

Pre-Prosthetic Orthodontic Treatment Using Personalized Elastic Separators for Optimization of Emergence Profile in Esthetic Crowns: A Clinical Report

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Abstract

Restoring a misaligned tooth with an inadequate contact point is a challenge to the practitioner. In some instances, teeth that could be repositioned and adequately restored are extracted. Thus, the aim of this article was to describe a treatment using orthodontic and prosthetic techniques to restore esthetics and function in a patient with a distally drifted maxillary lateral incisor. The patient's functional and esthetic expectations were successfully met with the outlined treatment.

Congenital aberrations in tooth morphology, extensive carious lesions, poorly contoured restorations lacking proper proximal contacts, or missing teeth may result in the drifting of teeth, making esthetic restoration difficult. Close root approximation, poor long-axis alignment, inability to restore proper contours, and inadequate pontic spaces are common problems when drifted teeth are planned for esthetic restoration.¹

Preservation or alteration of the natural dentition to an optimal state of health, function, comfort, and esthetics should be the goal of cosmetic and reconstructive dentistry.^{2,3} However, some clinicians have performed the exodontics of misaligned teeth even in the presence of healthy periodontium and proper bone support for later insertion of implant-supported restorations. On the other hand, it is well documented that teeth can move through alveolar bone by strains generated by orthodontic appliances.⁴ Thus, elastic separators have been used to perform minor tooth movement and to create space for crown restoration on misaligned teeth.^{1,5–12} However, prefabricated orthodontic separators (elastic rings) have predetermined thicknesses, limiting the magnitude of tooth movement and delaying treatment. Meanwhile, personalized separators are latex elastics (Astar Orthodontics, Inc., Shanghai, China) with different thicknesses that should be cut in small pieces according to the tooth width. The use of personalized elastic separators allows the movement of the misaligned tooth in a simple, fast, and accurate way according to the needs of each case.

The aim of this article was to describe a treatment using orthodontic and prosthetic techniques to restore the esthetics and function in a patient with a distally drifted maxillary lateral incisor.

Clinical report

A female patient (Caucasian, 32 years old) presented for dental treatment to improve smile esthetics. The maxillary central incisors were intact, and the lateral incisors showed proper root canal treatment and prior restoration with dowel/cores. The chief complaints of the patient were inadequate proportion in the size of the crowns, misalignment, and lack of shade in the maxillary anterior teeth. Preoperative radiographs showed that root length ensured adequate periodontal support, indicating a good prognosis for the misaligned tooth. No extractions were performed.

Initially, fixed orthodontic treatment was conducted to improve the alignment of the tooth long axes in the maxillary arch and realign the patient's midline. At the conclusion of orthodontic treatment (Fig 1), the existing maxillary lateral incisor crowns (right and left) were removed, and the upper anterior abutments (central and lateral maxillary incisors, right and left) were prepared to receive new interim crowns fabricated in accordance with a previous diagnostic wax-up. The maxillary central incisors presented proper positioning in the alveolar



Figure 1 Frontal view of patient smile after fixed orthodontic appliance removal.



Figure 2 Frontal view of the patient with interim crowns in the maxillary lateral incisors, but not in the maxillary central incisors.



Figure 3 Sequence of minor tooth movement: (A) maxillary lateral incisor drifted distally; (B) soft and narrow personalized elastic separator positioned between maxillary left canine and maxillary left lateral incisor to mesially drift the lateral incisor; (C) hard and large personalized elastic separator positioned to close the diastema between central and lateral incisors; (D) interim crown of maxillary lateral incisor maintaining the contact point with adjacent crowns after acrylic resin incremental in the distal face.

ridge, allowing fabrication of artificial crowns with sufficient quantity of restorative material in all dimensions (Fig 2); however, when the existing artificial crown in the left maxillary lateral incisor was removed, it was observed that the remaining



Figure 4 Frontal view showing esthetic harmony after new positioning of anterior interim crowns.



Figure 5 Frontal view of maxillary anterior teeth after crown preparation.



Figure 6 Frontal view of patient smile during a 4 year follow-up.

root was drifted distally, generating an interim crown with a high thickness of the restorative material in the mesial region.

To avoid this condition in the definitive crown, minor tooth movement was indicated to improve the distance between the prepared teeth (Fig 3). Then, new single polymethylmethacrylate interim crowns were fabricated and cemented using temporary cement (Rely X Temp NE, 3M ESPE, St. Paul, MN). Tooth movement was performed using a small piece of latex elastic separator. The elastic separator thickness should be selected according to the desired magnitude of tooth movement.

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Initially, the selected elastic separator was positioned between the distal surface of the lateral incisor and the mesial surface of the canine to move the lateral incisor mesially. Based on the techniques of Bondemark et al¹³ and Bergius et al,¹⁴ the latex elastic separator was replaced by a thicker one after 1 week to continue further mesial movement. After another week, the thicker latex elastic separator was removed, and acrylic resin was added in the distal face of the interim crown to create a proper contact point with the adjacent tooth and avoid the return of the tooth to the initial position. Figure 4 shows the new position of the interim crown of the left lateral incisor and its relation to the other maxillary anterior teeth, generating sufficient space for restorative material in all dimensions after tooth preparation (Fig 5).

The impression was made with polyether impression material (Impregum F, 3M ESPE) to fabricate Procera AllCeram single crowns (Nobel Biocare AB, Göteborg, Sweden) by the computer-aided design/manufacturing system. Figure 6 shows the maintenance of the esthetics and patient's satisfaction after a 4 year follow-up.

Discussion

The size and form of the maxillary anterior teeth are important in achieving pleasing dental and facial esthetics. To help harmoniously restore compromised teeth, the "golden ratio" can be a valuable guideline.¹⁵ Moreover, the golden ratio is important for artificial crowns, prolongation of tooth functioning, and in the planning of correct redistribution of chewing function.¹⁶ However, if space distribution of abutment teeth is not adequate, it may be difficult to achieve an ideal esthetic condition by the golden ratio principle. The aim of this combined treatment is to reposition the tooth orthodontically, often performing minor tooth movement using personalized elastic separators in conjunction with a polymethylmethacrylate interim crown to regain lost interproximal space, distribute excessive space (greater than 3 mm), and develop optimal space distribution for the placement of fullveneer crowns in accordance with golden ratio theory. As the elastic separators should be placed between the interim crowns, they were separate to allow abutment tooth movement. This combined orthodontic and prosthetic treatment may allow for a more favorable position and inclination of abutment teeth. This may reduce the need for aggressive preparations to achieve acceptable contour and alignment according to the golden ratio.8,12

Although the space may be regained with conventional orthodontics, this may not be an option in some cases due to financial or technical considerations.¹⁰ The treatment time when using elastic separators is less than that required for more complex orthodontic procedures involving brackets and wires. Usually, the desired minor tooth movement is reached in 2 to 4 weeks; however, the treatment time can be extended by 2 to 3 months when a larger tooth movement is required.¹⁰ Moreover, the bodily movement (translation) cannot be expected when using elastic separators because the application of force is a tipping force. As the tipping force is extrusive, the occlusion must be monitored during treatment time.¹ The regained space is maintained by the thicker elastic separator; however, it is common for the elastic separators to be lost between appointments. This can occur during eating or brushing, resulting in orthodontic rebounding of the teeth, loss of interproximal space, and return to the initial contact point tightness. Thus, the patient can be taught how to replace any separators lost during treatment. This potential disruption of treatment, as well as the discomfort experienced by patients during separation, suggests that the treatment time should be as short as possible.

In the present report, the abutment teeth were adequately positioned after orthodontic treatment. Nevertheless, it was noted that the left lateral incisor was drifted distally after crown removal. This tooth drifted distally due a poorly contoured restoration lacking proper proximal contacts. To correct the tooth position, personalized elastic separators were used in sequentially increased thicknesses as suggested by Smidt and Venezia.⁷ After tooth repositioning and removal of the thicker elastic separator, an anatomically correct interim crown was cemented, and the regained space was successfully retained. This clinical procedure was described in previous reports,¹ but only prefabricated orthodontic separators with predetermined thickness were used to perform the tooth movement. According to the clinical purpose, it may be a limitation to achieve higher magnitudes of tooth movement. VanderWeele et al presented another personalized way to regain lost interproximal space.¹⁰ They used prefabricated orthodontic separators in conjunction with an incrementally modified acrylic crown; however, this procedure is more technique sensitive, as the interim crown anatomy is constantly modified. Moreover, the successive crown alterations may result in porosity at the crown surface, damaging the quality of the interim restoration.

Because the tooth movement and the definitive crowns were fabricated in a short period of time, no orthodontic retainer was used during the interim crown stage. Hence, special attention should be taken by the clinician during evaluation of contact points between the new interim crowns. If a longer treatment time is expected, an ortho retainer can be provided for the patient. Also, the clinician should double check if a proper contact point is present during patient returns. In Figure 6, it is possible to see proper contact points between definitive crowns after a 4 year follow-up.

One disadvantage when using orthodontic devices such as elastic separators is that they inevitably produce discomfort that can last the whole week, due to the continued force and occlusal interferences.^{6,13,14} A clinical pain study recommended that the initial discomfort from elastic separator placement can be reduced by giving the patient 400 mg of ibuprofen orally 1 hour preoperatively.⁷ Patients should be warned that pain due to separation may affect their chewing, social life, school work, and sleeping. Nalbantgil et al⁵ and Bondemark et al¹³ also recommended analgesics and soft food following placement of separators.

Hypermobility of the involved tooth is another effect to consider when tooth movement is required.¹² Patients may become alarmed, but if a healthy periodontium is present, discontinuation of the procedure for a limited period of time should resolve the problem. After mobility is reduced, movement can be reinitiated.¹ To improve the emergence profile in the definitive crowns, a slightly subgingival interproximal and buccal margin will allow the dental technician to reach the contact point with a steep emergence profile (Fig 5). This provides better support to the papilla and enhances the natural appearance of the restoration at the soft tissue interface because it will not angle off abruptly, leaving an unnatural contour between the teeth.¹⁷

Conclusion

Prefabricated orthodontic separators, which open an interdental space for placing orthodontic bands, can be modified to serve as a prerestorative means for solving mesiodistal crowding of teeth in select cases where small changes in tooth position are required, such as the one presented. In this article, the classic method was modified by the use of personalized elastic separators in sequentially increased thickness, so that the space gained with one personalized elastic separator was followed and increased with a thicker one. The results of this technique were achieved rapidly and allowed for the placement of a physiologically contoured esthetic crown. This procedure was technically simple and was less expensive for the patient than conventional orthodontics.

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