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Research Article

Prevalence of Black Triangles in Post Orthodontic Adult Patients - A Retrospective Study

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Abstract

Introduction: Black angle (Latin: Angularis Nigra), also known as open gingival embrasures, and colloquially known as "black triangle", is the space or gap seen at the cervical embrasure, below the contact point of some teeth. The gingival black triangle does not only play a role in aesthetic concerns but also may cause plaque accumulation, further worsening periodontal disease, and phonetic problems.

Aims: The purpose of this study was to determine the prevalence of posttreatment black triangles in adult orthodontic patients and to examine the association of sex, type of malocclusion, and treatment plan with open gingival embrasures.

Materials and Methods: About 3500 patient records from three dental colleges were reviewed. A sample of 173 subjects was obtained and was used to determine the prevalence of black triangles in adult patients after orthodontic treatment. The data obtained were analysed using the chi-square test. The statistical analysis in this study was done using SPSS software.

Results: The mean age of the population included in the study was 22.61 ± 4.47 years. The prevalence of black triangles was 1.73% before orthodontic treatment in the selected study sample. The same sample showed prevalence rate of 36.42% post orthodontic treatment

Conclusions: In an average Indian adult orthodontic population, 36.42% of patients had open gingival embrasures after treatment.

Keywords: Black Triangle; Orthodontic Treatment; Prevalence

Introduction

The interdental papilla is a part of gingiva that fills the gap between two adjacent teeth. This papilla serves as a biological barrier protecting the periodontal tissues beneath it, as well as contributing to gingival aesthetics. The loss of papilla can lead to cosmetic deformities (called "black triangle disease"), phonetic problems where space allows passage of the air or saliva, and lateral food impaction. The interdental papilla is a key to anterior esthetics, and its loss or short interdental papilla may lead to a black gingival triangle [1].

Black triangle is defined as "Any interproximal soft tissue loss due to periodontal disease, traumatic, mechanical or chemical preparation or crown lengthening procedures" [2].

Open gingival embrasures or "black triangles" are the embrasures cervical to the interproximal contact that is not filled by gingival tissues [3]. They are both unesthetic and are an area where food can get trapped, leading to worsening of gingival health and speech problems. To improve aesthetics, the equilibrium between the gingiva and the teeth should be as natural as possible. When the healthy gum tissue pulls away from the top of the teeth, it can cause a black triangle to appear between them [4].

Adult patients often have higher expectations in terms of aesthetics, periodontal changes, and treatment time. An enticing smile demands a balance between macro, mini, and micro esthetic factors that include white esthetics related to teeth and pink esthetics related to the gingiva [5].

Black spaces will affect smile aesthetics and periodontal health due to prolonged retention of food debris and can cause subsequent gingival inflammation and abnormal gingival morphology.

In adult orthodontics cases, unravelling the incisors to correct crowding will often result in the unfortunate side effect - black triangle. Because of the high rate of open gingival embrasure following orthodontic therapy, it was advised that this issue be discussed with the patient before to beginning orthodontic treatment [6].

A study was done in 2001 to find the prevalence of posttreatment open gingival embrasures in adult orthodontic patients in Caucasian population and two decades have elapsed since then [5].

The purpose of this study was to determine the prevalence of posttreatment black triangles in Indian adult orthodontic patients and to examine the association of sex, type of malocclusion, and treatment plan.

Materials and Methods

About 3500 patient records from three dental colleges were reviewed. Patients were selected based on the following criteria: (1) age: 18 years old at the start of orthodontic treatment; (2) treatment included fixed appliance therapy; (3) treatment completed by 2021; (4) pre and post- treatment frontal intraoral photographs available. A sample of 173 subjects was obtained and was used to determine the prevalence of black triangles in adult patients after orthodontic treatment.

The patients who presented with black triangles before the start of the treatment were excluded. Patients with poor periodontal support were excluded. The gingival embrasure was defined as the embrasure located cervical to the interproximal contact, and it was considered as 'open gingival embrasure' or as 'black triangle' if the embrasure space was not completely occupied by the gingiva. The evaluators were junior residents pursuing post graduate orthodontic course evaluated the patients independently and were asked to use their clinical judgment to look for the presence of black triangles.

The data obtained were analysed using the chi-square test. The statistical analysis in this study was done using SPSS software.

Results

The mean age of the population included in the study was 22.61 ± 4.47 years. Males constituted 28.9%, while the females constituted 71.1% of the study population. The prevalence of black triangles was 1.73% before orthodontic treatment in the selected study sample. The same sample showed prevalence rate of 36.42% post orthodontic treatment.

Orthodontic treatment was done with fixed appliances using MBT technique in 97.69%, Begg in 0.58%, lingual in 0.58%, self-ligating in 0.58%, and Damon in 0.58% of the total sample size.

The study sample Diagnosis said the sample had 23.12% Class I bimaxillary protrusion individuals, 29.48% Class I crowding, 5.20% Class I mutilated malocclusion, 32.95% Class I spacing, 5.20% Class II malocclusion, 1.73% Class II malocclusion with spacing, 1.16% Class III malocclusion.

The sample involved the study had extraction and non-extraction modalities of treatment.

About 48.55% of the individuals underwent extraction mode of treatment and 51.45% underwent non-extraction mode of treatment (Table 1).

		Mean	Sd	N
Age		22.61	4.47	173
		Frequency	Percentage	
Sex	Male	50	28.9%	
	Female	123	71.1%	
Treatment done	MBT	169	97.69%	
	BEGG	1	0.58%	
	Lingual	1	0.58%	
	Self-ligating	1	0.58%	
	Damon	1	0.58%	
Black Triangle-before Treatment	Yes	3	1.73%	
	No	170	98.27%	
Black Triangle-after Treatment	Yes	63	36.42%	
	No	110	63.58%	
Diagnosis	Class 1 BIMAX	40	23.12%	
	Class 1 Crowding	51	29.48%	

Table 1: Basic Characteristics.

Out of entire sample, 36.42% individuals had developed black triangles post orthodontic treatment. The presence of black triangles in these individuals prior to orthodontic treatment was 3.2%, while 96.8% of these individuals had no black triangles prior to the treatment (Table 2).

Yes		Black triangle- before Treatment			P-Value
		No	Total		
Black Triangle-After treatment	Yes	2(3.2%)	61(96.8%)	63(100%)	0.62
	No	1(0.9%)	109(99.1%)	110(100%)	

Table 2: Comparison between black triangle before and after treatment.

The comparison was made between males and females with black triangles post orthodontic treatment and it was seen that 25.4% were males, and 74.6% were females (Table 3).

		Male	Female	Total	P-Value
Black Triangle- before Treatment	Yes	0	3(100%)	3(100%)	0.63
	No	50(29.4%)	120(70.6%)	170(100%)	
Black Triangle-after Treatment	Yes	16(25.4%)	47(74.6%)	63(100%)	0.55
	No	34(30.9%)	76(69.1%)	110(100%)	

Table 3: Comparison between male and female on black triangle before and after treatment.

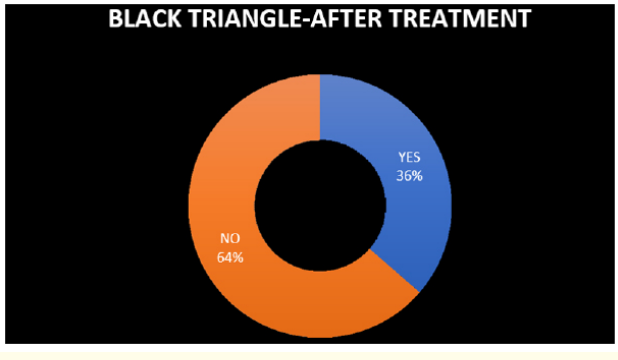

Figure 1: Pie chart showing prevalence of black triangle after treatment.

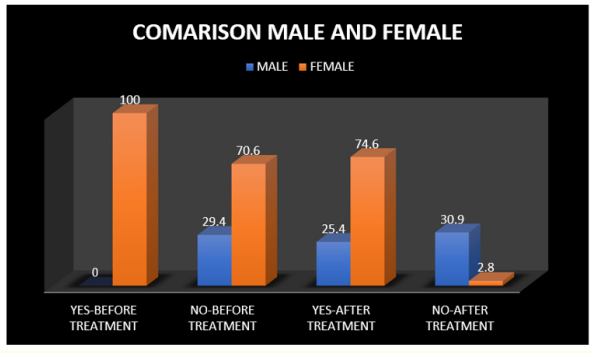

Figure 2: Graph showing comparison between male and female before and after treatment.

Discussion

Aesthetics are extremely important in modern dentistry. Aesthetics has its own set of values and perceptions, which may differ between the patient's and the clinician's perspectives. It is determined by each person's socioeconomic status, upbringing, and mentality. Despite this, certain universal standards of aesthetics must be maintained while performing any dental procedure [2].

When doing dental treatment, a variety of cosmetic considerations must be addressed which include, shade of teeth, the contour of teeth, positioning of appliances, occlusal level, and absence of high points, gingival colour and contour, the contour of lips, the outline of a mouth, and smile line [3].

The presence of "Black Triangles" can hamper proper aesthetics. It is referred to as the space seen at the cervical embrasure, below the contact point of some teeth. This space has many causes including gingival recession and periodontal disease. Hence, these areas present not only unique aesthetic issues but also functional problems. These problems can negatively affect the smiling profile. They also lead to retention of food particles, debris and also cause aggregation of dental plaque [4].

Sarver explained that the approximal contact points are the exact place where the teeth "appear" to touch and these points progress apically as the teeth proceed more posteriorly. The connector height is greatest between the central incisors and diminishes from the central to the posterior teeth. The appropriate ratio for the connector between the central incisors is 50% of tooth height [5].

The contact point between central incisors is closer to the incisal third rather than in the centre of the clinical crown as in most teeth. This feature might explain their greater propensity for the occurrence of black triangles [6].

The interdental papilla is a key to anterior esthetics. In cases of periodontitis, when a supportive alveolar bone is lost, connective tissue and epithelial attachment are compromised, papilla may be deficient. In adult patients, a growing segment of orthodontic practices, it is notable that the black triangle problem is surfacing in dental implant cases [7].

Since supporting tissues are compromised adjacent to the site of a missing tooth replaced with an implant-supported prosthesis, a black triangle may result in the interproximal space, multidisciplinary strategies for prevention and treatment are emerging. These spaces impact directly on the smiles aesthetics and function, interfering with the phonetics and facilitating food retention which can further negatively affect the periodontal health [8].

Studies have well documented that the etiology of gingival black triangle is multifactorial. Papillae dimension can be changed due to variety of reasons such as

- Inter-proximal space between teeth
- Distance between interproximal contact position to the bone crest
- Gingiva biotype
- Age of the patient
- Periodontal disease and loss of attachment, resulting in recession
- Root divergence after orthodontic treatment
- Tooth morphology: abnormal crown and restoration shape.

Incisor crowns which are triangular shaped usually overlap before treatment. Once teeth are straightened black triangles which had been formerly masked by the crooked teeth may now become apparent. The treating dentist should be able to detect and discuss this issue with patient before commencing treatment [9].

Arch length can be influenced by how many teeth are tipped. Therefore, it's possible to increase the arch length by changing crown angulation. However, root position must also be considered because tipping of central incisors mesially to close space and creating excessively divergent roots through the use of improper bracket placement can cause an open gingival embrasure.

The removal of the interdental papilla can result in cosmetic issues as well as speech and food impaction issues. The vertical distance between the bone base and the approximal contact is a determining factor in whether or not a papilla exists. A black triangle is always a possibility for patients with severe periodontitis. To avoid the typical noticeable interdental recession that might occur in these black triangles, special attention must be taken with individuals having orthodontic treatment who have received non-surgical periodontal treatments for severe periodontal disease [10].

Management of black triangle done by non-surgical and surgical approach. The non-surgical approach is achieved by correction of traumatic oral hygiene procedure, restorative/prosthetic restoration and orthodontic approach. The 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) [11].

Concerning the prevalence of black triangles after orthodontic treatment in the Caucasian population, one publication was identified. It was reported that the prevalence of posttreatment open gingival embrasures in an average adult orthodontic population is about 38% and pre- treatment maxillary central incisor rotation and overlap are not directly associated with posttreatment open gingival embrasures [12].

In our present study, we have determined the prevalence of posttreatment black triangles in adult orthodontic patients. We have also examined the association of sex, type of malocclusion, and treatment plan with black triangles in Indian population. The sample consisted of 173 individuals, and 1.73% individuals of the total sample size had black triangles prior to the start of orthodontic treatment, whereas 98.27% individuals had no black triangles prior to start of orthodontic treatment. Post treatment photographs were evaluated for the prevalence of black triangles and it was 36.42% (62 individuals). The remaining 63.58% had no black triangles after orthodontic treatment [13].

The sample used for the study had 173 females and 50 males. It was found that the prevalence of black triangles after orthodontic treatment is more in females with 74.6% when compared to males with 25.4%.

When the type of malocclusion is considered, the prevalence of black triangle is more in Class I Spacing cases with a prevalence of 32.95% followed by Class I crowding cases with the prevalence of

29.48% which is later followed by Class I Bimaxillary protrusion cases with the prevalence of 23.12%. The high prevalence with spacing can be attributed to the tipping movement which is used to close spaces in Class I spacing cases [14].

When teeth are overlapped, the incisal edges will wear unevenly. Since the incisal edge is a primary reference for bracket placement, undetected incisal wear may lead to incorrect bracket placement. This bracket position may align the incisal edges but could also produce divergent root alignment and an open gingival embrasure. Crowded teeth may also have excessive root tipping prior to orthodontic treatment. If this tipping is not accurately corrected during orthodontic finishing, black triangles may appear.

The prevalence of black triangles when the treatment plan (extraction or non-extraction) was considered there was no significant variation in the individuals with either extraction or non- extraction modalities.

The study did not consider the presence of alveolar bone levels in radiographs which plays a significant role in the formation of black triangles. The shape and size of the teeth were not evaluated as part of this study as it was already established in the previous studies.

Conclusion

The purpose of this study was to investigate the prevalence of open gingival embrasures and to examine specific factors associated with them in adult orthodontic patients in the Indian population. The results of this study indicate the following

- In an average Indian adult orthodontic population, 36.42 percent of patients had open gingival embrasures after treatment.
- In an average Indian adult orthodontic population, 74.6 percent of females had open gingival embrasures after treatment, compared to 25.4 percent of males.
- The prevalence rate of black triangles was maximum with 32.95% in Class I spacing, 23.12% in Class I bimaxillary protrusion individuals, and 29.48% in Class I crowding.
- The mode of treatment whether extraction or non-extraction was not very significant in the development of black triangles.

Before beginning orthodontic treatment, all etiological and risk factors, as well as therapeutic options for an open gingival embrasure, should be reviewed with the patient.

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