

## **Management of open gingival embrasures: A scope for prosthetic dentistry**

### **Abstract:**

A smile that is pleasing and beaming can be achieved by appropriate position of tooth, periodontal status of the tooth, type of prosthesis, as well as condition of the soft tissue. Any disharmony in these factors can lead to the formation of black triangles which are unesthetic. These unesthetic zones can be corrected by an interdisciplinary approach which includes orthodontic, prosthodontic, periodontic, endodontic branches. The treatment modality that is opted for a particular patient depends on the age of the patient, the biotype of gingiva, the form and condition of the radicular portion of the tooth as well as the interproximal space available. Surgical approach includes the recontouring, reconstructing, preserving of the interdental papilla. Surgical technique includes releasing, reflecting and stabilizing the interdental papilla. The non-surgical approach includes proper aligning of the maligned teeth by fixed orthodontic appliances thus decreasing the crest of bone and contact point distance. Endodontically the gingival black triangles can be treated by the use of composite resin in shades of pink to reproduce gingival contour. Open gingival embrasures can also be corrected with the help of ovate pontics that are easy to design and are more esthetic as compared to the conical pontic. To restore the scalloped architecture of the soft tissue, recontouring of the soft tissue surrounding the restoration followed by placement of ovate pontic can be done which is supported by the adjacent teeth. Open gingival embrasure can be masked with the use of silicones or removable acrylics as a gingival veneer. This type of prosthesis is also helpful in patients who have exposed radicular portion of the tooth because of excessive loss of alveolar bone. This review article discusses about the various etiologic factors accounting to the formation of open gingival embrasures, along with its classification and the various treatment modalities that are taken into consideration.

**Keywords:** open gingival embrasures, gingival black triangles, ovate pontic, gingival veneer, acrylic gingival veneer.

### **Introduction:**

Open gingival embrasure creates an unesthetic zone in the oral cavity. They are unacceptable to the patients with high vanity index. These unesthetic zones can be eliminated by surgical as well as non-surgical methods which includes recontouring, preserving or reconstructing interdental papilla, gingival veneers. Open gingival embrasures also termed as black triangles are the spaces that exist at the cervical level of the tooth due to the loss or deficiency of interdental papilla below the contact point. The reason that accounts to the formation of black triangles are as follows:

1. Abnormal shape of the tooth
2. Periodontally compromised tooth
3. Improper oral hygiene habits
4. Traumatic brushing technique
5. Over contoured restorations

Improper, ovate pontics, tissue volumizing, restoring and reshaping tooth morphology, orthodontic movements, using pink colored restorative material to mask black triangles and maintaining proper oral hygiene.

Generally open gingival embrasures are seen after placing crown or bridge in the front teeth and are of esthetic concern. Hence thorough examination of the prosthesis as well as soft tissue should be carried out.

Black triangles may cause problem in phonetics and can lead to food accumulation and plaque formation around the restoration. This review article discusses about the etiologic factors of open gingival embrasures along with its classification and various treatment modalities considered.

#### **Review of literature:**

According to a study performed by Kokich et al, black triangles more than 3mm in dimension are considered unesthetic by the dentist as well as the patient<sup>1</sup>. According to a study done by Kokich and Kurth almost 337 patients out of 4500 patients showed presence of gingival black triangles between the central incisors of upper jaw following the completion of treatment with orthodontics. 1/3<sup>rd</sup> of the population showed presence of incompleteness of interdental papilla between maxillary central incisors<sup>2</sup>. Adolescents making up to 15% of the general population who have undergone a fixed appliance treatment for teeth that are crowded in the anterior segment of the jaw showed presence of gingival black triangles after the treatment<sup>3</sup>. Treatment modalities to correct gingival black triangles have been inconsistent among the dentists due to poor blood supply to the interdental papilla which make them prone to gingival recession<sup>4-5</sup>. Thus, the outcome of the treatment is unpredictable. According to a study done by Blatz et al in 1999 reconstruction of interdental papilla is an effective technique for managing open gingival embrasures in patients who are compliant and have esthetic concerns<sup>6</sup>.

#### **Etiology of open gingival embrasures:**

Etiology of gingival black triangles is multifactorial<sup>7-8</sup>. Factors that cause alterations in the papilla dimensions are as follows:

1. Abnormal coronal tooth structure
2. Incorrect restoration/prosthesis
3. Roots that have become divergent after completion of orthodontic treatment
4. Biotype of gingiva
5. Age of patient
6. Periodontal condition of the oral cavity
7. Spacing present in the teeth
8. Interproximal space available between the two adjacent teeth
9. Distance between the crestal bone and the interproximal contact position

#### **Abnormal coronal tooth structure:**

Patients with short and slender tooth are more prone to get gingival black triangles as compared to the patients with wider coronal structure of tooth. As the mesiodistal dimension of the coronal structure of tooth is less, more space is available for interdental papilla leading to formation of black triangles.

#### **Incorrect restoration/prosthesis:**

Over contoured restoration creates a potential space for gingival black triangles.

### **Roots that have become divergent after completion of orthodontic treatment:**

According to a study performed by Burke et al<sup>3</sup> after reviewing 500 orthodontic records, he stated that there were increased instances of gingival black triangles after completion of orthodontic treatment as during the orthodontic movements of crowding in anterior teeth there is separation of roots which then separates the interdental papilla.

### **Biotype of gingiva:**

Biotype of gingiva was classified as thin and scalloped and thick and flat by Siebert and Lindhe<sup>9</sup>. Gingival biotype was further classified into 3 categories namely, flat, scalloped and pronounced scalloped by Becker et al<sup>10</sup>. Reaction to trauma or inflammation in the form of recession is more pronounced in scalloped thin tissue as compared to flat and thick tissue which reacts in deeper periodontal pockets<sup>11</sup>. When the blood supply is restricted at the tip of the papilla, healing can be interrupted which results in unpredictable repair. On the contrary as there is more vascular supply in thicker tissues, they react more favourably to tissue inflammation or trauma<sup>12</sup>. Papilla fullness can be achieved more easily in flat gingival biotype as considered to the scalloped gingival biotype. According to Ahmed<sup>13</sup> scalloped and thin gingival biotypes acts as a predisposing factor for formation of gingival black triangles. According to a study done by Chow et al<sup>12</sup> thicker buccal palatal tissues in sites with complete papilla.

### **Age of patient:**

Patients who are periodontally compromised are have diseases like osteoporosis are at a high risk of getting gingival black triangles. As the age progresses the oral epithelium gets thinner and degree of keratinization is also reduced resulting in decreased papillary height. Vandana and Savitha<sup>14</sup> stated that as the age progress, the oral epithelium starts thinning.

### **Periodontal condition of the oral cavity:**

Gingivitis and periodontitis acts as a contributory factor in formation of open gingival embrasures.

### **Interproximal space available betwixt the two adjacent teeth:**

The size of the interdental width can lead to the presence or absence of gingival black triangles. Greater is the width of the interproximal space greater will be the vascular supply to the tip of interdental papilla which helps in maintaining a full papilla length; but if the width in interdental region is further increased in can possibly result in open gingival embrasures due to stretching of papilla<sup>15</sup>. According to Tall<sup>16</sup> and Heins and Wieder<sup>17</sup> the integrity status of the interdental papilla is maintained by the lateral bone distance between the roots of two adjacent teeth. Tall stated that to facilitate the foundation of papilla minimum 3mm of inter dental distance is required. According to a study done by Martegani<sup>18</sup> et al when the distance between the two roots is more than 2.4 mm the occurrence of full papillae in front teeth of the upper jaw becomes less likely. This is independent of distance between the point of contacts and bone level. The presence of open gingival embrasures is mostly affected by the interdental height than by width<sup>19</sup>.

### **Distance between the crest of the bone to the interproximal contact position:**

According to Tarnow<sup>20</sup> there are 98% chances of presence of full papilla if the distance between the bone crest and the contact point is 5mm or less.

### **Classification of gingival black triangles/ open gingival embrasures:**

According to Nordland and Tarnow<sup>21</sup> which is on the basis of anatomical landmarks:

- The contact points interdentally
- Cemento-enamel junction at the facio apical extent

Extent of the coronal interproximal region of the cemento enamel junction

On the basis of above classification, the interdental papilla was labelled as:

- Typical- when the interdental papilla top most portion extends to interdental contact points.
- Grade 1- when the top most portion of the papilla is present betwixt the crown portion of interproximal cemento enamel junction and IDCP
- Grade 2-when the top most portion of the interdental papilla is present apical to CEJ rather than apical to apical extent of facial CEJ
- Grade 3- when the top most portion of the interdental papilla is at the same level or apical to facial to cemento enamel junction

#### **Management / treatment modalities of open gingival embrasures:**

**Surgical approach** includes the recontouring, reconstructing, preserving of the interdental papilla. Recontouring can be done in cases of enlargement of gingiva due to drugs like Amlodipine acting as a causative agent<sup>22</sup>. Gingivectomy can also be done.

It is also helpful in oral lesions like peripheral giant cell granuloma or a fibroma due to chronic stimuli which can be managed by excision under LA<sup>23</sup>. Surgical technique includes releasing, reflecting and stabilizing the interdental papilla (Seibert and Lindhe<sup>9</sup>).

**Maintaining proper oral hygiene** by adapting to modified bass technique of brushing, use of interdental aids, preventing traumatic brushing, use of chemical plaque control measures like fluoridated mouthwash.

#### **Restorative approach:**

Gingival black triangles can be masked by the use of composite resin in shades of pink to reproduce gingival contour. Along with this pink colored porcelain can also be used. It is advisable to use dark colored tooth shades as the optical properties of the material is limited. Stratified layering technique considered as esthetic resin should be used<sup>24</sup>.

#### **Orthodontic approach:**

Orthodontic tooth movements can be considered as an aid in reducing the gingival black triangles. In cases of spaced dentition closing of space, interdental contact points decrease the BC CP distance. Lesser is the distance between the alveolar bone crest and interdental contact point lesser will be the chances of formation of gingival black triangles. Along with the correction of the mal aligned teeth, proper gingival contour can also be established by conventional orthodontic treatment. With the help of silver modifies brackets, bacteria will adhere less thus improving the periodontal status<sup>25</sup>.

#### **Prosthetic considerations:**

Generally, contact point is located coronal to the normal position when the incisal edge is wider as compared to the cervical third in cases of anterior teeth mainly incisors. In such cases the dimensions of interdental papilla are increased cervically in the form of pyramid which results in incomplete closure of interdental space resulting in gingival black triangles. This can also be seen in improperly contoured restorations. The dimensions and location of the contact points can be altered with the help of prosthetic therapy.

### **1. Ovate pontics<sup>26</sup>:**

Ovate pontic is considered as the most esthetic prosthesis generally given in the anterior teeth which are of prime esthetic concern. To restore the scalloped architecture of the soft tissue, recontouring of the soft tissue surrounding the restoration followed by placement of ovate pontic can be done which is supported by the adjacent teeth. The distance betwixt the crest of ridge and contact point is 7mm when an ovate pontic is used. The ovate pontic provides emergence profile and assists in regenerating the interdental papilla. Plaque formation can be easily controlled in these types of pontics.

Proper implant positioning can also be considered as a treatment modality for open gingival embrasures. Healing following the implant placement with 12 weeks with maturation of soft connective tissue<sup>27</sup>.

### **2. Contour of the restoration:**

The contour of the restoration plays an important part in the available papillary space. Under contoured restoration will decrease the available space whereas over contoured restoration will create gingival black triangles and may lead to food accumulation and plaque formation. This factor influences the morphologic and biologic aspects of interdental papilla as well as the contour of the gingiva. Elimination of gingival black triangles can be achieved by establishing broad contact points which are in correct position to the alveolar bone crest. A non- invasive, inexpensive technique for hiding the gingival black triangles is the use of adhesive restoration directly over the concerned site.

### **3. Gingival veneers:**

Open gingival embrasure can be masked with the use of silicones or removable acrylics as a gingival veneer. This type of prosthesis is also helpful in patients who have exposed radicular portion of the tooth because of excessive loss of alveolar bone. Patients who have severe periodontitis as well as patients with high smile line can be given gingival veneer to hide black triangles. Gingival veneers help to overcome phonetic disability as well as prevents food impaction. Retention can be achieved by using gaps in the interproximal spaces by incorporation of the attachments that have slots or groove for retention in the prosthesis.

Other terminologies used are flange/rim prosthesis, gingival veneer prosthesis, non-fixed gingival veneer, acrylic gingival veneer, acrylic veneer for periodontal tissues, non -fixed extension of gingiva and gingival mask<sup>28</sup>.

Indications of gingival veneers are as follows:

1. Improve esthetics in anterior region after completion of periodontal therapy
2. Loss of periodontal attachments
3. In cases of implant supported prosthesis for gingival augmentation
4. To allow healing of soft tissue after initial periodontal therapy

Contraindications of gingival veneers are as follows:

1. Poor oral hygiene status of patient
2. Presence of extensive plaque in oral cavity
3. Non-compliant patients
4. In cases of chronic smokers
5. Patients with high caries index

### **Tissue volumizing:**

In cases of facial rejuvenation, hyaluronan can be used as a soft tissue volumizer<sup>29</sup>. Other volumizers frequently used are calcium hydroxyapatite, poly-L-lactic acid, liquid silicone and polymethylmethacrylate. According to a study performed by Becker et al<sup>30</sup>, gingival black triangles were significantly reduced or eliminated in the areas adjacent to dental implants and teeth in the esthetic zones by the use of hyaluronic acid. According to his study, in a period of 3 weeks 14 patients were successfully cured by injection of hyaluronan 2-4 millimeters apical to the top most portion of the interdental papilla. Even after 25 months no relapse was seen.

### **Conclusion:**

Open gingival embrasures are unesthetic and result in reduced patient acceptance of prosthesis even though it has good retention and functions well. Though many treatment modalities have been proposed, long term stability of the prosthesis is not yet confirmed. This review article discusses about the etiologic factors, classification and various treatment modalities of gingival black triangles. This review article focuses on the use of gingival veneers and ovate pontic to treat open gingival embrasure which are easy to fabricate and are less expensive. These offer predictable and satisfactory results in management of open gingival embrasures.

### **COMPETING INTERESTS DISCLAIMER:**

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

### **Bibliography:**

1. Kokich V, Kiyak A, Shapiro P. Comparing the perception of dentists and lay people to altered dental aesthetics. *J Esthet Dent* 2005; 1: 311–324.
2. Kurt J, Kokich V G. Open gingival embrasures after orthodontic treatment in adults: prevalence and aetiology. *Am J Orthod Dentofacial Orthop* 2001; 120: 116–123.
3. 2. Burke S, Burch J, Tetz J. Incidence and size of pretreatment overlap and post-treatment gingival embrasure space between maxillary central incisors. *Am J Orthod Dentofacial Orthop* 1994; 105: 506–511.
4. Wu Y J, Tu Y K, Huang S M, Chang C P. The influence of the distance from the contact point to the crest of bone on the presence of the interproximal dental papilla. *Chang Gung Med J* 2003; 26: 822–828. 10.
5. Sharma A A, Park J H. Esthetic considerations in interdental papilla: remediation and regeneration. *J Esthetic Restor Dent* 2010; 22: 18–28.
6. Blatz MB, Hurzeler MB, Strub JR. Reconstruction of the lost interproximal papilla-Presentation of Surgical and non- surgical approaches. *Int J Periodontics Restorative Dent* 1999;19:395-406.
7. Takei H, Yamada H, Hau T. Maxillary anterior aesthetics. Preservation of the inter-dental papillae. *Dent Clin North Am* 1989; 33: 263–273.

8. Chen M C, Liao Y F, Chan C P, Ku Y C, Pan W L, Tu Y K. Factors influencing the presence of interproximal dental papillae between maxillary anterior teeth. *J Periodontol* 2010; 81: 318–324.
9. Seibert J, Lindhe J. *Esthetics and periodontal therapy: textbook of clinical periodontology*. 2nd ed. Copenhagen: Munksgaard, 1989.
10. Becker W, Ochsenbein C, Tibbetts L, Becker B E. Alveolar bone anatomic profiles as measured from dry skulls. Clinical ramifications. *J Clin Periodontol* 1997; 24: 727–731.
11. Kao R T, Fagan M C, Conte G J. Thick vs. thin gingival biotypes: A key determinant in treatment planning for dental implants. *J Calif Dent Assoc* 2008; 36: 193–198.
12. Chow Y C, Eber R M, Tsao Y P, Shotwell J L, Wang H L. Factors associated with the appearance of gingival papillae. *J Clin Periodontol* 2010; 37: 719–727
13. Ahmed I. Anterior dental aesthetics: gingival perspective. *Br Dent J* 2005; 199: 195–202.
14. Vanadana K L, Savitha B. Thickness of gingival in association with age, gender and dental arch location. *J Clin Periodontol* 2005; 32: 828–830.
15. Cho H S, Jang H S, Kim D K et al. The effect of interproximal distance between roots on the existence of interdental papillae according to the distance from the contact point to the alveolar crest. *J Periodontol* 2006; 77: 1651–1657
16. Tal H. Relationship between the interproximal distance of roots and the prevalence of bony pockets. *J Periodontol* 1984; 55: 604–607.
17. Heins P J, Wieder S M. A histologic study of the width and nature of inter-radicular spaces in human adult pre-molars and molars. *J Dent Res* 1986; 65: 948–951.
18. Martegani P, Silvestri M, Mascarello F et al. Morphometric study of the interproximal unit in the esthetic region to correlate anatomic variables affecting the aspect of soft tissue embrasure space. *J Periodontol* 2007; 12: 2260–2265.
19. Chang L C. The association between embrasure morphology and central papilla recession. *J Clin Periodontol* 2007; 34: 432–436
20. Tarnow D P, Magner A W, Fletcher P. The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. *J Periodontol* 1992; 63: 995–996
21. Nordland W P, Tarnow DP. A classification system for loss of papillary height. *J Periodontol* 1998; 69: 1124–1126.
22. Kothari, L., Bajaj, P., Jaiswal, P., Agrawal, D., 2020. Prevalence of Amlodipine Induced Gingival Enlargement - A Hospital Based Study. *JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS* 9, 1012-1014. <http://doi.org/10.14260/jemds/2020/217>
23. Agrawal, D.R., Jaiswal, P., Masurkar, D., 2020. Gingival Fibroma: Report of two cases with different treatment modalities. *MEDICAL SCIENCE* 24, 2604-2609
24. Jaiswal, A.S., Nikhade, P. P., Chandak, M., Khatod, S., Rathi, C., Jaiswal, J., 2020. Colour Stability of Composite- A Review. *JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS* 9, 1928-1934. <http://doi.org/10.14260/jemds/2020/419>
25. Gilani, R., Bajaj, P., Mankar, N., Vishnani, R., Daigavane, P., Niranjane, P., 2020. Photo catalytic Silver Modified Orthodontic Brackets- An Innovative Method for Prevention of White Spot Lesions. *JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS* 9, 2787-2790.
26. Becker W, Ochsenbein C, Tibbetts L, Becker B E. Alveolar bone anatomic profiles as measured from dry skulls. Clinical ramifications. *J Clin Periodontol* 1997; 24: 727–731.
27. Sethiya, K.R., Dhadse, P., V., Healing after Periodontal Surgery-A Review. *JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS* 9, 3753-3759. <http://doi.org/10.14260/jemds/2020/824>

28. Alani A, Maglad A, Nohl F. The prosthetic management of gingival aesthetics. *Br Dent J* 2011; 210: 63–69.
29. Rohrich Rod J, Ghavami A, Crosby M A. The role of hyaluronic acid fillers (restylane) in facial cosmetic surgery: review and technical consideration. *Plast Reconstr Surg* 2007; 120: 41S–54S.
30. Becker W, Gabitov I, Stepanov M, Kois J, Smidt A, Becker B. Minimally invasive treatment for papillae deficiencies in the aesthetic zone: a pilot study. *Clin Implant Dent Relat Res* 2010; 12: 1–8.

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