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Apinya Namkarunaruoj

Chalernpol Leevailoj

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Original Article

บทความวิชาการ

The use of orthodontic elastomeric ligatures and composite resin as an alternative to orthodontic treatment in closing maxillary anterior spacing: a case report

Apinya Namkarunaroj, DDS¹

Chalermpol Leevailoj, DDS, MSD, ABOD, FRCDT²

¹Graduate student, Esthetic Restorative and Implant Dentistry, Faculty of Dentistry, Chulalongkorn University

²Associate Professor, Program Director of Esthetic Restorative and Implant Dentistry, Faculty of Dentistry, Chulalongkorn University

Abstracts

Objective This case report showed the alternative management of anterior spacing by the use of orthodontic elastomeric ligatures to redistribute the spaces at the maxillary anterior teeth of one patient and followed by closing all the spaces between teeth with composite resin restoration.

Materials and methods A 23-year-old female presented with spacing in the maxillary anterior teeth. The teeth were located in a position which might not be suitable for achieving a restoration with good proportion. After evaluating the patient's dentition with the recurring esthetic dental (RED) proportion, it was concluded that minor tooth movement was needed by moving the lateral incisors distally to increase the space between the central incisors and lateral incisors; this would allow the addition of composite resin on the distal of maxillary anterior teeth. In order to achieve these goals and the desired proportions, orthodontic elastomeric ligatures were used for tooth separation and to subsequently distribute space between the maxillary teeth. The separating procedure was considered complete when adequate space had been obtained.

Results Composite resin was used to close all the spaces and recreate the anterior teeth esthetically following the RED proportion.

Conclusion Management of anterior spacing by using orthodontic elastomeric ligatures combined with composite resin is an easy and simple procedure that can be used by a general dentist. Nevertheless, case selection is crucial for the technique.

(CU Dent J. 2012;35:93-104)

Key words: composite resin; dental spacing; minor tooth movement; orthodontic elastomeric ligature

Introduction

Space between teeth (spacing), an important esthetic concern, can be managed via several approaches, including direct space closure with composite resin, alternative space closure by orthodontic treatment, or esthetic ceramic veneer or fixed prosthesis.¹ When teeth are severely misaligned, an orthodontic treatment can contribute to the creation of proper tooth position. Previous studies have shown that orthodontic treatment commonly provides satisfactory results without any loss of tooth structure, but this requires clinical training and special equipment with proper instrumentation. Disadvantages for this type of treatment modality are higher cost, time required and exceptional special care.²

However, in the case of good occlusion with proper vertical and horizontal overlaps, the use of direct restorations using composite resin could be considered as an alternative low-cost treatment. Furthermore, little or no preparation of a tooth is required, preserving maximum amount of tooth structure, thus achieving a long-lasting enamel bond.³ Longevity of the bond between composite and enamel is well documented.⁴ Improvements in the characteristics of recently developed composites resin have resulted in increased durability, esthetics and strength. Therefore, the use of composite resin restorations for closing spaces can provide impressive results in terms of both esthetics and function.⁵ Peumans et al. (1997) evaluated direct composite restorations over five years, and found that the anatomic form and surface texture remained unchanged, and a good appearance was maintained in terms of color matching and marginal adaptation.⁶ These findings were in consistent with other studies,^{7,8,9} where only minor changes were noticed such as surface appearance and marginal discoloration, while marginal adaptation was found to be sound after one year.

This article presents an alternative to orthodontic treatment for tooth movement, using orthodontic elastomeric ligatures to distribute spaces for esthetic

restorations. The anterior spacing can then be closed with composite resin, following the “recurring esthetic dental” (RED) proportion.

Clinical report

A 23-year-old female presented with canine Class I occlusion, spacing in the maxillary anterior teeth, left posterior maxillary and mandibular edentulous spaces, and retained right maxillary and mandibular primary second molars (Figure 1a–e). Maxillary and mandibular dental midline coincided with the facial midline. Mandibular dental midline was deviated 1 mm to the right from the maxillary dental midline. The maxillary dental midline was used as a reference midline. Both vertical and horizontal overlaps were 2 mm. Radiographs revealed the absence of right maxillary and mandibular second premolars (#15, #45) (Figure 2).

Preliminary impressions were made using alginate, and diagnostic casts fabricated. Dentoalveolar discrepancies were then identified. The axis of the left central incisor (#21) was noted to have deviated from normal inclination. The cause of the maxillary anterior teeth spacing present may be related to tooth size discrepancy. The options for this case could be corrected by orthodontic treatment or by restorations. After discussing with the patient, she declined orthodontic treatment neither by fixed nor removable appliances due to financial inconvenience. Therefore, the final treatment plan included space closing of the maxillary teeth, and implant placements in the areas of retained primary teeth (#55, #85) and in the edentulous areas of missing teeth #24, #25, #35.

When restoring anterior teeth, tooth proportion is an important consideration affecting the final esthetic result of the restoration. The use of the “recurring esthetic dental” or RED proportion instead of the “golden proportion” has been widely discussed.¹⁰ The RED proportion indicates, as viewed from the front, that the proportion of the widths of the maxillary teeth should

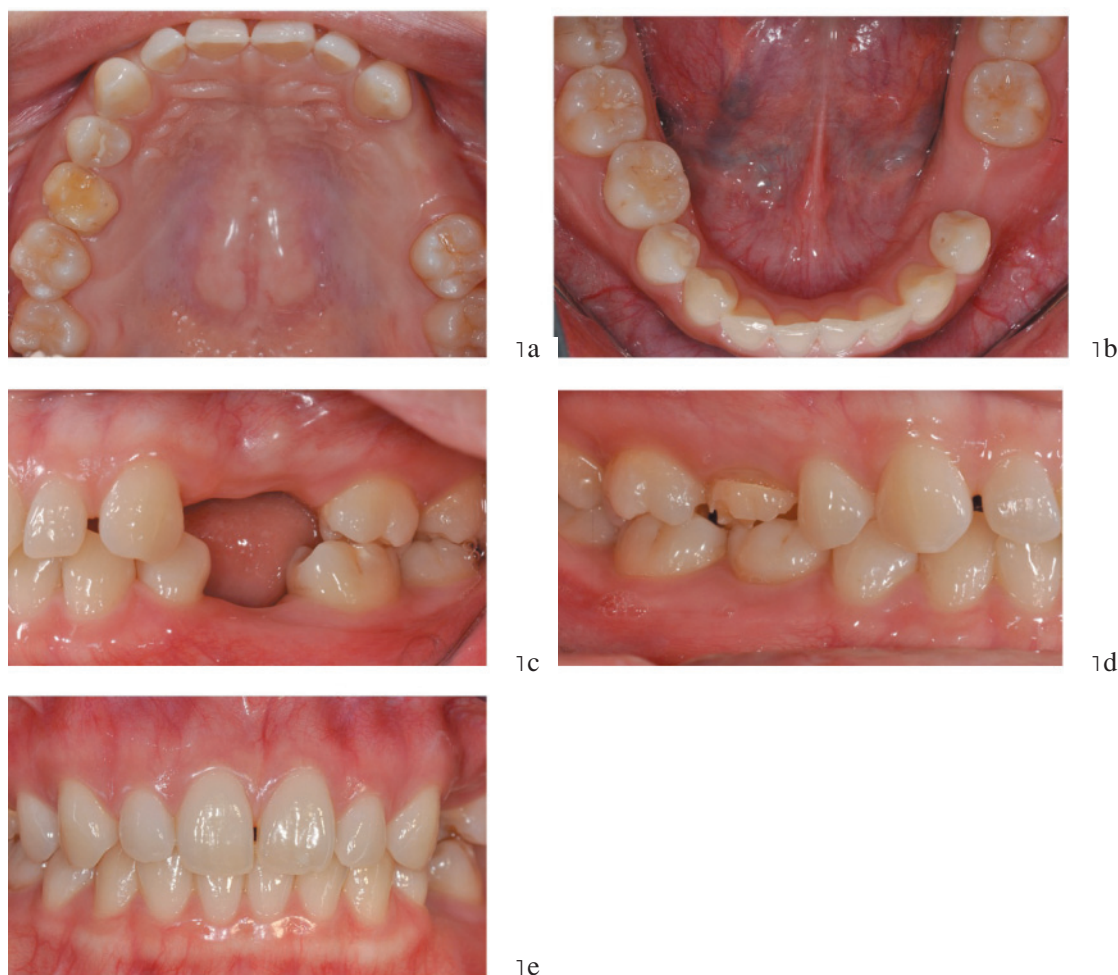


Figure 1: 1a, 1b, Occlusal views showing spaces between maxillary central incisors and, between lateral incisors and canines. Edentulous space at #24 and #25 areas, prolonged retention of a deciduous tooth (#55), edentulous area #35 and prolonged retention of another deciduous tooth (#85). 1c, 1d, Lateral views showing canine class I occlusion in both quadrants. 1e, Frontal view showing space between maxillary central incisors. Lower dental midline is deviated 1 mm from upper dental midline to the right.

remain constant (constant ratio 66–78%), progressing from the width of the maxillary lateral incisor to the width of the maxillary central incisor, and from the maxillary canine to the width of the lateral incisor.¹¹ In the present case, the width from frontal view of right canine to left canine was 36 mm. The width from frontal view of right central incisor, lateral incisor, and canine were 7.5, 5.5 and 5 mm, respectively. The width from frontal view of left central incisor, lateral incisor, and canine were 8, 5, and 5 mm, respectively (Figure 3). The space between the maxillary central incisors was

0.5 mm, the space between the right lateral incisor and canine was 0.9 mm, and the space between the left lateral incisor and canine was 1.1 mm (Figure 4).

The treatment plan was designed in accordance with the RED proportion concept of 70%.¹¹ The width observed from frontal view of central incisor, lateral incisor, and canine were assumed as X, Y and Z respectively. Then, the formulas were constructed as followed; $X + Y + Z$ is equal to 18 mm and Y / X is equal to Z / Y which is equal to 0.7. Though, $X + 0.7X + 0.49X$ is equal to 18. Thus, X is equal to 8.2, Y is



Figure 2: Preoperative radiograph reveals the absence of right maxillary and mandibular second premolars.

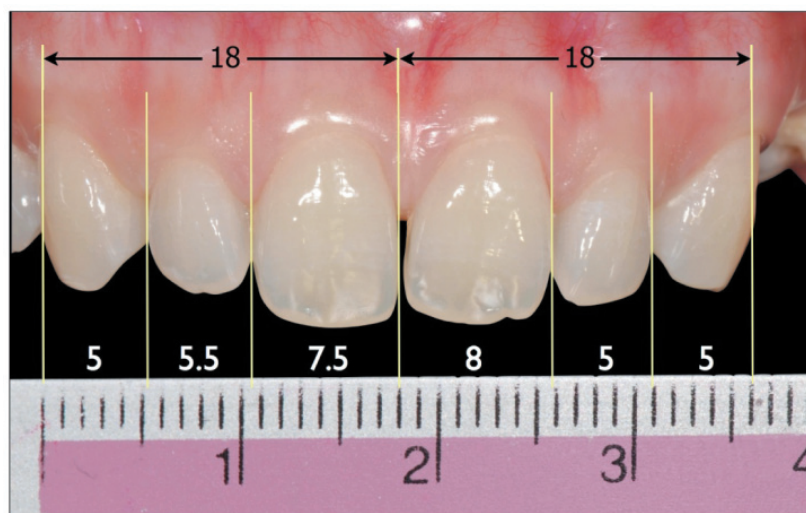


Figure 3: Axis of left central incisor deviated too mesially. The width from frontal view of right canine to left canine was 36 mm. Tooth width from frontal view of right central incisor, lateral incisor, and canine were 7.5, 5.5, 5 mm, respectively. Tooth width from frontal view of left central incisor, lateral incisor, and canine were 8, 5, 5 mm, respectively.

equal to 5.8, and Z is equal to 4. According to RED proportion, the widths observed from the front of central incisor, lateral incisor, and canine should be 8.2, 5.8, and 4 mm, respectively.

After evaluating the patient's dentition by the RED proportion, a diagnostic wax-up on the study model was done to demonstrate the expected final outcome to the patient (Figure 5). The treatment plan included minor tooth movements, which were necessary to achieve a more equal space distribution, combined with direct restorations.

The goals of this treatment were to move the lateral incisors (#12, #22) distally in order to create spaces between #11/#12 and #21/#22, which would result in tilting the central incisors mesially to close the space between #11/#21, and decreasing the space between the lateral incisors and canines (#12/#13) (Figure 4).

In order to achieve these planned positions, two orthodontic elastomeric ligatures with inside diameter of 1.25 mm, a width of 0.6 mm (Alastik Module, 3M Unitek, USA) were placed between tooth #11/#12 and

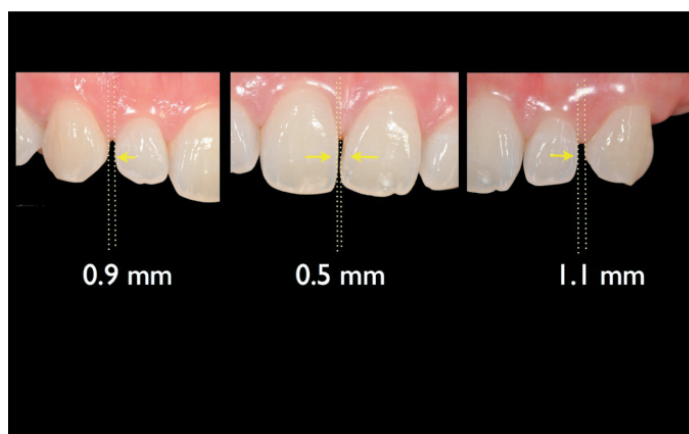


Figure 4: The space between maxillary central incisors is 0.5 mm. Space between right lateral incisor and canine (#12/#13) is 0.9 mm. Space between left lateral incisor and canine (#22/#23) is 1.1 mm. The goals of this treatment were to move the lateral incisors (#12, #22) distally in order to create spaces between #11/#12 and #21/#22, which would result in tilting the central incisors mesially to close the space between #11/#21, and decreasing the space between the lateral incisors and canines (#12/#13) by using orthodontic elastomeric ligatures.

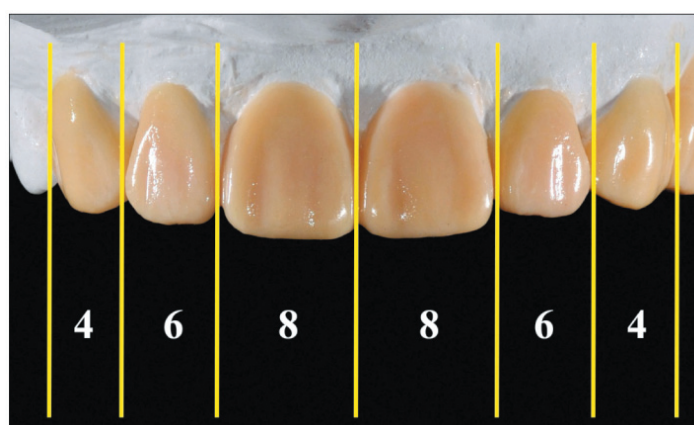


Figure 5: According to the recurring esthetic dental (RED) proportion, a diagnostic cast wax-up was done. The widths from frontal view of the central incisors, lateral incisors and canines should be 8, 6 and 4 mm, respectively.

tooth #21/#22 to redistribute space between the maxillary teeth (Figures 6a). After one week, the distal tipping of lateral incisors and the mesial tipping of central incisors were observed resulting in the space closure between the central incisors and space created between central and lateral incisors (Figure 6b). The central incisors were prepared for composite restoration.

The margins of the distal maxillary right central incisor (#11) and maxillary left central incisor were prepared without a bevel (#21). The maxillary right central incisor was etched for 15 seconds using a 37.5% phosphoric acid gel (Gel Etchant, Kerr, USA). The etchant was removed by rinsing with water spray, followed by air-drying of the enamel surface. Primer



Figure 6: **6a**, Orthodontic elastomeric ligatures were used for dental retraction between central incisors and lateral incisors in order to tilt lateral incisor distally and tilt central incisor mesially. **6b**, After a week of separation, the orthodontic elastomeric ligatures were removed resulting in creating spaces between central incisors and lateral incisors, and also deviate central incisor to close space at midline. **6c**, The spaces were then maintained using resin composite restoration by adding at distal of both left and right central incisors. The orthodontic elastomeric ligatures were still required for further separation between central incisors and lateral incisors.

was applied (OptiBond FL; Kerr, USA) to the preparation, and gently air-thinned. Adhesive (OptiBond FL) was then applied, gently air-dried, and light-cured for 20 seconds. Composite resin (Premise; Kerr, USA) shade A2 was applied using an incremental technique, and light-cured for 40 seconds on both labial and palatal surfaces. A celluloid strip was used to generate anatomic contour. Finishing and polishing steps were performed to achieve a smooth and anatomic form.

The restorative procedure described for tooth #21 was repeated for tooth #11 (Figure 6c).

At this point, further orthodontic elastomeric ligatures separation was required at the same location to achieve the treatment goal. Therefore, the process was repeated until proper space distribution was achieved and esthetic restorations accomplished (Figure 7a–d). The tooth #21 were reshaped and restored with composite resin to achieve better alignment (Figure 8a– b). After

Table 1 Tooth widths from frontal view before and after treatment

Tooth number	Tooth width before treatment (mm)	Tooth width after treatment (mm)
13	5	4.5
12	5.5	5.5
11	7.5	8
21	8	8
22	5	5.5
23	5	4.5



Figure 7: 7a, 7b, After a week of second separation, the spaces between central incisors and lateral incisors were created, spaces between lateral incisors and canines were decreased. 7c, 7d, The created spaces were closed by enlarging the central incisors (#11, #21) distally and the lateral incisors (#12, #22) mesially with composite resin. The spaces distal to the lateral incisors in both quadrants were filled using composite resin at mesial surface of right canine (#13), at distal surface of left lateral incisor (#22) and mesial surface of canine (#23).

treatment, the class I canine occlusion, horizontal and vertical overlaps were maintained. The final widths from frontal view of central incisors, lateral incisors and canines are 8, 5.5 and 4.5 mm as shown in figure 9 and table 1.

While these treatment procedures were ongoing, sinus lift surgery was performed at the upper left edentulous area with simultaneous implant placement. An implant was also placed at the location of tooth #35. Figure 10 shows comparison photos of pre-treatment



Figure 8: 8a, The restoration were then finished and polished. 8b, The final restoration after reshaping the left central incisor (#21).

(Figure 10a-d), and follow-up after 7 months of treatment (Figure 10e-h).

Discussion

This case report demonstrates an alternative to orthodontic treatment for closing maxillary anterior spacing with the use of orthodontic elastomeric ligature for tooth realignment and space distribution, followed by tooth reshaping using composite resin in order to achieve an esthetic result.

In the present case, an esthetic and functional outcome was achieved with very limited tooth movement combined with the use of composite resin materials. In cases which require only minor tooth movement or a small space to close, the use of orthodontic

elastomeric ligature may be considered. An orthodontic elastomeric ligature is a tiny rubber band which fits around the orthodontic bracket to hold the arch wire in place. Orthodontic elastomeric ligatures have a wide variety of colors, including clear.¹² For this reason, clear-colored orthodontic elastomeric ligature can be used to separate teeth, especially in the esthetic area.

In this case, orthodontic elastomeric ligatures were used for minor tooth movement to create the desired space in order to restore the teeth with RED proportions. Orthodontic elastomeric ligatures place force at the contact point, and separate teeth over a period of several days, increasing the space until the desired distance is obtained. However, the results from using orthodontic elastomeric ligatures as separators to create space can be unpredictable. The tooth, where the

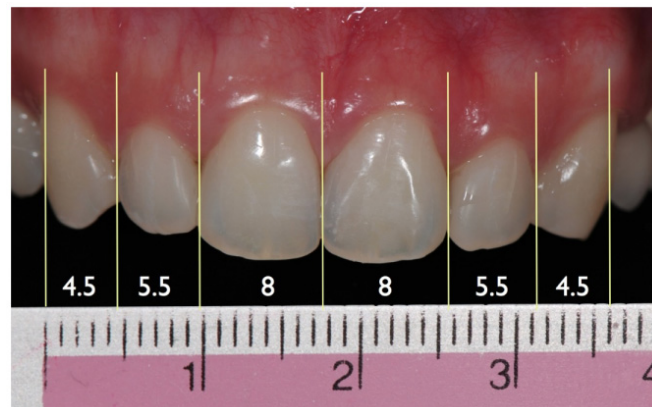


Figure 9: The final widths from frontal view of central and lateral incisors, and canines are 8, 5.5, and 4.5 mm, respectively.



Figure 10: Comparison photos of pre-treatment (10a, 10b, 10c, 10d), and follow-up after 7 months of treatment (10e, 10f, 10g, 10h).

orthodontic elastomeric ligature is applied, moves from the force generated by the orthodontic elastomeric ligatures towards the space. Tooth size and tooth axis also affect the distance of the tooth movement. Moreover, bodily tooth movement cannot be generated because the applied force is only a tipping force. In this case, the use of orthodontic elastomeric ligatures may have tendency to cause the axis of the left central incisor (#21) which was deviated from normal inclination to tilt more medially apico-incisal and create black triangle between maxillary central incisors. In order to correct the angulation of tooth #21 as well as to close the black triangle between #11/#21, the tooth #21 was slightly reshaped and restored with the composite resin by adding a filling material and creating a new mesial line angle to achieve better alignment.

In the present case, the recurring esthetic dental (RED) proportion was used to evaluate tooth size. Ward (2001) found that better esthetic results can be achieved if proportions are 70% when the length/width ratio of the central incisor is around 0.75–0.78.¹¹ Gillen et al. (1994) concluded that the central incisors and canines should be approximately equal in length, and 20% longer than the lateral incisors. The accepted length/width ratios of the central incisor should be 0.75–0.8.¹³

In achieving the RED proportion and esthetic result, the proper values for the length and width ratio of the maxillary teeth should be determined before treatment begins. For instance, in some cases when teeth need to be made wider, it is also important to make them longer to maintain the proper dimension. The correct proportion is an important preoperative consideration since some proportions may not be esthetic in some patients.¹³ However, a limitation of this technique is that undesired direction can occur from using orthodontic elastomeric ligatures resulting in unexpected final result. In the present case, the proper proportions could not be achieved; resulting in the length and width ratio that appeared to be higher than normal range. In order to obtain esthetic proportion, crown

lengthening procedure had been suggested. Nevertheless, the patient was satisfied with the result and declined to do crown lengthening.

The described technique is considered a simple way to regain space, and needs no special equipment other than orthodontic elastomeric ligatures. However, close observation is needed by the dentist, and the patient's cooperation is a prime factor in treatment success. The use of orthodontic elastomeric ligatures involves minimal discomfort and inconvenience to the patient. However, the location of orthodontic elastomeric ligatures application is important. If the orthodontic elastomeric ligature is placed too close against the gingiva, it can cause periodontal damage. The patient should be instructed to immediately report any orthodontic elastomeric ligature displacement. Proper case selection is an important factor for the technique.

In addition, to use restorative dentistry to resolve esthetic problems, clinicians need to explain to the patient that shade and texture of the restorative materials, especially resin composite, will gradually change with time, and that the restorations require periodic maintenance. Moreover, the margin of composite resin should be smooth otherwise it could be harmful to the gingiva resulting in gingival inflammation. Additionally, the patient should be advised to practice good oral hygiene, emphasizing daily tooth brushing and flossing as mandatory.

Conclusion

This article presents an alternative treatment to close spaces in the maxillary anterior esthetic zone. Orthodontic elastomeric ligatures were used in order to achieve minor tooth movement. This is an easy and simple technique, and a procedure that can be used by a general dentist. This technique offers an option for patients with improper distribution of anterior tooth spaces, in addition, it is more comfortable, costs less and less time-consuming for the patient compared to orthodontic treatment.

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การใช้เส้นมัดจัดฟันอีลาสโตเมอร์ร่วมกับ เรซินคอมโพสิตแทนการจัดฟันเพื่อปิดช่องว่าง บริเวณฟันหน้าบน: รายงานผู้ป่วย 1 ราย

อภิญา นาคารุนอรุณโรจน์ ท.บ.¹

เฉลิมพล ลิ่วโรจน์ ท.บ., วท.บ., ABOD, ส.ร.ท.พ.ท.²

¹นิสิตบัณฑิตศึกษา หลักสูตรทันตกรรมบูรณะเพื่อความสวยงามและทันตกรรมรากเทียม คณะทันตแพทยศาสตร์
จุฬาลงกรณ์มหาวิทยาลัย

²ประธานหลักสูตรทันตกรรมบูรณะเพื่อความสวยงามและทันตกรรมรากเทียม คณะทันตแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

บทคัดย่อ

วัตถุประสงค์ ในรายงานผู้ป่วยฉบับนี้นำเสนอวิธีการรักษาแก้ไขการปิดช่องว่างบริเวณฟันหน้าบน โดยใช้เส้นมัดจัดฟันอีลาสโตเมอร์ ในการปรับเปลี่ยนขนาดของช่องว่างบริเวณฟันหน้าบนกรณีกรไกรบนในผู้ป่วยหนึ่งราย ตามด้วยการปิดช่องว่างนั้นโดยใช้วัสดุอุดฟันเรซินคอมโพสิต

วัสดุและวิธีการ ผู้ป่วยหญิง อายุ 23 ปี แสดงลักษณะการมีช่องว่างบริเวณฟันหน้าบน ซึ่งฟันนั้นอยู่ในตำแหน่งที่ไม่เหมาะสมในการบูรณะเพื่อที่จะได้ขนาดสัดส่วนของฟันที่ดี หลังจากทำการประเมินขนาดของฟัน และช่องว่างของผู้ป่วยรายนี้โดยใช้หลักสัดส่วนทางทันตกรรม พบว่ามีความจำเป็นที่จะต้องมีการเคลื่อนฟันเฉพาะตำแหน่ง โดยทำการเคลื่อนฟันตัดซี่ข้างไปทางไกลกลางเพิ่มขึ้น และเพิ่มช่องว่างระหว่างฟันตัดซี่กลางและฟันตัดซี่ข้าง ซึ่งจะสามารถทำให้เพิ่มความกว้างทางด้านไกลกลางของฟันตัดซี่กลางได้อีกโดยใช้วัสดุอุดฟันเรซินคอมโพสิตเพื่อให้ได้สัดส่วนขนาดของฟันตามที่ต้องการ เส้นมัดจัดฟันอีลาสโตเมอร์ได้ถูกนำมาใช้ในการแยกฟัน และทำให้เกิดการปรับเปลี่ยนขนาดของช่องว่างบริเวณฟันบน ขั้นตอนการแยกฟันจะเสร็จสมบูรณ์เมื่อขนาดของช่องว่างที่เกิดขึ้นใหม่ได้ตามที่ต้องการ

ผลการศึกษา วัสดุอุดฟันคอมโพสิตเรซินได้ถูกนำมาบูรณะปิดทุกช่องว่างบริเวณฟันหน้าและทำการขัดแต่งให้ได้รูปร่างที่สวยงามได้หลักสัดส่วนทางทันตกรรม

สรุป การแก้ไขการปิดช่องว่างบริเวณฟันหน้า โดยใช้เส้นมัดจัดฟันอีลาสโตเมอร์ร่วมกับเรซิน คอมโพสิตนั้นเป็นวิธีการที่ง่าย ไม่ซับซ้อน และสามารถทำได้โดยทันตแพทย์ทั่วไป อย่างไรก็ตาม การทำการรักษาด้วยวิธีนี้ควรเลือกทำเฉพาะในผู้ป่วยที่เหมาะสมเท่านั้น

(จ. ทันต. จุฬาฯ 2555;35:93-104)

คำสำคัญ: การเคลื่อนฟันเฉพาะตำแหน่ง; ช่องว่างระหว่างฟัน; เรซิน คอมโพสิต; เส้นมัดจัดฟันอีลาสโตเมอร์