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Restorative Treatment Considerations for Black Triangle: A Case Series

Hazira M. Yusof[1] Nur Ayman Abdul Hayei[2]

[1] Department of Conservative and Prosthodontic Dentistry, Faculty of Dentistry, Universiti Sains Islam, Malaysia
[2] Department of Periodontology and Community Oral Health, Faculty of Dentistry, Universiti Sains Islam, Malaysia

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Address for correspondence Hazira M. Yusof, BDS (Malaya), MClinDent (Prosthodontics) (Manchester), Level 15 Menara MPAJ, Faculty of Dentistry, Universiti Sains Islam Malaysia, Jalan Pandan Utama, 55100 Pandan Indah, Kuala Lumpur, Malaysia (e-mail: hazirayusof@usim.edu.my).

Abstract

The interdental papilla is of utmost importance in smile aesthetics. Missing interdental tissue often raises an aesthetic concern; however, the issue is more than just an aesthetic complication. This study reviews the most commonly seen cases and methods to minimize the aesthetic complications caused by missing interdental tissue. The technique that will be discussed is from nonsurgical techniques, including composite restoration, indirect restorations, and gingival veneer. This article is clinically relevant in educating clinicians on various methods to restore and improve the optics that arise from a missing interdental papilla.

Keywords
- black triangle
- dental aesthetic
- gingival recession
- interdental papilla

Introduction

Beauty lies in the eye of the beholder, but a beautiful smile often had a touch of a dentist. An aesthetic smile is composed of a smile arc; the harmony of the shade, shape, and position of the anterior teeth; a healthy gingival architecture; the presence of buccal corridor; and finally the lip volume.[1] Being one of the main components in determining smile aesthetics, the harmony of gingival architecture is crucial in dental treatment. The presence of a black triangle is ranked as the third perceived aesthetic problem behind caries and exposed crown margin.[2] Interpapillary loss is classified based on the position of the interdental papilla in the cementoenamel junction (CEJ) area as shown in ►**Fig. 1**, where the classifications are ranked into normal, class I, class II, and class III.[3]

The etiology of interpapillary loss is likely to be multifactorial, with risk factors such as poor oral hygiene, orthodontic treatment, presence of median diastema, periodontal diseases, root divergence, improper control of oral hygiene, inadequate interdental restoration, missing teeth, and trauma.[4] In some cases, the missing tissue can be reversible, such as in the case of traumatic toothbrushing, where the papilla rebounded after correction of habit. However, in the cases where the papilla is not reversible, the aesthetic concern will prompt a patient to seek correction. The presence of the black triangle is more than just an aesthetic concern, as the missing soft tissue also leads to food impaction and speech disturbances due to interdental airflow.[5]

The intervention for the black triangle has been reported for over six decades. In 1956, Kromer became the first to report on conventional papilla preservation procedures.[6] Following this report, steady growth of evidence on the management of the black triangle could be traced. Among the techniques, the semilunar incision proposed by Han and Takei has gained the most attention due to the predictability in regenerating the interdental papilla by coronal displacement of the entire gingival papillary unit.[7] Since then, the proposed surgical techniques include semilunar incision, roll technique, envelope and tunnel, and Beagle's technique. However, in 2012 de Oliveira and coresearchers conveyed their concern on the predictability of the treatment approaches and preferred preventive therapy over surgical correction.[8] In the last 10 years, the therapeutic focus has changed to minimally invasive therapy. A recent article published in 2020 that reviewed the papillary regeneration procedures using

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Class I	Class II	Class III
		
The tip of the papilla is between the interdental cementoenamel junction (CEJ) and the contact point	The tip of the papilla is between the buccal CEJ and the interdental CEJ	The tip of the papilla is apical to the buccal CEJ

Fig. 1 Interpapillary loss classification based on Nordland and Tarnow.[3]

hyaluronic acid (HA) injection conclude that the application of HA may be used to repair a defective papilla.[9] Since then, a growing number of evidence has shown that concentrated growth factors and HA injection are effective in papillary regeneration. However, not every patient is keen on going through a surgical route albeit a minor one. This narrative review will focus on the nonsurgical techniques to overcome the missing interdental papilla. It has the advantages of being noninvasive and widely accepted by patients while being clinically proven to improve aesthetics.

Methodology

The Scale for the Assessment of Narrative Review Articles (SANRA) is used as a guide for the articles chosen in this case series.[10] Articles were searched in PubMed/Medline to identify relevant articles using the combination of search terms: black triangle, dental aesthetic, gingival recession, restorative treatment, interdental papilla, and nonsurgical treatment. The literature was then narrowed down only to restorative treatments and of those identified, we eliminated the repeated and similar types of treatment.

Treatment Planning

The consultation visit started with recording a detailed history and intraoral examination including patients' concerns, examination of dentition, occlusion, periodontal condition, and analysis of the patient's smile. Study models are crucial where occlusion can be further analyzed and the wax-up and mock-up of the planned restoration can be made and discussed. Patients' opinions and preferences, age, and financial status should also be taken into consideration while planning for the treatment.

Smile analysis is done to assess the features of a patient's smile to aid with diagnosis and treatment planning. A low smile line is more forgiving than a patient with a high smile line; however, there are patients who conditioned themselves with a practiced small smile to hide their teeth and ended up with a wide smile at the end of a successful treatment. A video of the patient in a relaxing small conversation can help in determining the lip movements. A trial mock-up can be done to enable the clinician and patient to visualize the outcome of the treatment. It is done by using the putty index of the study model that has been waxed up or by chairside freehand composite buildup. As a guide, the wax-up should be done in accordance with the golden proportion,[11] while further adjustments according to occlusion or aesthetic preference can be made directly to the mock-up intraorally. Upon agreement on the mock-up, a final impression can be made to be used as a reference during treatment.

Restorative Treatment

Composite Buildups to Mask Black Triangle

Resin composite restoration is a minimally invasive and less costly treatment option relative to a fixed option. Composite restoration has a long-term survival rate and aesthetic benefit with the advantage of a straightforward maintenance visit such as minor repair or polishing of a chipped composite.[12,13] These failures are less catastrophic relative to the indirect fixed option. A composite restoration, however, will require regular maintenance mostly due to chipping and discoloration.

The patient in ►**Fig. 2A** complained of black triangle in between teeth 12, 11, and 21 post-orthodontic treatment. The gingiva is healthy, there is no bleeding on probing, and no pocketing can be seen. The treatment of choice is a direct composite laminate veneer restoration for a minimally invasive approach to the treatment.

Restoring the teeth will invariably change the width of the tooth. To create the visuals of an ideal teeth proportion, an optical illusion has to be applied by manipulating light reflection. This can be done by increasing the width of the labial embrasure to reduce shadow while maintaining the

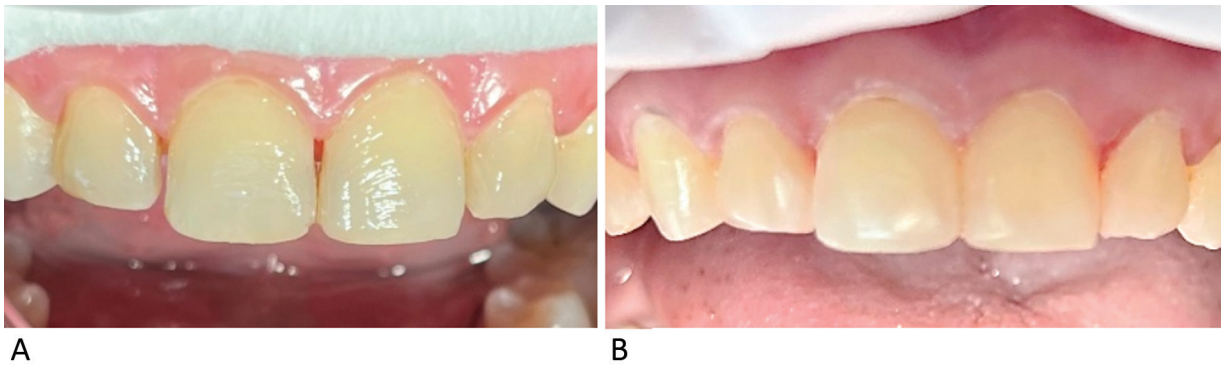

Fig. 2 **(A)** Missing interdental tissue causing aesthetic concerns. **(B)** Closure of missing interdental tissue using direct composite technique.

width of the flat area that reflects light.[14] When restoring the anterior teeth, the use of a nanohybrid composite is suggested, which has a superior light reflectivity for aesthetics.[15] It was also noted that the contact point for this case is situated at the incisal one-third of the tooth. Tarnow et al stated that when the distance between the contact point and the interproximal osseous crest is $\leq$5 mm, there will be a complete fill of interdental soft tissue.[16] The opposite happens when the distance is more than 5 mm; there is 50% chance of loss of the interdental papilla with every 1 mm. With that in mind, the contact point will need to be positioned at the cervical one-third to close the black triangle. The position of the contact point is mostly done arbitrarily by a clinician, but it can also be determined with the bone-sounding technique. This technique was done by locating the bone crest using a k-file inserted in the anesthetized mid-papilla area between teeth 11 and 21.[14] This will eventually identify the 5-mm distance required in between the interproximal osseous crest and the start of the contact point position and also avoid the violation of the biological width. The tooth shape will change from triangular to square, reducing the distance from the contact point to the interproximal osseous crest and produce a longer area of the contact point (►**Fig. 2B**).

The patient in ►**Fig. 3A** complained of discolored teeth, generalized spacing, and unsightly restorations of teeth 11 and 21. The disparity of the shapes of teeth 11 and 21 is apparent. After a root canal treatment and teeth whitening procedures, the existing composite restorations were removed and the generalized gaps were restored. The gap between teeth 41 and 42 was left with a minimal gap (►**Fig. 3B**) to avoid creating an overcontoured and bulbous emergence profile that will be required for a definite closure of the gap. This is to ensure easy cleaning and to avoid the accumulation of plaque underneath the contact point.

Indirect Restoration

A study assessing the 5-year survival rate of metal ceramics and all-ceramic single crowns found that the fixed dental prosthesis has a survival rate of 95% for metal ceramics and most all-ceramic single crowns have a similar survival rate at 5 years .[17] A lower survival rate has also been reported for feldspathic or silica-based ceramic crowns in the same study.[17] Although composite restoration has come a long way with modern technology, indirect restoration is still indicated in some cases. Examples of cases that may require indirect restoration include the following[18]:

- Repeated fracture of the same restorations.
- Missing one or more posterior cusps.
- Extensively restored tooth.
- A tooth that had undergone endodontic treatment, especially for the posterior teeth.
- Presence of bruxism or evidence of parafunctional habits.

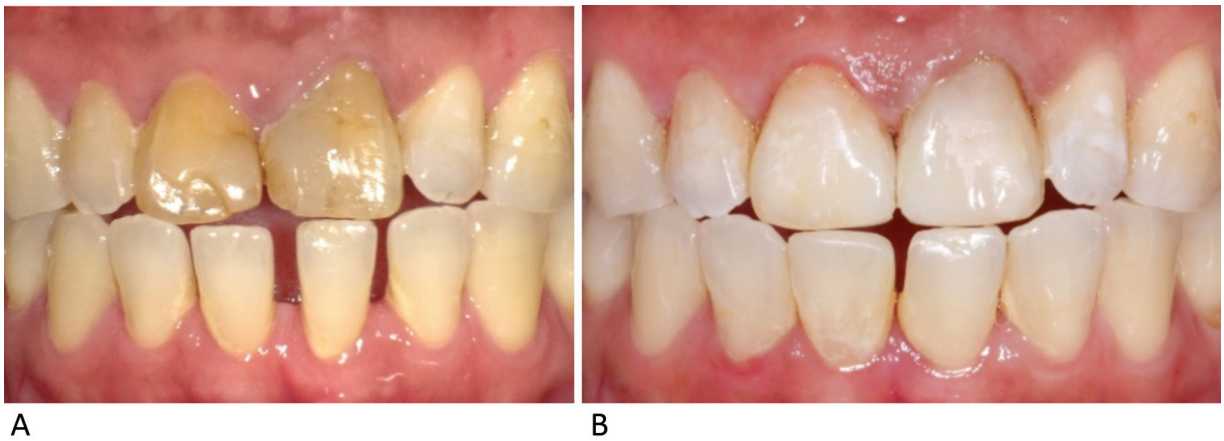

Fig. 3 **(A,B)** Before and immediately post-treatment for the upper and lower anterior teeth.

Fig. 4 Discolored core with feldspathic ceramic veneer on tooth 11.

Before choosing the type of indirect restoration, a thorough examination and investigation are done. This includes patients' aesthetic concern, assessment of the static and dynamic occlusion, presence or absence of parafunctional habits, and assessment of the remaining tooth structure while also considering the expertise of the clinician and the technician.[19] These assessments will determine the materials of choice, margin placement, and types of indirect restorations suitable for each case.

Veneer and Crown

Veneer preparation is minimal and has the benefit of bonding by remaining in enamel. It derives its strength from the enamel bonding and thus becomes a monobloc along with the tooth[19] and is thus unsuitable for a tooth that has been extensively restored. Due to the need for bonding, the margin should be at the equigingival margin for easy moisture control and aesthetic purposes. The minimal preparation, however, reduces its masking ability, making it aesthetically contraindicated for a tooth with a dark core.

►**Fig. 4** shows a tooth with a dark core replaced with a feldspathic porcelain veneer that causes the darker tooth core to be visible through the crown. Veneer preparation to mask the black triangle should include extending the veneer preparation to the palatal area to avoid the visible transition line from tooth to ceramic. The margin of the veneer should begin at the equigingival area or not more than 0.5 mm below the gingival margin at the interdental area to assist a natural emergence profile while hiding the demarcation line and shade differences between the veneer and the tooth. The dental laboratory should be informed of the request for an elongation of the contact points to minimize the presence of the black triangle. For effective communication with the laboratory, the shade guide used should match the laboratory, while the shape of the tooth should be accompanied by the photographs and mock-up model that has been agreed upon.

Crown preparations require extensive tooth structure removal in relative comparison to veneer preparation. ►**Fig. 5A** shows composite restorations done on teeth 11 and 21 after endodontic treatment. Although an endodontic treatment on an anterior tooth may not warrant coronal coverage, the patient complained of repeated fractures to the composite and requested a more durable material of choice. During the examination, it was also noted that the length of the restoration given to the patient is slightly elongated and the protrusive guidance were heavy on teeth 11 and 21. A mock-up was done and the option was to give the patient a slightly shorter crown with group function that will help protect both the tooth and the crown. A veneer is not chosen due to the fact that one-third of the tooth is restored with composite restorations.

After cementation (►**Fig. 5B**), there was a minimal black triangle due to the blunt interdental papilla caused by rubber dam isolation and cement removal. Gingiva biotypes should be taken into consideration when handling soft tissue. A patient who presented with a thin gingival biotype is prone to developing tooth recession, while a patient with a thick gingiva biotype is prone to inflammation.[20] Careful soft-tissue handling during tooth preparation, rubber dam, and retraction cord placements is necessary to avoid iatrogenically induced trauma to soft tissue. The patient should also be given thorough oral hygiene care instruction, and a review visit is necessary.

Gingival Veneer

A gingival recession is represented by apical migration of the gingival margin exposing the root surface of the tooth. The patient who underwent periodontal treatment often ends up with generalized recession, which posed an aesthetic challenge to the patient with unsightly black triangles. It is associated with issues such as dentine hypersensitivity, root caries, and compromised aesthetic and plaque control. Although gingival augmentation is an efficient and well-

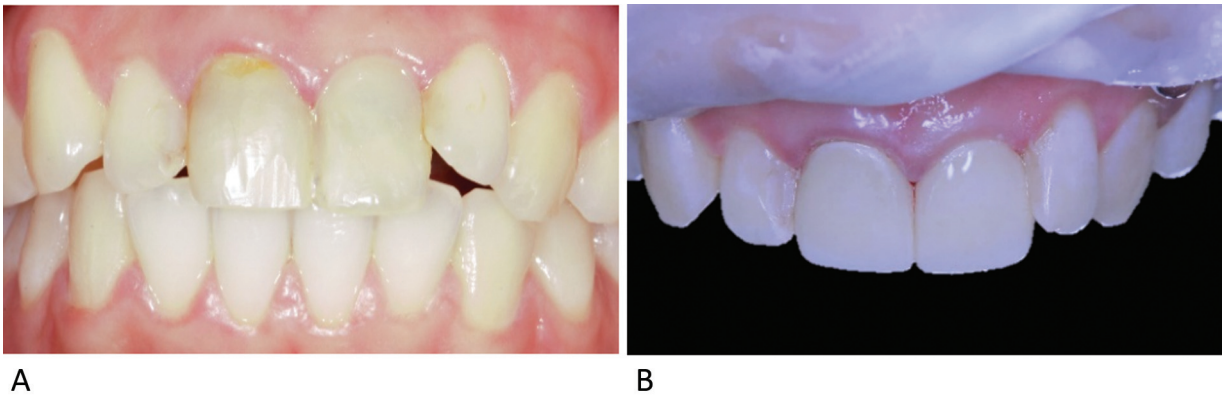

Fig. 5 **(A)** Elongated contact point of teeth 11 and 21. **(B)** Immediately post-cementation crown teeth 11 and 21.

Fig. 6 Generalized recession and the illustrative representation of the planned gingival veneer.

documented treatment, some patients are not keen for surgical intervention.

Apart from surgical intervention, a less invasive approach can be employed by prescribing a gingival veneer. A gingival veneer is constructed to cover the buccal aspects of the exposed areas of black triangles by using pink acrylics, flexible acrylics, or silicone materials[21] as illustrated in ►**Fig. 6**. This prosthesis can be used as a reservoir for the delivery of desensitizing agent for patients with dental hypersensitivity or fluoride therapy for patients who are susceptible to root caries. A patient who is prescribed the prosthesis will be required to adhere to rigorous oral hygiene care and persistently good plaque control including cleaning after eating and removal of the prosthesis at night.

The construction of the gingival veneer begins with the construction of a custom special tray. The special tray should cover the buccal and incisal areas, but should not extend to the palatal area. The impression materials of choice should allow flows through the interdental area and not distort or tear during the removal of the impression. To avoid impression materials from flowing through to the palatal area, wax should be inserted at the palatal embrasures. Caution should be employed when using rigid impression material to avoid the material from flowing through the interdental area and engaging the undercut. This can result in the difficulty of impression removal. The retention of the gingival veneer is obtained from the insertion of the acrylic projections halfway into the undercut. It needs to be made as thin as possible without interfering with the strength so that the thickness would not change the patient's facial profile.

Conclusion

Multiple techniques can be employed for treatments of black triangle. Some of these have been summarized in this study. Proper planning is needed before each treatment. An evaluation of the case is necessary before choosing the minimally invasive approach or surgical intervention. The decision, however, is also subject to the skills and experience of the clinician. The final intervention should reflect the ability of the clinician and must be beneficial to the patient.

Conflict of Interest
None declared.

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