold and confident, proper dentofacial harmony is essential. Thus, an expedient relationship between gingival scaffold, lip and teeth is indispensable. Even in the contempt of being healthy, if the gingiva has irregular arrangement it becomes a concern for optimal esthetics. In 1999, the American Academy of Periodontology has perceived gingival excess as mucogingival deformity. One of the important causes of gingival excess is altered passive eruption (APE)<sup>[1]</sup>.

Successful treatment depends on a meticulous diagnosis. APE not only features a gummy smile (excessive exposure of gingiva while smiling) it also presents a short clinical crown which is often mistreated prosthodontically. In this review, we

discuss the prevalence, classification, etiology, diagnosis and management of APE.

### Eruption:

Eruption includes two processes, an active eruption phase which is the movement of a tooth from the germinative position towards a functional occlusal position in oral cavity and a passive eruption phase which is the movement of dentogingival junction apically from the crown.

### Passive eruption

In 1933, Gottlieb and Orban coined the words passive eruption. It is the apical migration of attachment epithelium from enamel and they may migrate further apically and expose the cementum. They are divided into four stages based on the position of the base of

the gingival sulcus and the apical portion of the attachment epithelium.

Stage I - base of gingival sulcus is in enamel, apical portion of attachment epithelium is in CEJ,

Stage II - base of the gingival sulcus is still in enamel, apical portion of attachment epithelium is repositioned to cemental surface,

Stage III - base of gingival sulcus is in CEJ, entire attachment epithelium is in cemental surface,

Stage IV - The entire attachment epithelium is present on the cementum. Orban described the first two stages as physiologic and the last two stages as a probable pathology.

Thus the vertical motion of active eruption causes displacement of soft tissue along with crown whereas passive eruption causes migration of attachment epithelium apically and gradually exposes tooth<sup>[2]</sup>.

### Altered passive eruption

Goldman & Cohen (1968) described altered passive eruption as 'failure of the tissue to adequately recede to a level apical to the cervical convexity of the crown'. APE is also referred to as retarded or delayed passive eruption<sup>[3]</sup>.

Volcansky and Cleaton Jones (1974) described, 'tissue's failure to reach cemento-enamel junction as delayed passive eruption (DPE)',<sup>[4]</sup>

Cohen (1980) – 'Gingival margin instead of being located at or apical to the axial tooth curvature, the gingival margin fails to recede during tooth eruption to a level apical to the cervical convexity of the tooth crown'<sup>[5]</sup>.

Alpiste Illueca defined 'altered passive eruption as a variant of habitual periodontal morphology, which is characterized at the level of upper central incisor by overlapping of gingiva on the anatomic crown of teeth equivalent to more than 19% of its height',<sup>[6]</sup>

### Prevalence:

In 1976, Volcansky and Cleaton Jones reported 12.1% of 1025 patients with a mean age of 24.2±6.2 years displayed APE. Tjan and colleagues (1984) noted APE occurrence as 7% in men and 14% in women. In a study of prevalence about gummy smile 20.8% of patients presented with APE alone, 45.3% patients presented with hypermobility of upper lip

and 34% patients presented with APE and hypermobility of upper lip<sup>[7]</sup>.

Nart et al, conducted a cross-sectional study to compare and evaluate the prevalence of altered passive eruption among patients who never received orthodontic therapy and those who had undergone orthodontic treatment. The results of this study showed a higher prevalence of APE among orthodontically treated patients. APE was found in 29.5% of individuals who never received orthodontic therapy and 42.1% of patients who had undergone orthodontic therapy had APE. But the results were not upto a statistically significant degree<sup>[8]</sup>.

### Classification

In 1977 Coslet et al, has put forward a classification for APE which is being used till now. It is based on the position of mucogingival junction (MGJ) with respect to alveolar bone crest (ABC) and they are further subclassified into two groups based on the location of alveolar bone crest with respect to the cemento-enamel junction.

Depending on the position of mucogingival junction in regard to an alveolar bone crest (Gingival – anatomic crown) (Figure 1)

Type I – Gingival margin is incisal or occlusal to cemento-enamel junction (CEJ) and the mucogingival junction is usually apical to alveolar crest. There is a wider band of attached gingiva from marginal gingiva to mucogingival junction than the generally accepted mean width. Ainamo and Loe conferred mean gingival width as 3 to 4.2 mm and 2.5 to 2.6mm in maxilla and mandible respectively.

Type II – In this type, the width of the attached gingiva from the gingival margin to mucogingival junction appears to be within normal mean gingival width as mentioned above. Although all the attached gingiva is positioned on the anatomic crown with mucogingival junction located at the level of cemento-enamel junction.

Depending upon the location of an alveolar bone crest in regard to cemento-enamel junction (Figure 1)

Subtype A – The alveolar crest is present in normal distance i.e., 1-2 mm (apical) to cemento-enamel junction. This allows the gingival fiber apparatus to get inserted normally into the cementum.

Subtype B – The alveolar crest is coronal or it coincides with CEJ. This impinges the attachment of connective tissue fibers. Subgroup B is usually seen in transitional dentition, during active eruption phase<sup>[9]</sup>.

In 2016 Mariana S et al, has proposed a modification in Coslet's classification. They have described the nearness or coincidence of alveolar bone crest to CEJ as Altered Active Eruption (AAE).

APE Type I - keratinised gingiva/tissue > 2mm

### Etiopathogenesis:

1. Based on the location of an alveolar bone crest to cemento-enamel junction, Evian et al have hypothesized two possible mechanisms as an etiopathology for altered passive eruption. If the alveolar bone crest is close to CEJ as seen in Coslet subtype B they may impede gingival migration in the course of the passive eruption. This establishes a distinction between altered active and altered passive eruptions. According to this, they have hypothesized, that there are two mechanisms involved, forming two different dentogingival junction morphological patterns.

APE type I is due to failure during the passive eruption phase, leading to increased gingival overlap on the anatomic crown. Still, the distance from the alveolar crest to CEJ is normal.

APE type II is due to failure in the active eruption phase leading to insufficient tooth emergence from the alveolar bone. Hence, CEJ is in the vicinity of alveolar bone crest. This prevents migration of gingiva apically during passive eruption<sup>[6]</sup>.

Nevertheless, the cause for failure in eruption and factors determining dentogingival junction morphology is not yet fully understood. Various theories have been put forward to comprehend the etiology of arrested tooth eruption. However few studies regarded the morphology acquired by coronal periodontium<sup>[11]</sup>.

2. Several causes for mitigation in the mechanism of the eruption have been reviewed in literature like mechanical factors, endocrine disorders, genetic causes.

APE Type II - keratinised gingiva/tissue  $\leq$  2mm

Subtypes of Coslet's classification were excluded and new categories based on AAE are included.

APE type I -AAE - keratinized gingiva/tissue > 2mm with an insufficient distance from CEJ to alveolar bone crest.

APE type II -AAE - keratinized gingiva/tissue  $\leq$  2mm with an insufficient distance from CEJ to alveolar bone crest<sup>[10]</sup>.

2A. Mechanical factors that can modify eruption mechanism are root ankylosis, supernumerary teeth, odontogenic cyst and tumors, soft tissue interferences, malformation in crown and root of teeth.

2B. Endocrine disorders like hypopituitarism, hypothyroidism, hypoparathyroidism, hypogonadism, pseudohypoparathyroidism cause delayed passive eruption<sup>[12]</sup>.

2C. Rossi et al, conducted a study among 20 subjects of altered passive eruption and their immediate family members. They concluded that there is a strong correlation of APE among family members, as 65% of patients who attended the study had at least one member in their family having a similar condition and 155 had the entire family with APE. However, there was no correlation in regard to the type of APE amid family members. These results show that the genetic factor plays an important role in the etiology of APE<sup>[13]</sup>.

3. Primary failure of eruption is a condition described by Proffit and Vig in which a tooth fails to erupt even in the absence of any mechanical hindrance<sup>[14]</sup>. This condition is commonly seen in posterior teeth where the tooth erupts partially and the eruption gets ceased completely. The tooth will remain submerged but they are not ankylosed. The etiology of this condition is unknown, although some researchers have proposed a possible genetic causative factor. It may be associated with disorders such as chondroectodermal dysplasia, Downs syndrome, Achondroplasia, Osteoporosis, Cleido cranial dysplasia<sup>[15]</sup>.

4. Nart et al have studied the relationship between APE and gingival biotype. Categorizing gingival biotype into thin scalloped, thick scalloped and thick

flat. They found that APE was significantly higher among patients with flat biotype.

5. Alpieste Illueca has proposed a hypothesis in his study stating that APE suggests a relative failure in complete tooth eruption which is characterized by two mechanisms: i) Inadequate space for complete eruption of antagonistic teeth due to compromised space. Facial growth patterns may be entailed in this restriction of space since they ultimately dictate maxillary and mandibular vertical space relationships. ii) The second mechanism is based on the dimensional characteristics of periodontal tissues encircling the tooth. Disproportionate dimensions among periodontal tissues regarding tooth size and eruption can complicate the movement of tooth as well as withdrawal during active and passive eruption respectively<sup>[16]</sup>.

#### **APE and periodontal health:**

Inflammation of the gingiva is likely to be seen in APE, during the orthodontic and restorative procedures due to coronally placed marginal gingiva. This coronally placed marginal gingiva is more prone to trauma. There may be debris accumulation and interference during oral hygiene measures<sup>[17]</sup>. Volchansky in his study has seen a significant correlation among APE and Vincent's infection. He suggested that it is due to deep gingival sulcus in APE, which predisposes to an anaerobic environment. However, in the case of good oral hygiene, this situation is unlikely<sup>[4]</sup>.

#### **Diagnosis**

For proper diagnosis both intraoral and extraoral examination is inevitable. The first examination to be done is to observe the patient's natural smile at rest. If excessive gingival display is found further evaluations should be done. Diagnosis of APE includes the following steps,

1. **Facial analysis:** A meticulous facial evaluation includes analysis of facial symmetry or midfacial deficiency or excess which helps to identify vertical maxillary excess (VME). VME is one of the common extraoral etiology of gummy smile which should be treated surgically.
2. **Lip analysis:** The length of upper lip and mobility of the upper lip should be assessed. Lip length is calculated from subnasale to wet

border of the upper lip. The average length of the upper lip is about 20 to 22 mm. If an individual's lip measurement is less than this, then it can be considered as short upper lip. [Vig and Bruno (1972) average lip length 16 to 24mm]. Short upper lip and hypermobility of upper lip causes gummy smile.

3. **Dentoalveolar analysis:** On dentoalveolar analysis, interlabial distance should be appraised to rule out vertical maxillary excess (VME) or over eruption of teeth. Horizontal and vertical dimensions of the clinical crown should be measured in case of a short clinical crown, a differential diagnosis of APE can be done. However, in the case of short clinical crowns, incisal wear should be precluded<sup>[18]</sup>.
4. **Periodontal examination:** In a study on morphology and dimension of dentogingival unit in APE, diagnosis of APE was based on 2 clinical criteria i) increasingly flattened gingival festooning ii) disproportionate papillary base width concerning the height of the papilla tip. They concluded that the dentogingival unit of APE has more bone crest thickness and connective tissue attachment thickness and increased biological width<sup>[17]</sup>.

On examination following criteria should be evaluated - probing depth, position of the mucogingival line, width of keratinised gingiva, alveolar crest height, clinical crown dimensions and occlusal wear of teeth<sup>[19]</sup>. It has been proposed by various authors that if gingival sulcus is healthy and without any pathological signs with a probing depth over 3mm it might be APE<sup>[20,21]</sup>. However, in the study conducted by Alpieste Illueca probing depth in APE was less than 3mm mostly 1.5mm. According to Dolt and Robbins,

1. The first step in the diagnosis of APE - Is to locate the CEJ position using an explorer (Figure 2). If CEJ is located in gingival sulcus then it is not a case of APE. If CEJ is not located in the sulcus, a provisional diagnosis of APE can be done.
2. The second step is to do a crestal bone sounding. Crestal bone sounding (Figure 3A and 3B)-The area to be assessed is



anesthetized and probing depth is measured. Probe is pushed further to penetrate the gingival sulcus and CEJ and alveolar bone crest is detected. The distance between the base of the sulcus to CEJ and the alveolar bone crest is also recorded. However this approach can be quite difficult to identify CEJ in the case of APE because the buccal surface of gingiva is tightly attached to enamel surface with long junctional epithelium, which makes probing difficult and also APE is frequently related to buccal bone crest at or coronal to CEJ, which makes CEJ detection difficult<sup>[20]</sup>.

3. Third step is to locate mucogingival junction and measure attached gingiva width (Figure 4A and 4B). If the mucogingival junction is apical to alveolar bone crest then a diagnosis of type I is done. If the entire attached gingiva is located in the anatomic crown of the tooth then a diagnosis of type II is done<sup>[9]</sup>.
4. Fourth step is to do transgingival probing (Figure 5A and 5B) which helps to differentiate subtypes A and B (Flowchart – 1). If CEJ is detected first, a diagnosis of subtype A can be made but if alveolar bone is palpated first without CEJ detection then a diagnosis of subtype B is done<sup>[20]</sup>. Nonetheless, it is scarce to use sounding since it is rather hard to differentiate CEJ from alveolar bone crest subgingivally<sup>[22]</sup>.

### Radiographic analysis:

Intraoral periapical radiograph taken using paralleling angle technique can be done used to acquire details about CEJ and alveolar bone crest. Parallel profile radiography can be used to study the dentogingival unit<sup>[23]</sup>.

Radiographs can be used as a guide during surgery. To avoid radiographic magnification error, Zucchelli has compared both clinical and radiographic crown lengths. He also calculated the distance between CEJ & bone crest and gingival margin & bone crest. If the clinical and radiographic crown length has a difference of  $\geq 3$ , and then it can be diagnosed as APE. Clinical crown length is measured from occlusal or incisal edge to gingival margin and radiographic crown length is measured from occlusal or incisal edge to CEJ. If the alveolar bone crest is

found apical to CEJ radiographically, then it can be considered as type A. However, to differentiate subtypes A and B in IOPA is difficult<sup>[22]</sup>. Batista et al, has used CBCT for diagnosis and treatment of APE.

### Treatment

The foremost objective in the management of altered passive eruption is to obtain esthetic harmony. So as to achieve esthetic harmony especially in anterior segment following parameters should be considered for symmetry.

1. Gingival line – A line which is drawn from the cervical area of right cuspid to the cervical area of left cuspid (Figure 6). It runs parallel to occlusal and commissural line. Under an ideal circumstance, central incisor and canine should touch this line, lateral incisor should be approximately 1mm above this line.

2. Interpapillary line

3. Gingival zenith or height of gingival contour (Figure 7)

Gingival zenith should be as follows for,

Central incisor -distal third

Lateral incisor -central

Cuspid -distal third

4. Occlusal line – A line which is drawn across the incisal edges of cuspids. It ought to be parallel to interpapillary and commissural lines.

5. Commissural line – An imaginary line drawn through the commissures of lip<sup>[24]</sup>.

On reviewing the literature, the management of altered passive eruption is mainly surgical. It chiefly falls under two surgical procedures as advised by Garber and Salama namely gingivectomy and apically position flap and with osseous surgery if needed. In the case of type I subgroup A gingivectomy or gingivoplasty can be done with scalpel or electrosurgery or laser. Type 2 subgroup A should be treated with apically positioned flap and if there is an increased buccal bone thickness osteoplasty should be done. Type 1 subgroup B and type 2 subgroup B are treated with apically position flap and osseous resection<sup>[25]</sup>.

## Conclusion

APE is a mucogingival condition, where gingival margin fails to recede apical to the cervical convexity of tooth. It is eminent to consider APE in the differential diagnosis of gummy smile and short clinical crowns. The difficulty in the management of mystery like altered passive eruption can be subdued with a methodical diagnosis of clinical and radiographic parameters. Currently, two types and two subtypes of altered passive eruption are recognized based on bone and soft tissue relationship.

Therapeutic management of altered passive eruption is mainly surgical, which is in accordance with its type and subtype. Eventhough this review has described APE in detail, further studies are essential for a better understanding of etiology and new treatment modalities for the management of APE.

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### FIGURE LEGEND

Figure 1: Classification of altered passive eruption Figure 1A-Type IA, Figure 1B-Type IB, Figure 1C-Type IIA, Figure 1D-Type IIB [Courtesy – Robert Ullrich , Atlas of cosmetic and reconstructive periodontal surgery]

Figure 2: CEJ detection

Figure 3A and 3B: Crestal bone sounding

Figure 4A: Parts of gingiva , Figure 4B : Locate mucogingival junction and measure attached gingiva.

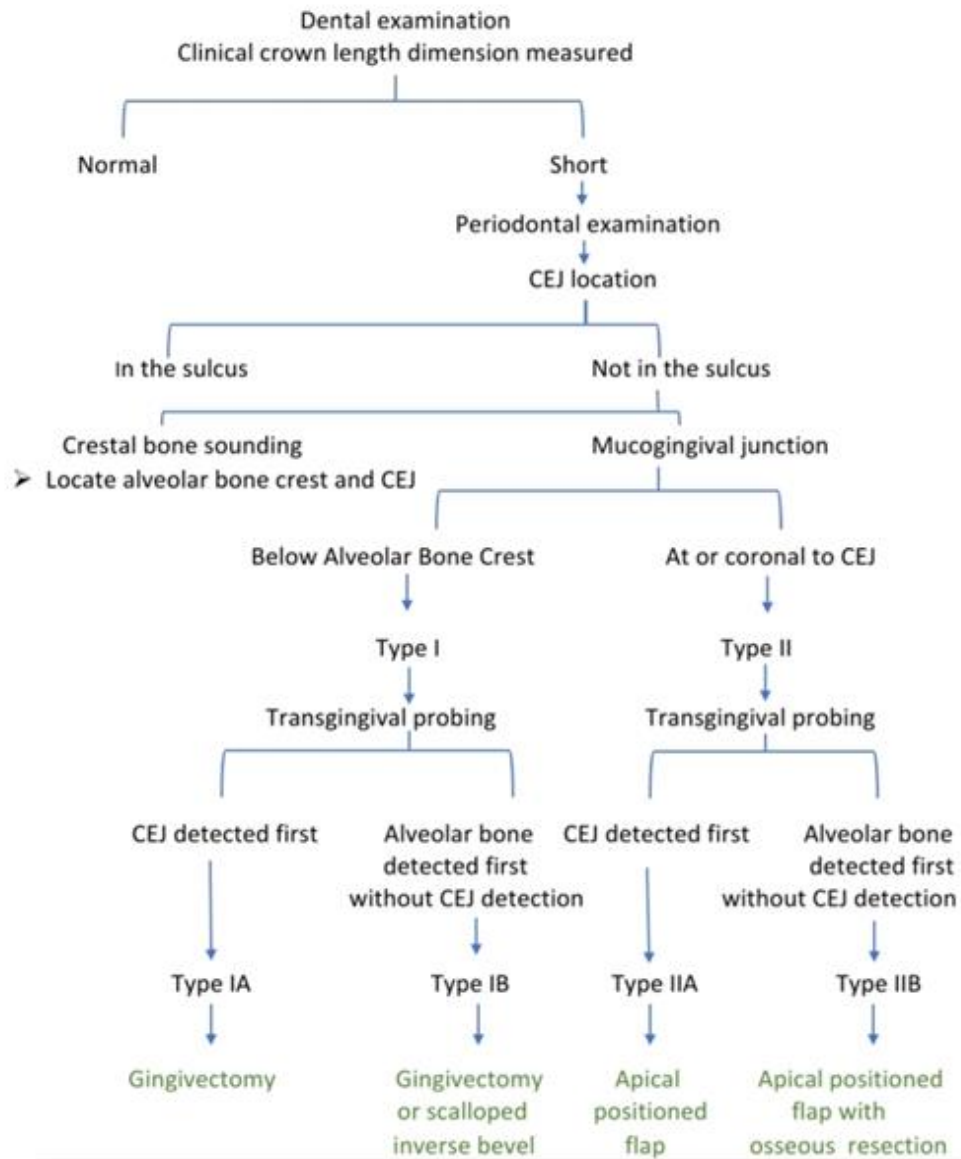
Figure 5A: Transgingival probing [Courtesy – Shalu Bathla, Textbook of Periodontics] and

5B : Transgingival probing

Figure 6: Gingival line

Figure 7: Gingival Zenith [Courtesy – Robert Ullrich, Atlas of cosmetic and reconstructive periodontal surgery]

Figure 8: Occlusal line [Courtesy – Robert Ullrich, Atlas of cosmetic and reconstructive periodontal surgery]



Flowchart 1  
Foot note:CEJ – Cementoenamele juncton



Figure 1:

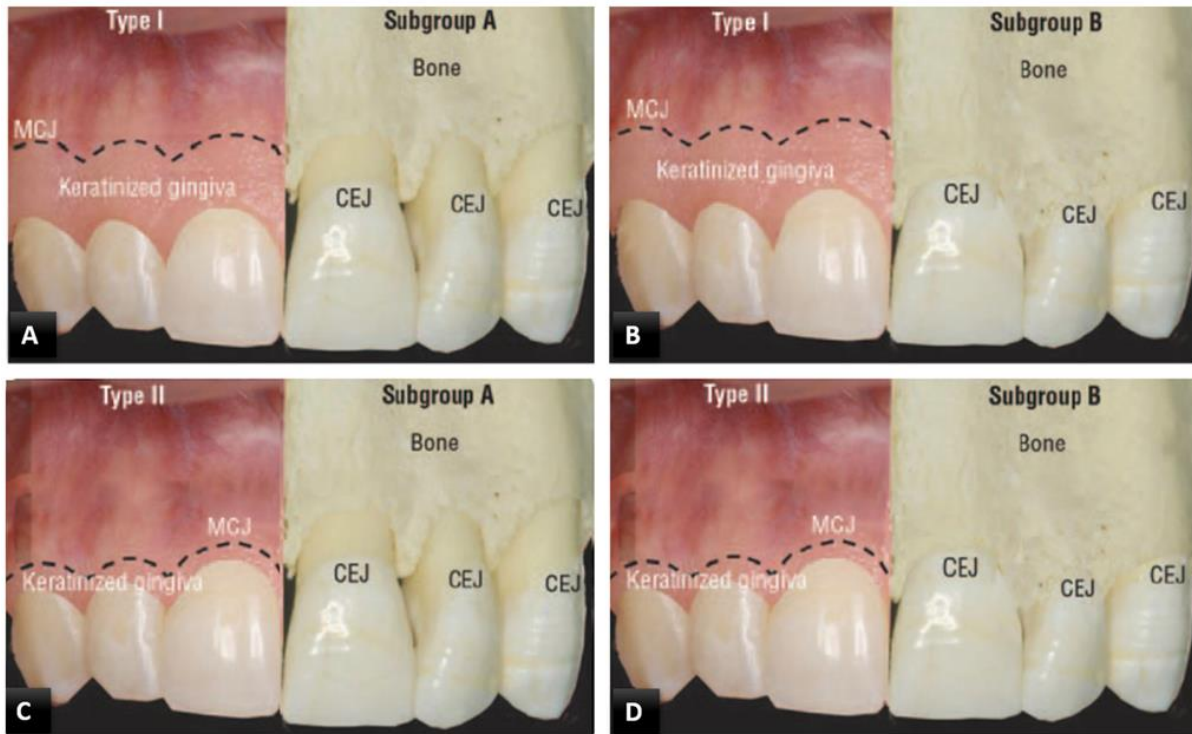


Figure 1: Classification of altered passive eruption  
Footnote : Figure 1A-Type IA, Figure 1B-Type IB, Figure 1C-Type IIA, Figure 1D-Type IIB  
CEJ – Cementoenamel Junction, MGJ – Mucogingival junction



Figure 2 : Detect Cementoenamel Junction

Figure 3A:

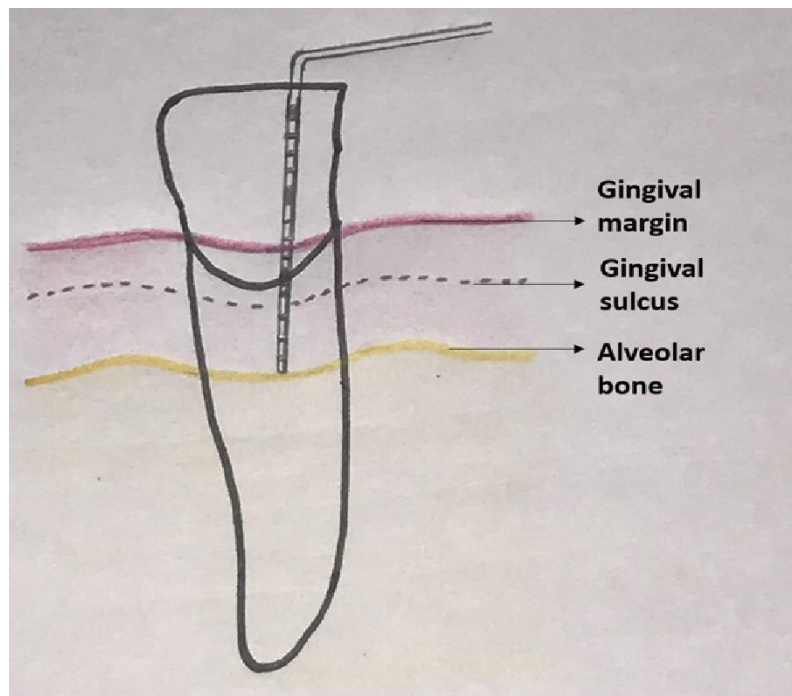


Figure 3A : Crestal bone sounding

Figure 3B:



Figure 3B : Crestal bone sounding

Figure 4A:

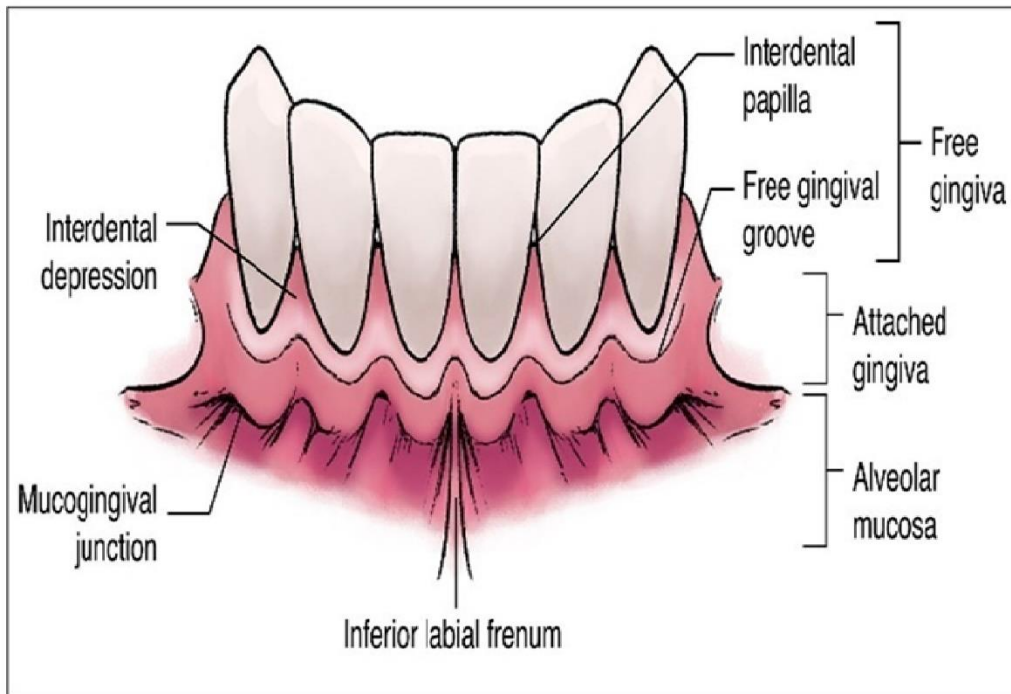


Figure 4A : Parts of gingiva

Figure 4B:

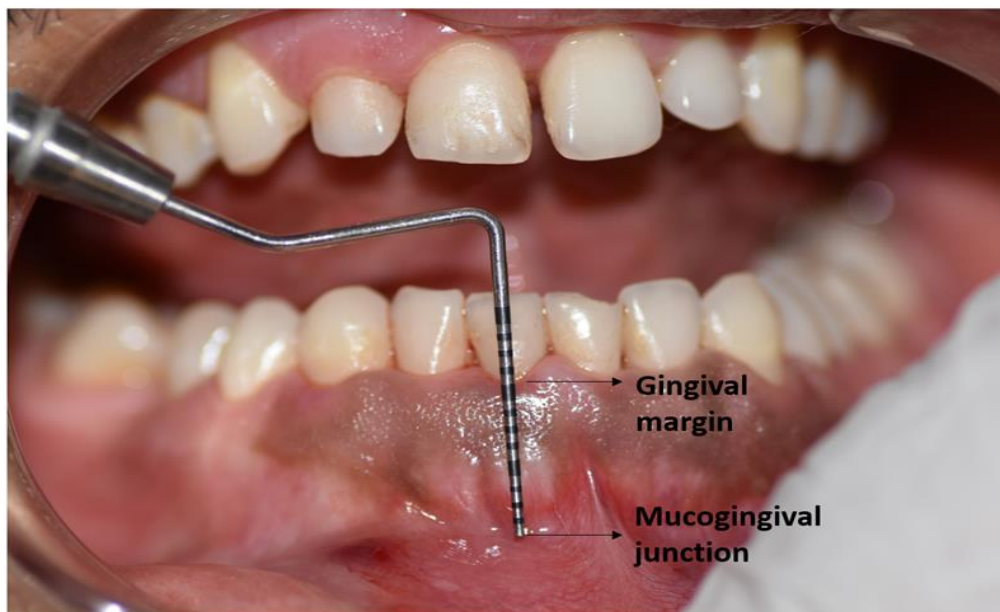


Figure 4B : Locate mucogingival junction and measure attached gingiva



Figure 5A:

Probe is directed horizontally into soft tissue until it strikes underlying bone

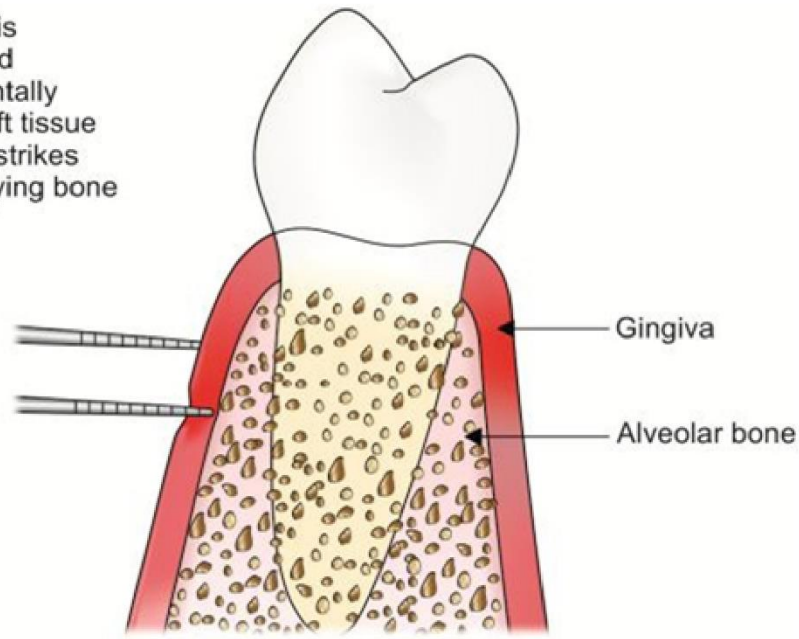


Figure 5A : Transgingival probing

Figure 5B:



Figure 5B : Transgingival probing

Figure 6:



Figure 6 : Gingival line

Figure 7:

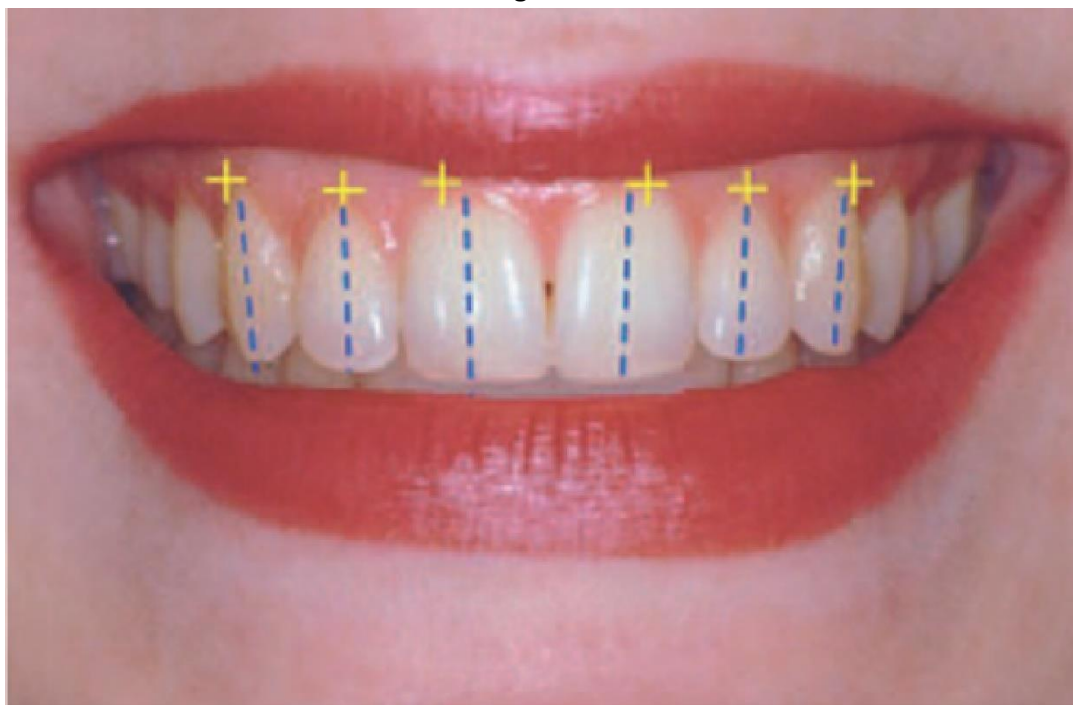


Figure 7 : Gingival Zenith