

Original Article

Prevalence of Black Triangle Amongst Young Adults: A Cross-sectional Study

Monika Singh¹, Vivek Kumar Bains², Rajesh Jhingran³, Ruchi Srivastava², Rohit Madan²

ABSTRACT

Objective: The loss of papilla especially in the anterior region can lead to esthetic deformities or a “black triangle.” The objective of this study was to assess the prevalence of black triangle amongst young adults in each interdental papilla of maxillary anterior region.

Material and Method: A total of 100 subjects were enrolled for the study. Amongst these 7 interdental papillae of 100 subjects were evaluated (total 700 papilla). Participants with age between 22 and 26 years were included in this study. Loss of interdental papillae classified and calculated according to the Papilla Presence Index 1, 2, 3, and 4 (PPI 1, PPI 2, PPI 3 and PPI 4). All the interdental papilla between the maxillary anteriors were viewed clinically with help of mouth mirror and classified according to Cardaropoli’s classification. The presence of papilla and degree of loss of papilla was measured.

Result: The results of this study showed that there was a statistically significant difference in prevalence of PPI 2 at different locations, mainly governed by movement from lateral to central location ($p < 0.001$). There was no gender wise difference in black triangle PPI 2 for the given age group.

Conclusion: Numerous techniques are available for the esthetic recovery of the gingival tissues. Maintenance of these tissues with adequate surgical and prosthetic techniques involves a multidisciplinary approach in aesthetic reconstructive dentistry.

Keywords: Black triangle; gingival biotype; interdental papilla; pink esthetics

INTRODUCTION

Aesthetic has been studied from different perspective to obtain an esthetically pleasing smile; many components should be in harmony and symmetry. These include gingival display, lips contour and outline, and tooth shape, color, size, and position.^[1] Consequently, open gingival embrasures or black triangles are unaesthetic and creates functional problems that are noticeably unaesthetic and negatively affect smile. Open

gingival embrasures “black triangles” are defined as the embrasures cervical to the interproximal contact that is not filled by gingival tissues (Fig. 1). Open gingival embrasures contribute to retention of food debris and can adversely affect the health of the periodontium.^[2] The presence or absence of the interproximal papilla is of great concern to periodontists, restorative dentists, and to the patients. The loss of papilla can lead to cosmetic deformities (so-called “black triangle

¹Director, Dwarka Metro Hills Hospital, Varanasi,
²Department of Periodontology, Saraswati Dental College,
³Private Practitioner, Aditya Dental Clinic, Lucknow (UP), India.

Address for Correspondence:

Dr. Ruchi Srivastava Department of Periodontology,
Saraswati Dental College, Tiwari Ganj, Faizabad Road,
Lucknow (UP), India. drruchi117@gmail.com,
+91 9793889594

Date of Submission: August 20, 2018

Review Completed: September 15, 2018

Date of Acceptance: September 16, 2018



Figure 1: Black triangle

disease”), phonetic problems (space allows passage for the air or saliva), and lateral food impaction.^[3,4] Black triangles are rated as third most disliked aesthetic problem after caries and crown margins.^[5] Often the loss of papilla is a consequence of periodontal disease because of gingival inflammation, attachment loss and interproximal bone height resorption. There are several risk factors leading to the development of open gingival embrasures. These factors include aging, periodontal disease, loss of height of the alveolar bone relative to the interproximal contact, length of embrasure area, root angulations, interproximal contact position, and triangular-shaped crowns.^[6,7] Other factors are tooth brush trauma, plaque, thin biotype of gingiva, stretching of gingival fibers.^[8] Morphologically, the papillae had been described first in 1959 by Cohen.^[9] Topographically, the gingiva has been divided into three classic categories: free, attached and interdental gingiva. Interdentally, the gingiva that occupies the space coronal to the alveolar crest is known as interdental gingiva. In the incisor area, it has a pyramidal shape with tip located immediately beneath the contact point, it is narrower and it is referred to as a dental papilla. In the posterior region, it is broader and has formerly described as having a concave col or bridge shape.^[9] The col is a valley like depression which connects the buccal and lingual papillae and takes the form of the inter-proximal contact. The borders of dental papilla are superiorly the base of the contact point between two adjoining teeth, inferiorly the alveolar crest and lateral borders delineated by the concave mesial and distal marginal gingiva of adjacent teeth.^[10,11] Black triangles are best managed with a team work involving restorative, orthodontic and periodontal parts (Fig. 2). The purpose of this study is to evaluate the presence and degree of black triangle amongst young adults in each interdental papilla of maxillary anterior region.

MATERIALS & METHODS

The present cross-sectional study was conducted in Department of Periodontology. The Institutional Human Ethics Committee approved the design of the study. Based on initial screening, subjects meeting the inclusion and exclusion criteria were recruited among the

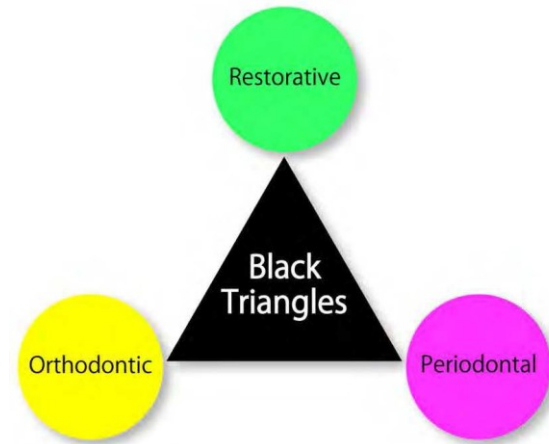


Figure 2: Interdisciplinary approach to overcome the black triangle

patient pool visiting the department. All the participants were provided with the information sheet and written informed consent was obtained. A total of 100 subjects were enrolled for the study. Amongst these 7 interdental papillae of 100 subjects were evaluated (total 700 papilla). Participants with age between 22 and 26 years were included in this study.

Inclusion criteria:

1. Periodontally healthy individuals with good oral hygiene.
2. Maxillary anterior teeth present (from canine to canine and first premolar in both the quadrants).
3. Both male and female subjects between age group of 20 and 28 years.
4. Patient not undergone any periodontal surgery in the past 1 year.

Exclusion criteria

1. Periodontitis patients.
2. History of orthodontic treatment.
3. Prosthetic or restorative treatment in the selected teeth.
4. Crowding and malalignment of teeth.
5. Spacing between the maxillary anterior teeth
6. Patients who are medically unfit to participate in the study.

Loss of interdental papillae classified according to the Cardaropoli.^[12]

Papilla Presence Index (PPI-1): When the papilla is completely present and coronally

extends to the contact point and at the same level as the adjacent papillae.

Papilla Presence Index (PPI-2): Papilla is no longer completely present and lies apical to the contact point and not at the same level as the adjacent papillae, but the interdental cementoenamel junction (iCEJ) is still not visible.

Papilla Presence Index (PPI-3): Papilla is moved more apical and the iCEJ becomes visible.

Papilla Presence Index (PPI-4): Papilla lies apical to both the iCEJ and buccal CEJ.

All the interdental papilla between the maxillary anteriors viewed clinically with help of mouth mirror and classified according to Cardaropoli's classification and measured its presence and degree of loss of papilla (Fig. 3).



Figure 3: Different types of Interdental papilla clinically measured between the maxillary anteriors

STATISTICAL ANALYSIS

SPSS package version 15.0 was used to analyze the data. The value of continuous variables was expressed as \pm standard deviation. Chi-square test and Friedman's test were applied for the purpose of comparison of data. The confidence level was kept at 95% and a p value <0.05 was proposed to show a significant association.

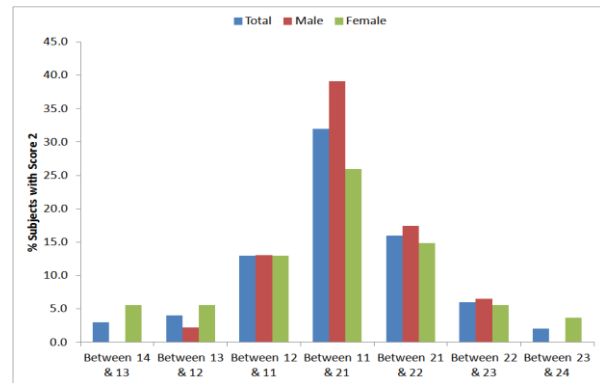
RESULTS

The study was attempted to evaluate the prevalence of loss of papilla in young adults in cross-sectional study design. A total of 100 patients completed the study. 700 papillae were evaluated for the loss of interdental papillae.

Table 1: Total number of patients evaluated showing PPI

Between tooth number	Total patients (n=100)		Total Male patients (n=46)		Total Female patients (n=54)	
	PP1	PP2	PP1	PP2	PP1	PP2
14 & 13	97	3	46	-	51	3
13 & 12	96	4	45	1	51	3
12 & 11	87	13	40	6	47	7
11 & 21	68	32	28	18	40	14
21 & 22	84	16	38	8	46	8
22 & 23	94	6	43	3	51	3
23 & 24	98	2	46	-	52	2
Total papilla examined	624	76	286	36	338	40
	700		322		278	

Graph 1 : Gender wise comparison of number of subjects with PPI 2



Graph 2 : Comparison of number of PPI-2's in an individual

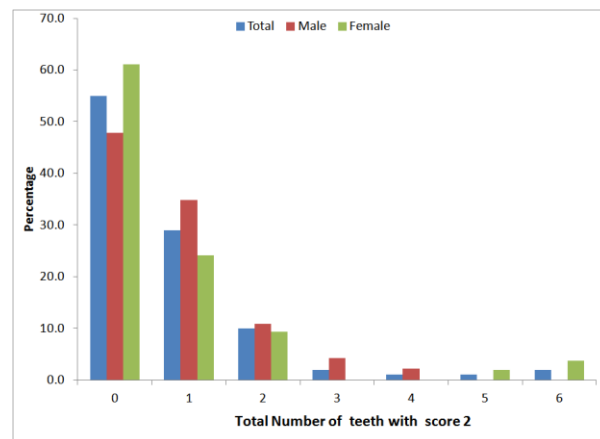


Table 2: Gender-wise Black Triangle PPI.

Site Between	Total (n=100)		Males (n=46)		Females (n=54)		Statistical significance	
	PPI 1	PPI 2	PPI 1	PPI 2	PPI 1	PPI 2	χ^2	P
14 & 13	97	3	46	0	51	3	2.635	0.105
13 & 12	96	4	45	1	51	3	0.740	0.390
12 & 11	87	13	40	6	47	7	0.000	0.990
11 & 21	68	32	28	18	40	14	1.990	0.158
21 & 22	84	16	38	8	46	8	0.123	0.726
22 & 23	94	6	43	3	51	3	0.041	0.839
23 & 24	98	2	46	0	52	2	1.738	0.187
Among different locations (Friedman test)	$\chi^2=87.145$; $p<0.001$		$\chi^2=57.429$; $p<0.001$		$\chi^2=31.200$; $p<0.001$			

Table 1 shows the total number of patients evaluated with their papillae presence index 1,2,3. Total 700 papillae evaluated out of which papillae with PPI 1, 2, 3 were 624, 76, 0 respectively. None of the patients who were evaluated having PPI 3. Majority of subjects irrespective of gender had PPI 1. Prevalence of PPI 2 increased from lateral to central incisors. At central incisors, prevalence of PPI 2 was maximum (Table 2). Statistically, there was a significant difference in prevalence of PPI 2 at different locations, mainly governed by movement from lateral to central location ($p<0.001$).

Gender wise the difference in black triangle PPIs at different locations was not significant statistically (Graph 1). Majority of subjects did not have any teeth with black triangle PPI 2 ($n=55$; 55%). Number of PPI 2 black triangles ranged from 0 to 6 with a mean value of 0.76 ± 1.20 . In both males and females, majority did not have any black triangle PPI 2 or had only 1 tooth with black triangle PPI 2. Statistically, this difference was not significant (Table 3, Graph 2). Therefore, black triangle PPI 2 is observed in almost half the subjects. There was no gender wise difference in black triangle PPI 2 for the given age group.

Table 3: Comparison of number of PPI-2's in an individual

Number of teeth with PPI 2's	Total (n=100)		Males (n=46)		Females (n=54)	
	N	%	N	%	N	%
0	55	55	22	47.8	33	61.1
1	29	29	16	34.8	13	24.1
2	10	10	5	10.9	5	9.3
3	2	2	2	4.3	0	0
4	1	1	1	2.2	0	0
5	1	1	0	0	1	1.9
6	2	2	0	0	2	3.7
Mean No. of teeth with PPI 2±SD	0.76 ± 1.20		0.78 ± 0.96		0.74 ± 1.38	

$\chi^2=7.921$ (df=6); $p=0.244$

DISCUSSION

The primary objective of the study was to evaluate how much is the prevalence of loss of papillae in young adult as loss papillae or open gingival embrasure gives unaesthetic appearance and creates a functional problem. Black triangle leads to retention of food debris and can

negatively affect the healthy periodontium. In this study we found that PPI 2 that is the presence of black triangle was more prevalent and increasing from lateral to central incisor and its prevalence was maximum between central incisors. Significant difference was observed at different location with PPI 2 ($p < 0.001$).

Kotsakis *et al.*^[13] evaluated the presence of loss of interdental papillae and its association with smile line and observed that the high prevalence of midline papillary recession in the maxilla found in Caucasian population. Papillary recession was found in 46.4% of study participants ($n = 211$), while the prevalence of visible recession among maxillary midline papilla during maximum smile was 38.4%, which was statistically significantly less than that of patients diagnosed intraorally with loss of papillary height ($P < 0.001$).

There are number of factors affecting the presence or absence of the papilla. They can be availability of underlying osseous support. Ochsenbein described the term “positive architecture” which refers to the osseous crest follows the shape of the cemento-enamel junctions, and the position of the interproximal bone is more coronal than the radicular bone.^[14] The more pronounced gingival scallop had a higher level of the interdental bone when compared with a flatter gingival scallop (4.1 mm vs. 2.1 mm). Also when the distance from the contact point to the alveolar bone was less or equal to 5 mm, the papilla was present in 98% of the times, while at 6 mm it dropped to 56% and at 7 mm it was only present 27% of the times. Tal studied the interproximal distance of roots and the prevalence of infrabony defects. The author reported that only when the distance between roots was ≥ 3.1 mm, two separate infrabony defects were noted.^[15] This implies that a minimal of 3 mm interdental distance may be needed in maintaining papillae. The number of papillae that filled the interproximal space decreased with the increasing distance from the contact point to the alveolar crest and interproximal distance of the roots. Another factor is periodontal biotype, the morphologies of interdental papilla and the osseous architecture can be categorized in to thin and thick periodontal biotype. The thin periodontal biotype are friable, escalating the risk

of recession following crown preparation and periodontal or implant surgery. Due to the fragility of the thin tissue, delicate management is essential for avoiding recession and hence visibility of subgingivally placed crown margins at the restoration/tooth interface. Thick biotype is better than thin biotype.^[16] Thick biotype is fibrotic and resilient, making it resistant to surgical procedures with a tendency for pocket formation (as opposed to recession). While the interdental gingival tissue possesses biological tissue memory, rebound of the gingival tissue is more likely than thin. Therefore, a thick biotype is more conducive for implant placement, resulting in favorable aesthetic outcomes.

The subjects were periodontally healthy in our study with no mucogingival problems. The only factor which was causing the presence of black triangle with PPI 2 was the morphology of tooth. Out of 100 subjects 53 subjects were having interproximal contact position more incisally & 47 subjects were having triangular shaped crown. Presence of black triangle at young age group indicates that it would result in severe periodontal destruction if not corrected. Loss of interdental papilla creates a space for lateral food impaction which leads to gingival inflammation, attachment loss, and interproximal bone height resorption.^[17,18]

Management of black triangle done by non-surgical and surgical approach. Non-surgical approach is achieved by correction of traumatic oral hygiene procedure, restorative/prosthetic restoration & orthodontic approach.^[19,20] Surgical approach is achieved by papilla recontouring, papilla preservation flap, papilla reconstruction (pedicle flap, semilunar coronally repositioned flap, envelope type flap, autogenous osseous and connective tissue grafts, microsurgery).^[21]

In the present study loss of interdental papilla was because of position of interproximal contact point and triangular shaped crown thus management could be achieved by non-surgical approach. Restorative and orthodontic procedure will fill the open gingival embrasures in these cases.^[22,23] Interproximal reduction (IPR) of enamel on triangular crowns will convert a point contact to a broader contact area that will reduce open gingival embrasures. Reduction of interproximal

enamel with a reducing diamond strip to recontour the mesial surface of the central incisors.^[24] Typically, 0.5 to 0.75 mm of the enamel is removed with IPR. IPR and space closure will lengthen the contact point gingivally. There are several considerations in planning restorative treatment for large open embrasures. Mesiocervical restorations or veneers will reduce the appearance of open embrasures by altering the crown form.^[25] All these treatment plan were explained to the subjects with open gingival embrasures to reduce its negative effects on periodontium in future. Case selection is important, as patients require good oral hygiene, a low caries rate, and proper prosthetic maintenance. Biofilm accumulation due to inadequate prosthetic hygiene may contribute to microorganism colonization of the intaglio surfaces of prostheses, encouraging opportunistic oral infections. Thus, careful daily removal of biofilm from the oral cavity and surfaces of removable prostheses is important to minimize the risk of infection, contribute to good oral and overall systemic health and maintenance of proper esthetics.

CONCLUSION

Gingival defects may be treated with surgical or prosthetic approaches. Restoration and maintenance of these tissues with adequate surgical and prosthetic techniques involves a multidisciplinary approach in modern esthetic dentistry. The etiology of black triangle is multifactorial. It is possible to create esthetically pleasing and anatomically correct tissue contours when small volumes of tissue are being reconstructed, but this method is unpredictable when a large volume of tissue is missing. Position of interdental contact points and triangular shaped crown i.e., morphology of the tooth appears to be most significant factor. To determine the ideal treatment for the patient, early diagnosis and evaluation of soft or hard tissue problem by dentist is a must. An interdisciplinary team approach including restorative, orthodontic and periodontal parts is critical for restoration of open gingival embrasures. Gingival biotype is concerned with the particular pattern and thickness of gingival tissue around the teeth and is of greatest concern in aesthetic reconstructive dentistry.

Source of support : Nil

Conflict of interest : None reported

REFERENCES

1. Van der Geld P, Oosterveld P, Van Heck G, Kuijpers-Jagtman AM. Smile attractiveness, Self-perception and influence on personality. *Angle Orthod* 2007;77:759-65.
2. Park JH, Tai K, Morris J, Modrin D. Clinical considerations of open gingival embrasures. Pathogenesis and Treatment of Periodontitis. Prof. Nurcan Buduneli (Ed.), ISBN: 978-953-307-924-0.
3. Singh VP, Uppoor AS, Nayak DG, Shah D. Black triangle dilemma and its management. *Dent Res J* 2013;10:296–301.
4. Schroeder HE, Listgarten MA. The gingival tissues: the architecture of periodontal protection. *Periodontol* 2000 1997; 13: 91–120.
5. Cunliffe J, Pretty I. Patients ranking of interdental "black triangles" against other common aesthetic problems. *Eur J Prosthodont Restor Dent* 2009;17:177- 81.
6. Sharma AA, Park JH. Esthetic consideration in interdental papilla: remediation and regeneration. *J Esthet Restor Dent* 2010;22:18-28
7. The American Academy of Periodontology. Glossary of Periodontal Terms, 3rd ed. Chicago: The American Academy of Periodontology 1992; 32.
8. Tanaka OM, Furquim BD, Pascotto RC, Ribeiro GLU, Bosio JA . The dilemma of the open gingival embrasure between maxillary central incisors. *J Contemp Dent Pract.* 2008;9:92-98.
9. Cohen B . Morphological factors in the pathogenesis of the periodontal disease. *British Dental Journal* 1959;7:31-39.
10. Zetu L, Wang HL. Management of interdental/inter-implant papilla. *J Clin Periodontol* 2005;32:831-839.
11. Lang NP, Loe H. The relationship between the width of keratinized gingiva and gingival health. *J Periodontol* 1972; 43: 623-7.
12. Cardaropoli D, Re S, Corrente G. The Papilla Presence Index (PPI): A new system to assess interproximal papillary levels. *Int J Periodontics Restorative Dent* 2004;24:488–92.
13. Kotsakis GA, Maragou T, Ioannou AL, Romanos GE, Hinrichs JE. Prevalence of maxillary midline papillae recession and association with interdental smile line: a cross-sectional study. *Int J Periodontics Restorative Dent* 2014;34:81-7
14. Oschenbein C. Osseous resection in periodontal surgery. *J Periodontol* 1986;57:15–26.

15. Tal H. Relationship between the interproximal distance of roots and the prevalence of intrabony pockets. *J Periodontol* 1984;55:604-7.
16. Agarwal SK, Jhingran R, Bains VK, Srivastava R, Madan R, Rizvi I. Patient-centered evaluation of microsurgical management of gingival recession using coronally advanced flap with platelet-rich fibrin or amnion membrane: A comparative analysis. *Eur J Dent* 2016;10:121-33.
17. Seibert JL, Lindhe J. Esthetics and periodontal therapy. In: Lindhe J, ed. *Textbook of Clinical Periodontology*, 2nd ed. Copenhagen, Denmark: Munksgaard; 1989:477-514.
18. Kois JC. Altering gingival levels: The restorative connection. Part. 1: Biologic variables. *J Esthet Dent* 1994; 6: 3-7.
19. Chen MC, Liao YF, Chan CP, Ku YC, Pan WL, Tu YK. Factors influencing the presence of interproximal dental papillae between maxillary anterior teeth. *J Periodontol* 2010; 81: 318-24.
20. Olsson M, Lindhe J. Periodontal characteristics in individuals with varying form of the upper central incisors. *J Clin Periodontol* 1991;18:78-82.
21. Chang LC. The association between embrasure morphology and central papilla recession. *J Clin Periodontol* 2007; 34: 432-6.
22. Wennstrom J.L. Lindhe J, Sinclair F, Thilander B. Some periodontal tissue reactions to orthodontic tooth movement in monkeys. *J Clin Periodontol* 1987;14:121-9.
23. Berglundh T, Lindhe J, Ericsson I, Marinello CP, Liljenberg B, Thomsen P. The soft tissue barrier at implants and teeth. *Clin Oral Implants Res* 1991;2:81-90.
24. George JP, Dhir S. Soft tissue and esthetic considerations around implants. *J Int Clin Dent Res Organ* 2015;7:119-31.
25. Ankli V, Limeira FIR, Yamauti M, Sá TCM. Gingival Veneer Used as Prosthetic Solution for Esthetic-Compromised Malpositioned Dental Implant. *Contemp Clin Dent* 2018; 9:123-127.

To cite: Singh M, Bains VK, Jhingran R, Srivastava R, Madan R. Prevalence of Black Triangle Amongst Young Adults: A Cross-Sectional Study *Asian J Oral Health Allied Sc* 2018;8(2):35-41.