



Original Article

บทความวิชาการ

Esthetic treatment of minor malaligned maxillary anterior teeth using a removable orthodontic appliance, tooth whitening, and veneer

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Abstract

Objective This case report describes the esthetic treatment of mildly crowded maxillary anterior teeth using a removable orthodontic appliance, bleaching, composite resin and porcelain veneer to maximize the treatment results.

Materials and methods A 28-year-old male with minor crowding of the maxillary anterior teeth wanted his teeth to look straight and unnaturally extremely white color. A treatment plan was developed with the priority being orthodontic treatment to move teeth into alignment. Then the patient's expectations were adjusted based on information from the team dentists. By the end of whitening treatment, the patient was satisfied with the whiteness of his teeth even though they were not extreme whiteness. The maxillary right lateral incisor, which was slightly rotated after orthodontic treatment, was minimally prepared for porcelain veneer.

Results Adjunctive orthodontic treatment with a removable appliance helped minimize the amount of enamel and dentine loss and decrease the number of teeth needed to undergo veneer work. Bleaching gave the patient natural white teeth to meet his modified expectations.

Conclusion This treatment method is capable of preserving a significant amount of enamel and dentine for the patient and achieving an aesthetically pleasing alignment of teeth with natural white color.

(CU Dent J. 2012;35:229-40)

Key words: bleaching; crowding; removable orthodontic appliance

Introduction

Teeth are the key elements of facial appearance; perfectly aligned, white teeth can contribute significantly to the confidence of a person. Crowding of anterior teeth can be a major obstacle to achieve dental perfection. However, this problem can be corrected by either orthodontic treatment or esthetic restorative procedure. The former is generally chosen for more severe cases, where fixed or removable appliances are used. Orthodontic treatment produces predictable outcomes; but treatment duration can be quite long with high costs, and a satisfactory result depends significantly on patient cooperation. For mild crowding, esthetic restorative procedure can help reshape certain teeth by using composite resin and veneers as well as crowns to achieve a pleasing alignment. This treatment requires a shorter time, but a

considerable amount of enamel and dentine has to be sacrificed.

Esthetic restorative procedure requires careful planning. A wax-up model helps determine the locations where tooth structure must be added or reduced in order for all incisors to be perfectly aligned. If a significant amount of dentine has to be removed, the pulp may be exposed and intentional root canal treatment would be carried out; in this case an alternative treatment plan with adjunctive orthodontic treatment should be considered.

This report proposes an alternative esthetic treatment for a patient with mild crowding of the maxillary anterior teeth, starting with minor tooth movement using a removable orthodontic appliance followed by bleaching and veneer restoration with a minimally invasive protocol.



Fig. 1 Before treatment: front view of upper anterior teeth (1a), front view when biting (1b), occlusal view of upper teeth that showed malalignment (1c).

Case Report

The patient was a 28-year-old Thai male, who visited the Esthetic Restoration and Implant Dentistry Clinic at the Faculty of Dentistry, Chulalongkorn University, with the intention of seeking a veneer procedure to achieve straighter and whiter teeth. He was specific that he wanted his teeth to be “as white as sanitary ware”.

Upon oral examination, 12 (the maxillary right lateral incisor) was found to be significantly rotated mesiolabially. The gingival level was considerably higher than that of 11 (the maxillary right central incisor) and almost the same as the gingival level of 13 (the maxillary right canine) (Fig. 1a). Teeth 11 and 21 (the maxillary right and left central incisor) were slightly retroclined as a result of crowding due to tooth size–arch length discrepancy. The incisal edge of 11 was slightly canted distally, possibly due to uneven wear of enamel (Fig. 1b and 1c). The maxillary dental midline had shifted 1.5 mm to the right. The overbite was 2.5 mm at 11 and 21, and 1.5 mm at 12 and 22. The overjet was 1 mm at 11 and 21, 1.5 mm at 22, and 3.5 mm at 12. The color of the maxillary incisors, when compared with the Vita classical shade guide, matched the A2 shade.

Because 12 was significantly rotated mesiolabially, and immediate veneer work would have required the removal of dentine to the extent where the pulp might be exposed, root canal treatment therefore had to be carried out.

Orthodontic treatment with a fixed appliance was recommended, but the patient refused on account of the lengthy process, esthetic impairment during treatment, and financial concerns. Another treatment option was orthodontic treatment with a removable appliance, followed by bleaching and esthetic restoration.

A treatment plan was proposed where a removable appliance would be used to procline 11 and 21 and derotate 12 to achieve proper alignment before beginning bleaching and restorative procedure (Figs. 2 and 3). The major advantage of this treatment plan was that root canal treatment of 12 would not be required, and fewer teeth would need to undergo veneering. The patient agreed to this treatment plan.

Clinical Report

Stage 1: Space analysis

Measurements determined that the sum of tooth width from 13 to 23 (the maxillary left canine) was

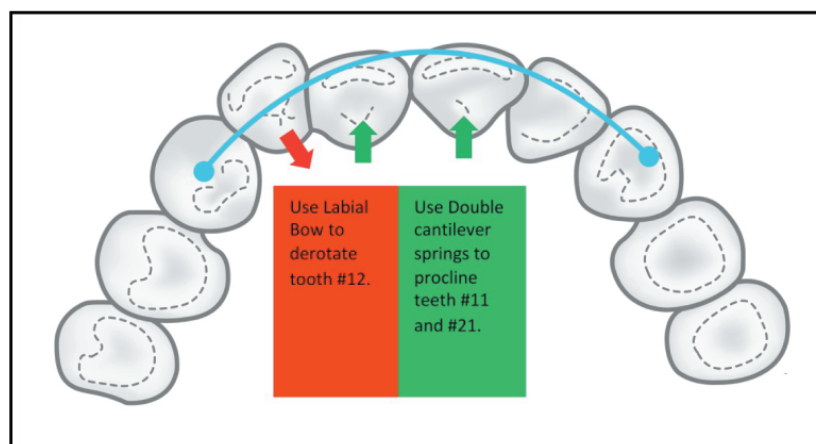


Fig. 2 Maxillary anterior teeth alignment correction treatment plan.

Table 1 The size of each tooth before treatment

Tooth	13	12	11	21	22	23
Size (mm)	7.5	7.5	8	8	7	8



Fig. 3 Wax-up model for the treatment planning process.

46 mm (Table 1), but the arch length in the maxillary anterior segment measured only 44.5 mm.

Table 1 suggests that there was a 1.5 mm tooth size-arch length discrepancy, resulting in crowding of maxillary incisors. Therefore, a 1.5 mm space was needed for these incisors to be properly aligned. By using a removable orthodontic appliance, 11 and 21 would be proclined while 12 would be derotated into alignment, with appropriate overjet and overbite.

Stage 2: Minor tooth movement using removable orthodontic appliance

The removable appliance was consist of two double cantilever springs at the palatal surface of 11 and 21, and a labial bow with loops from 13 to 23. Retentive components included Adams clasps on first molars and triangular clasps between first and second molars (Figs. 4a, and 4b).

Tooth movements were accomplished in two phases. Proclination of 11 and 21 was achieved by activation of the double cantilever springs to produce 25-40 grams of force on the incisors. The patient was instructed to wear the appliance at all times except when eating and brushing, and was asked to revisit the clinic once a month to have the appliance adjusted. After five visits, 11 and 21 were successfully proclined, as seen by increased overjet and good alignment.

Stage 3: Interproximal reduction

As teeth 11 and 21 were aligned, aluminum strips and fine diamond burs (Intensiv, Switzerland) were used to gradually reduce the enamel on the distal surface of 11 and the mesial surface of 12, on each visit when the patient returned to have the appliance adjusted.

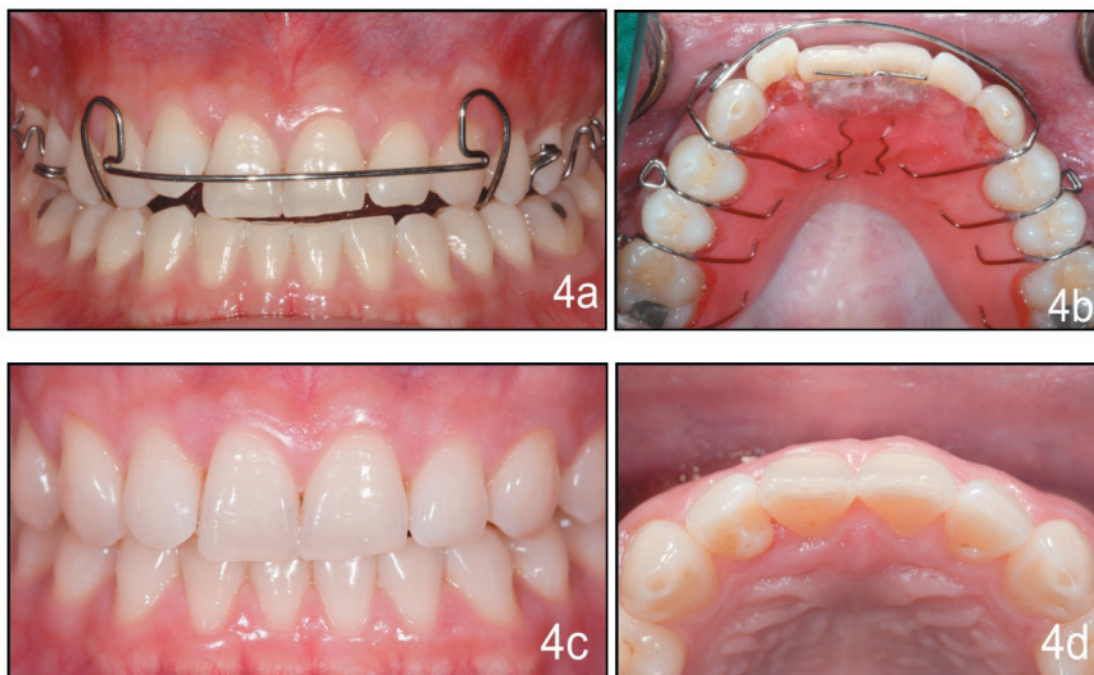


Fig. 4 Using removable appliance; Frontal view of removable appliance (4a) and occlusal view of removable appliance (4b). After using removable appliance; Front view of upper anterior teeth when biting (4c), occlusal view of upper anterior teeth that showed 12 slightly rotated (4d).

Stage 4: Minor tooth movement using removable orthodontic appliance

At this phase, the palatal side at 12 of removable orthodontic appliance or acrylic base plate was gradually removed with carbide bur and the labial bow was adjusted to derotate this tooth. After five weeks with minor adjusting the appliance, 12 remained rotated slightly mesiolabially due to the limited space obtained from interproximal reduction (Figs. 4c and 4d). However, this minor rotation would be corrected by a porcelain veneer.

Stage 5: Retention

A maxillary impression was taken for fabrication of a clear retainer, using 0.04-inch-thick plastic tray sheet (Keystone Dental, USA). After the retainer was delivered, the patient was advised to wear the appliance at all times, except when eating and brushing.

Stage 6: Tooth whitening

Initially, the patient had come to the clinic with the desire to have veneer restorations with an unnatural, extremely white color. However, after minor tooth movement, he realized that the restorations he wished to have would appear to be very unnatural looking; also, the procedures required to accomplish the veneer restorations would cause a significant removal of tooth structure on both maxillary and mandibular teeth. He was given information about the disadvantages of tooth structure loss at a young age, and was ultimately convinced to do tooth bleaching at home to whiten the tooth color. He was then treated with tooth whitening and asked for satisfaction of the results in every dental appointment. For doing so, the patient's expectations were adjusted and the conservative treatment could be suggested at the end.



Fig. 5 Frontal view of the maxillary clear retainer and the bleaching tray from the mandibular teeth (5a). Change of tooth color from A2 Vita Classic before the treatment to 1M1 Vita 3D after the treatment (5b and 5c).

A lower bleaching tray was produced for home whitening with reservoir using 0.035-inch-thick soft tray sheet. For maxillary teeth, a clear retainer (used for tooth stabilization after minor tooth movement) was used as a bleaching tray without making reservoir (Fig. 5a). Carbamide peroxide gel (15%) as prescribed (Opalescence gel; Ultradent Products, USA). The patient was instructed to wear the trays with whitening gel for 6 hours a day over a 2-week-period.

Tooth color was rechecked on a weekly basis. In this case, the patient did not experience any tooth sensitivity; therefore the whitening treatment was extended to 3 months. The original tooth color before whitening was Vita classic A2 shade. After 3 months of tooth whitening, the tooth color match was beyond Vita classic B1 shade to Vita 3D 1M1 shade (Figs. 5b, and 5c). The patient was pleased with this result, and finally decided to have one veneer on 12, as in our original suggested treatment plan.

Stage 7: Ceramic veneer restoration on 12

With minor tooth movement the alignment of 12 was significantly improved, but was still rotated slightly mesiolabially with the incisal edge shifted downward to the left. A wax-up model was prepared for the final shaping of 12.

The width and height of 11 and 21 were measured, which showed the need to reshape 11 to be wider and shorter (Figs. 6a–6e). The incisal edge of 11 was reshaped to 10 mm, matching tooth 21 (Fig. 6f). Then, tooth preparation for a ceramic veneer on 12 was performed by standard procedures, with labial reduction of 0.3–0.5 mm, and labial margin 0.5 mm subgingival. Removal of the tooth structure was carried out throughout the contact area (Fig. 6g). The final preparation was checked against the silicone index of the desired final restoration.



Fig. 6 Measurement of the width of 11 and 21 (6a, 6b). Measurement of the height of 11 and 21, illustrating that the crown of 12 was longer (6c, 6d). The extent of incisal edge of 11 needed to be reshaped (6e). After reshaped incisal edge of 11 (6f). Preparation of 12 for veneer work (6g). After esthetic restoration on distal aspect of 11 to be as wide as 21 with composite resin (6h).



Fig. 7 After the porcelain veneer was delivered.

Tooth 11 was restored with resin composite at the distal surface in order to reshape the tooth to be as wide as 21 (8 mm) and to manage the space to ensure the proper width of 12. Resin composites (Venus; Heraeus Kulzer, Germany) were used, with shade S0 for dentin, S1 and S2 for enamel, and T1 for incisal edge. Finishing and polishing of the restored resin composite were done using fine diamond finishing burs (Intensiv, Switzerland), resin-impregnated polishing burs (Enhance; Dentsply International, USA), and silicone rubber polishing burs (HiLuster Plus polishing system; SDS Kerr, USA) (Fig. 6h).

A polyvinylsiloxane impression (Flexitime; Heraeus Kulzer) was carried out using double impression technique and submitted to the laboratory. 1M1 Vita 3D was the shade selected. Resin composite was used as the temporary to protect the prepared tooth.

A ceramic veneer (Empress Esthetic; Ivoclar, Liechtenstein) was fabricated for 12. Try in of the veneer was performed to check the fit and color match of the restoration. The ceramic veneer was etched with hydrofluoric acid and silanated. The tooth surface was etched with 37% phosphoric acid (Kerr Gel Etchant; SDS Kerr, USA) and rinsed with water; then dentin adhesive was applied (OptiBond FL; SDS Kerr, USA).

The veneer was cemented onto the tooth with resin luting cement (NX3 shade BL; SDS Kerr, USA). Excess cement was removed, and polishing procedures were performed (Fig. 7). The patient was instructed about veneer maintenance.

Stage 8: Follow-up and maintenance

After delivery of the veneer on 12, an impression was taken for a new maxillary clear retainer using 0.04-inch-thick plastic sheet. The patient was instructed to wear the retainer at all times during the first 6 months. The 6-month-follow-up result (Figs. 8a, 8b, 8e and 8f) shows improvement of the gingival level of 12 (Figs. 8c, and 8d). It was recommended that the patient wear the retainer only at night to allow continued remodeling of periodontal tissue.

Discussion

Esthetic restorative treatment planning requires an interdisciplinary approach to achieve the best results. Adjunctive orthodontic treatment is essential in cases where restorative procedure alone would require massive removal of tooth structure. In this case, orthodontic treatment could move teeth into a more



Fig. 8 The smile before and after the 6 months post treatment (8a, 8b). Comparison of the teeth prior to the treatment and 6 months post treatment shows the gingival level of 12 which previously higher than that of 11 is now at the same level (8c, 8d). Comparison of the occlusal view of teeth before and after 6 months post treatment (8e, 8f).

appropriate position to facilitate the subsequent restorative treatment.

Adjunctive orthodontic treatment using a removable appliance is practicable by a general practice dentist, provided that the process is thoroughly studied and understood. In this case we used a removable orthodontic appliance with a double cantilever spring to procline 11 and 21 and derotate 12. Proffit and Fields have stated that springs usually can move teeth only a limited distance; however that was all that was required for this patient.¹

Following the conclusion of orthodontic treatment, the alignment of 11, 21 and 12 was significantly

improved, even though 12 was still slightly rotated due to a mild tooth size-arch length discrepancy. However, this minor crowding was easily corrected with the following restorative procedure. Another advantage of adjunctive orthodontic treatment is the improvement of the gingival level, which is a key contribution to anterior dental esthetics. Normally, the gingival level of 12 should be slightly lower than 11 and 13. In this patient, the pretreatment gingival level of 12 was significantly higher than 11. After 11 and 21 were proclined and 12 was derotated, the gingival level of 12 was at almost the same level as 11, resulting in more esthetic gingival levels of the anterior teeth—a result which could not be obtained by

restorative procedure alone.

At-home and in-office bleaching are two types of tooth whitening prescribed by dentists. At-home bleaching requires a longer time compared to in-office bleaching, but the whiteness result can be maintained for a longer period of time. Furthermore, the patient can manage the period and duration of treatment with at-home whitening. The use of 10% carbamide peroxide gel in custom bleaching trays is safe, cost-effective, and highly efficient.² The whiteness achieved is no different from the use of 15% carbamide peroxide gel for the same 1-month-period.³ Mean while, the subsequent reshaping of a tooth and restoration with resin composite has been found to have no significant detrimental effect on the bond to the enamel of the bleached tooth if a period of two weeks has elapsed from the bleaching.⁴ In the case where a delay cannot be allowed, an aluminum oxide strip can be used to grind the bleached tooth surface before the bonded restoration is carried out; this will ensure a satisfactory bonding of the material to the tooth surface.^{5,6}

According to Haywood *et al.*, the rates of whitening for reservoir and non-reservoir whitening trays were found to be not significantly different.⁷ However, a study by Kirsten *et al.* compared the use of bleaching trays with and without a reservoir.⁸ They found that a tray with a reservoir is more likely to cause gingivitis, and of greater severity, especially when compared to immediately after bleaching. This might be caused by the design of the bleaching tray, whose edge lapse 1 mm beyond the gingival margin, and because the flexibility of silicone used to produce the bleaching tray might push the gel out. Furthermore, Kirsten *et al.* stated that the use of a firmer material or the cutting of the edge to create a parallel line with the incisal or occlusal plane might help avoid or minimize gingivitis. For this patient, since a clear retainer was used on the maxillary teeth, it had to be as close to the tooth surface as possible to ensure good retention. Therefore, a hard non-reservoir tray was used as a

bleaching tray, in combination with its purpose as a retainer. Matis *et al.* found no difference in gingival sensitivity between bleaching with and without a reservoir.⁹ Also, as in the case of this patient, the act of bleaching with 15% carbamide peroxide gel (Opalescence gel; Ultradent Products) does not significantly change the polished surface of the composite resin.¹⁰ The patient was advised not to apply bleaching gel to the veneer surface, as it does not affect porcelain veneers in any case.¹¹

For ceramic veneer restoration on 12, incisal bevel preparation was required in order to increase the length of the incisal edge of the restored tooth¹² so it would resemble and blend in with the other teeth. Additionally, the break through contact point on the mesial side was to reshape the tooth which remained slightly rotated and allow a convenient reshaping of the distal surface of 11.

Retainers are available in many forms, such as clear, Hawley, and fixed retainers. Mollov *et al.* used questionnaires to survey 555 patients who had undergone orthodontic treatment; 50, 36 and 35% were very satisfied with their clear retainer, fixed retainer and Hawley retainer, respectively.¹³ Furthermore, this study found that the type of retainer had an effect on the continuity of its use. The rates of continuous retainer use were 68, 65 and 45% for fixed, clear and Hawley retainers, respectively. On average, fixed, Hawley and clear retainers lasted 7.8, 3.5 and 1.8 years, respectively. While a fixed retainer lasts the longest, it is the type of retainer associated with the greatest difficulty in maintaining good oral hygiene. Additionally, there have been cases where the retainer has become dislodged from the teeth without the patient's knowledge, resulting in the failure to maintain teeth in position. In the present case, a clear retainer was chosen for retention; it also served an additional purpose as a bleaching tray.

Friedman stated that 93% of ceramic veneers are successful over a period of 15 years; the 7% that failed were a result of breakage (67%), leakage (22%) and detachment (11%) of the veneer.¹⁴ One factor which increases the risk of breakage is the habits and behaviors of the patient, which suggests excessive use of force both in the cases of correct and incorrect usage of the veneers. This results in the increase of tensile stress to beyond the limit that the porcelain can bear. It is imperative that the patient should exercise care in maintaining and using his teeth properly in order to enjoy beautiful teeth for as long as they last.

Conclusion

Adjunctive orthodontic treatment together with esthetic restorative procedure is capable of preserving a significant amount of dentine for patients with crowding, reducing the need for root canal treatment, and achieving an aesthetically pleasing alignment of teeth with a natural white color. The procedures can be carried out by general dentists in the most time-and cost-effective manner for the patient.

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การรักษาฟันหน้าบนที่ซ้อนเกเล็กน้อยให้สวยงาม ด้วยการใช้เครื่องมือจัดฟันแบบถอดได้ การฟอก สีฟัน และเคลือบฟันเทียม: รายงานผู้ป่วย

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บทคัดย่อ

วัตถุประสงค์ รายงานผู้ป่วยนี้เพื่อเสนอการรักษาด้านความสวยงามของฟันหน้าบนที่ซ้อนเกเล็กน้อยด้วยเครื่องมือจัดฟันแบบถอดได้ การฟอกสีฟัน การใช้วัสดุเรซินคอมโพสิต และพอร์ซเลนวีเนียร์

วัสดุและวิธีการ ผู้ป่วยชาย อายุ 28 ปี มีฟันซ้อนเกเล็กน้อยบริเวณฟันหน้าบน และผู้ป่วยระบุว่าต้องการมีฟันขาวเกินพันธรรมชาติ จึงทำการวางแผนการรักษาด้วยการจัดฟันก่อน เพื่อให้ฟันอยู่ในตำแหน่งที่เหมาะสมในส่วนโค้งขากรรไกร ผู้ป่วยได้ถูกปรับลดความคาดหวังของสีฟันลงโดยทีมทันตแพทย์ แม้ท้ายที่สุดฟันไม่ขาวเกินธรรมชาติตามที่ผู้ป่วยระบุแต่ผู้ป่วยก็พอใจ และมีการเตรียมฟันตัดซี่ข้างบนขวาที่ยังคงบดหมุนอยู่หลังการจัดฟันเพื่อทำพอร์ซเลนวีเนียร์

ผลการศึกษา การจัดฟันด้วยเครื่องมือจัดฟันแบบถอดได้ ทำให้ผู้ป่วยลดการสูญเสียเคลือบฟันและเนื้อฟัน และลดจำนวนฟันที่ต้องทำพอร์ซเลนวีเนียร์ การฟอกสีฟันทำให้สีฟันขาวอย่างเป็นธรรมชาติ ซึ่งตรงกับความคาดหวังที่ถูกลดของผู้ป่วย

สรุป การรักษาด้วยวิธีนี้เป็นการลดการสูญเสียเคลือบฟันและเนื้อฟันอย่างมาก ทำให้ผู้ป่วยมีฟันที่เรียงตัวสวยงามและมีสีขาวยตามธรรมชาติ

(ว.ทันต.จุฬาฯ 2555;35:229-40)

คำสำคัญ: การฟอกสีฟัน; เครื่องมือจัดฟันแบบถอดได้; ฟันซ้อนเก