ว ทันต จุฬาฯ 2555;35:131-40
CU Dent J. 2012;35:131-40

Original Article
บทวิทยาการ

The use of a removable orthodontic appliance for space management combined with anterior esthetic restorations: a case report

Pasumon Sawangnimitkul DDS[1]
Chalermpol Leevailoj DDS, MSD, ABOD, FRCDT[2]

[1]Graduate Student, Esthetic Restorative and Implant Dentistry Program, Faculty of Dentistry, Chulalongkorn University
[2]Esthetic Restorative and Implant Dentistry Program, Faculty of Dentistry, Chulalongkorn University

Abstract

Spacing in the esthetic area results in an unconfident smile. To solve this problem, many alternative treatments can be used with multidisciplinary knowledge: for example, orthodontic treatment and restorative treatment. The treatment plan should be performed under conservative consideration, while the esthetic outcome should persist in the long term. Instead of using only restorative treatment to close several spaces, minor tooth movement before restorative procedures may achieve a preferable result since the teeth can be realigned to the proper position; it also requires less tooth structure preparation. This case report demonstrated the use of a removable orthodontic appliance to distribute the anterior space before restoring the bilateral peg-shaped lateral incisors with porcelain laminate veneers to close all the spaces in the maxillary anterior area. This resulted in a natural appearance with healthy gingival tissue during the 8-month follow-up period. This treatment principle can be applied for use in other small spacing cases.

(CU Dent J. 2012;35:131-40)

Key words: *esthetic; interdisciplinary approach; peg-shaped lateral incisor; porcelain veneer; removable appliance; spacing*

Introduction

Today, most people are concerned about their health and appearance; this includes healthy teeth and a beautiful smile, which will increase their confidence when out in public. The so-called esthetic zone in the anterior maxilla has the greatest impact on smile design. Tooth anomalies occurring in this area-such as misalignment, discoloration, or malformed and missing teeth-can lead to unattractive smiles with non-harmonious pink and white esthetic in the esthetic zone, which may sometimes reduce a person's confidence in smiling during their social lives.[1]

One common esthetic problem in the maxillary anterior area is a peg-shaped or mesiodistally deficient maxillary lateral incisor. The definition of a peg-shaped lateral incisor is given in the "Glossary of Prosthodontic Terms" (2005) as an "undersized, tapered tooth".[2] Atypical tooth shape may result from an inappropriate proliferation of the tooth bud cells during tooth formation.[3] Peg-shaped lateral incisors may cause spacing in the anterior maxilla, transposition of adjacent teeth, and prolonged retention of deciduous canines.[4] The incidence of peg-shaped lateral incisors is approximately 2% to 5% of the population, and occurs more frequently in females than in males.[5,6] Anatomically, peg-shaped lateral incisors are found predominately on the left side of the arch.[5,7]

There are two alternative treatments for peg-shaped lateral incisors. The first option is to move the canine forward with a fixed orthodontic appliance to close the space between the lateral incisor and canine, and then reshape the lateral incisor to make it appear more normal. The other treatment is to maintain the canines in Angle's class I relationship and restore the malformed teeth with resin composites, porcelain veneers or crowns. These restorations are used to close the space and change the peg-shaped lateral incisors into their natural shape.[8] The treatment time of the latter method is less, and the esthetic and functional outcomes are satisfactorily achieved.[4,9] However, in some cases the clinical situation is somewhat more complex and may not be able to be corrected by only restorative means. When teeth are severely misaligned, an orthodontic appliance can contribute to creating the proper tooth position prior to any restorative treatment. Furthermore, in some cases, periodontal surgery may be indicated in order to improve the gingival levels to create a more desirable symmetry and harmony of the pink esthetic.

Removable orthodontic appliances could be considered as an alternative treatment for patients with a single or a few misaligned teeth. Patients feel more comfortable with removable appliances compared to fixed appliances since they can be removed occasionally. A removable appliance will not compromise the patient's oral hygiene, and it requires less clinical chair time since the appliance is fabricated in a laboratory.[10] It can only apply tipping force to move the misaligned tooth; therefore, the treatment needs strict supervision by the dentist. Moreover, accomplishment of the treatment depends on the patient's cooperation. It is also difficult to create complex tooth movement because the removable appliance cannot achieve two-point contacts on teeth, which are necessary to control tooth movement in three dimensions.[10,11] In addition, the acrylic plate may affect speech and cause discomfort while wearing the appliance.[10]

A removable appliance with clasps and finger springs may be used for minor tooth movement in the anterior area, such as a small median diastema approximately 2 millimeters or less. Palatal finger springs are often used to move teeth in a mesiodistal direction in orthodontic treatment.[11] Optimum force for continuous tooth movement in a single-root anterior tooth is approximately 25-40 grams.[10,12] Activation of the palatal finger springs at 1.5 to 2 millimeters distance can move the maxillary central incisor about 1 millimeter in one month. Excessive force can complicate

the treatment, and insufficient force can prolong the treatment time.[10] Although removable appliances with a finger spring can shift the tooth to the correct position, the tooth does not have bodily movement in the same way as with a fixed appliance because the finger spring has only a point contact on the tooth. Therefore, only the tipping movement can be performed by removable appliances.[10]

Peg-shaped lateral incisors need restoration, such as direct resin composite or porcelain laminate veneers, to restore the tooth shape and close the space.[13,14] While composite veneers have the advantage of being a low-cost conservative procedure, porcelain laminate veneers have other advantages such as high longevity, material biocompatibility, and a highly esthetic result.[14,15] Porcelain can mimic the natural appearance of enamel.[16] Moreover, porcelain veneers retain less staining and are more durable compared to resin composite.[15] Friedman and colleague reported that the long-term clinical longevity of porcelain veneers was up to 15 years, with only 7% failure rate due to fracture, leakage, or veneer debonding. This indicates that porcelain veneers are very predictable restorations.[17] However, in order to fabricate a high-quality porcelain veneer, teeth need to be prepared to allow for adequate thickness of the material. Generally a feldspathic veneer requires a minimum thickness of 0.3 millimeters.[16] However, the fabrication of a 0.3-millimeter-thick high-strength leucite-reinforced veneer is very difficult. One study revealed some cracking of 0.3-millimeter-thick veneers during cement polymerization when the veneers wrapped over the incisal edge.[18] From these data, the recommended thickness for the veneers should be at least 0.5 millimeter if they cover the incisal edge or interproximal area.[18] However, peg-shaped lateral incisors need minor preparation because the teeth have enough space for porcelain veneer fabrication except at the cervical margin. Sufficient tooth preparation at the cervical margin is recommended in order to avoid an overcontoured restoration.[18]

In this case report, the patient was treated by minor tooth movement with a removable appliance to distribute the spacing more favorably. Then esthetic restorations were performed by correcting the peg-shaped lateral incisors with ceramic veneers.

Clinical report

A 19-year-old male patient was referred to the Esthetic Restorative and Implant Dentistry Clinic, Chulalongkorn University, for closing the space in the upper anterior maxillary region and to change both lateral incisors' shape. Intraoral examination revealed spacing between teeth 11 and 21 due to the distal migration of tooth 21 approximately 0.5 millimeter, while the mesial of tooth 11 coincided with the dental and facial midline. The shifting of tooth 21 was likely caused by malformation of the lateral incisors. The patient presented with two peg-shaped lateral incisors, teeth 12 and 22 (Fig. 1A). Tooth 13 was slightly mesiolingually rotated. All of the teeth were sound and asymptomatic. The patient had 2 millimeters of overjet and 2 millimeters of overbite. Radiographic examination found that tooth 21 was minorly tipped to the distal. Teeth 13 to 23 had an intact lamina dura, with no periapical radiolucency observed (Fig. 1B-D).

Our treatment plan was to do minor tooth movement of tooth 21 to close the median diastema (without moving tooth 11) by using a removable orthodontic appliance, and then to restore both peg-shaped lateral incisors with ceramic veneer facings. The orthodontic removable appliance was composed of one finger spring at distal of tooth 21, which generated force to move tooth 21 mesially, and one acrylic stop at distal of tooth 11, which helped stabilize the tooth 11 when tooth 21 was moved into contact. This procedure needed two weeks of force application and two weeks of stabilizing the tooth in position before the final restorations were performed. The case was finished by

Fig. 1 Pretreatment. 1A, Tooth 21 aligned distally while tooth 11 coincided with the facial and dental midline. 1B-D, Radiographic examination revealed sound maxillary anterior teeth and tooth 21 minorly tipped to the distal.

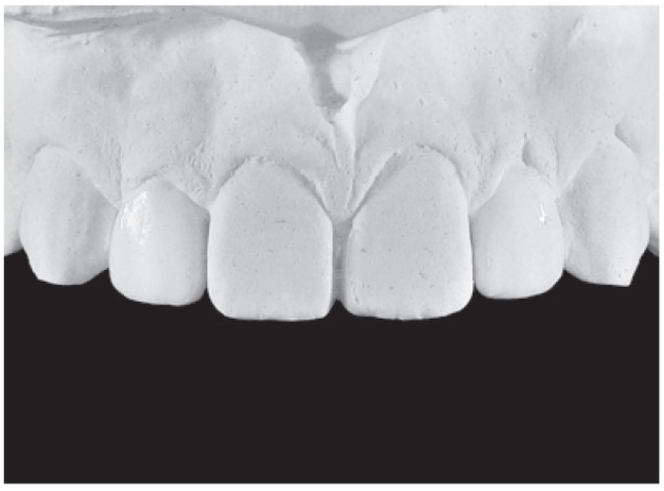

Fig. 2 Wax-up model was fabricated to present the possible outcome to the patient.

placing ceramic veneers on the two lateral incisors to close the space and change the tooth shape. The patient was asked to wear a full-time retainer for three months to stabilize the anterior teeth and continued to wear a part-time retainer for a year.[10]

With this preliminary condition, if the space was managed without using a removable orthodontic appliance, the median diastema would be closed by either resin composite or ceramic, which might result in unequal size of the central incisors. Under the proposed treatment plan, the two central incisors would not be prepared. Their alignment would be corrected by means of minor tooth movement. The two peg-shaped lateral incisors would be the only teeth that needed restoration. Consequently, the patient accepted our proposed treatment plan.

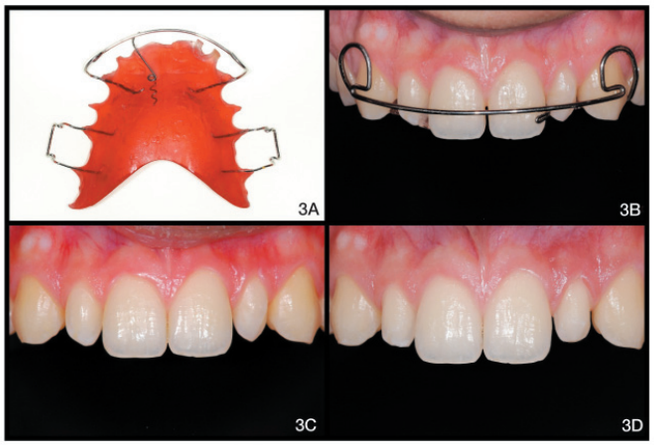

Fig. 3 Minor tooth movement with removable orthodontic appliance and tooth preparation. 3A, Removable orthodontic appliance with a finger spring at distal of tooth 21 and an acrylic stop at distal of tooth 11. 3B, The removable orthodontic appliance was inserted in the mouth. 3C, Frontal view after minor tooth movement was achieved. 3D, Minimal preparation on teeth 12 and 22 without using local anesthesia.

Clinical procedures

On the first visit, oral examination and smile analysis were performed. Then the patient's present dental condition was recorded, including radiographs of teeth 13 to 23. Impressions of maxillary and mandibular teeth were taken for preparing the study models.

On the second visit, a wax-up model was used to communicate with the patient about the treatment plan, treatment procedures and the outcome (Fig. 2). Then the removable orthodontic appliance, composed of one finger spring and one acrylic stop, was fabricated.

On the third visit, the spring-activated removable orthodontic appliance was delivered, and oral hygiene instructions were given (Fig. 3A and B).

Two weeks after appliance application, the space between teeth 11 and 21 was evaluated. The space was closed completely, as shown in Fig. 3C. Radiographic examination showed minimal alteration of the angulation of tooth 21.

Shade selection for porcelain veneers was performed using a Vita 3D-Master Shade Guide (Vident, USA) by selecting value, chroma and hue, respectively. The selected shade was 2M1. Teeth 12 and 22 were prepared for porcelain veneers using a conservative approach by removing minimal tooth structure at the cervical margins and labial surfaces, and shaping the incisal edges without using local anesthesia (Fig. 3D). A final impression was taken with light-body and putty polyvinyl siloxane (Flexitime, Heraeus Kulzer, USA) using double-mixed single-impression technique prior to fabricating the working model. Bite registration was taken using Blu-Mousse (Parkell, USA). Temporary restorations were carried out using resin composite (shade A2, Premise; Kerr, USA) with spot etching.[16] The temporary restorations were finished out of occlusion, and the patient was instructed to clean gently and avoid biting on these areas.

A photograph with shade tab and a drawing of the color mapping were used to mimic the nature of tooth (Fig. 4A and B). Then, two Empress Esthetic veneers (Ivoclar Vivadent, Liechtenstein) were fabricated with layering technique to create high translucent areas at the incisal third (Fig. 4C).

Clinically, the veneers were tried in after temporary veneers were removed. Resin cement (bleach shade, NX-3 Nexus; Kerr, USA) was used to cement both

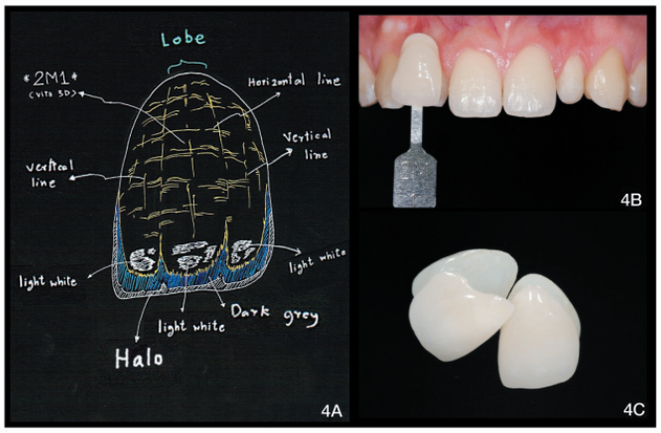

Fig. 4 Color mapping and shade selection of tooth 22. 4A, Drawing of tooth 22, showing color mapping and tooth characteristics, was sent to communicate with the laboratory technician. 4B, Photograph of adjacent teeth with matched shade tab. 4C, Veneers fabricated with translucent area and characterized to mimic adjacent teeth.

veneers. The inner surfaces of the veneers were treated with 4% buffered hydrofluoric acid gel (Porcelain etchant, Bisco, USA) for 4 minutes, and rinsed; then silane (Monobond-S; Ivoclar Vivadent, Liechtenstein) was applied, and dried with warm air for 1 minute.[19] Tooth surfaces were treated with 37.5% phosphoric acid gel for 15 seconds (Gel Etchant; Kerr, USA) and then rinsed. Primer and bonding agents (OptiBond FL; Kerr, USA) were applied following manufacturer's instruction. Bleach shade resin cement was applied on the inner surfaces of the veneers, which were subsequently cemented on both teeth and light-cured for 2 minutes. After cementation, occlusal adjustment was done and excess cement was removed. The patient satisfied with the result (Fig. 5). During the 8-month follow-up period, the patient was recalled and the veneers maintained their natural appearance with healthy gingival tissue (Fig. 6).

Discussion

In this case report, the finger spring was designed to be used with a slightly displaced tooth in the mesio-distal direction, since this spring has minor force that only lasts for a short period. The direction of the force from the spring should be perpendicular to the long axis of the tooth, and the force should pass as close to the center of resistance as possible to reduce tooth's rotation movement.[11] The use of a finger spring generates a center of resistance to the tooth at the middle of the root. The movement of the tooth is perpendicular to the tangent of the tooth surface at the contact point of the spring.[12] With a finger spring, it is not possible to move both the crown and the root simultaneously because the direction of the spring's force cannot pass the center of resistance. As a result, the root apex will move in the opposite direction compared to the crown.[12] Furthermore, the finger spring contacts the tooth at only one point, which leads the tooth to tip mesially or distally.[11] Minor tooth movement with a finger spring is acceptable in the case of tooth movement of a few millimeters. However, control of the root is needed when moving the tooth crown more than 3 to 4 millimeters.[10] As mentioned above, these are the limitations of a removable appliance with finger spring. However, the finger spring is appropriate in a case where the tooth needs uprighting in order to move the tooth to the right place, and it is inappropriate in a case where the tooth is already angulated in the desired direction.[11]

Orthodontically treated teeth tend to relapse over time, after the appliances are removed. A few factors are the major causes of relapsing. In this case report,

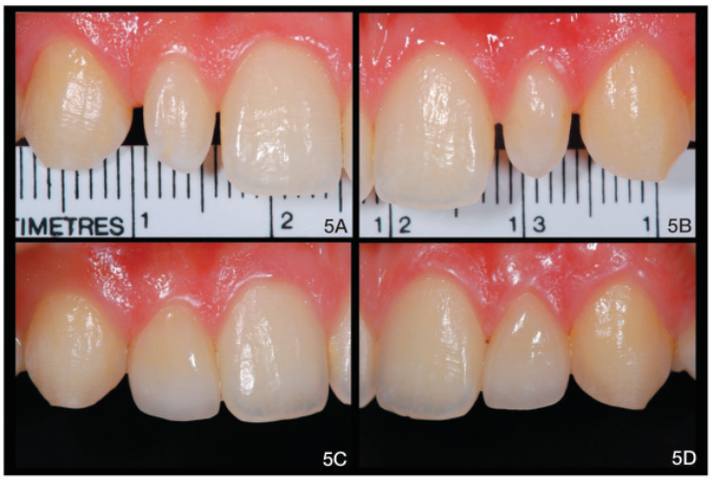

Fig. 5 Pretreatment and posttreatment of both peg-shaped lateral incisors. 5A and B, Equal spaces of teeth 12 and 22 were accomplished after tooth 21 was tipped mesially by using removable orthodontic appliance. 5C and D, Natural appearance of teeth 12 and 22 was achieved after veneer cementation.

Fig. 6 Comparison photos of pretreatment (left), and 8-month follow-up (right). 6A and B, The change in the facial appearance and the new smile refreshed the whole facial composition. 6C and D, The veneers gave the patient more confidence which showed in new natural smile. 6E and F, The veneers remained in natural appearance with healthy gingival tissue.

the primary cause was periodontal and gingival tissue reorganization. A previous study demonstrated that the periodontal ligament needs 3 to 4 months to reorganize itself, but the collagenous and elastic fibers in the gingival tissue need 4 to 6 months to do so. The supracrestal fiber can remodel extremely slowly, and may cause the tooth to displace within 1 year after treatment. This is why every patient needs to wear a full-time retainer for at least a few months, and this should be continued for 12 months as a part-time retention.[10]

Daily oral hygiene maintenance of the veneers is similar to that for natural teeth. Normal toothbrushing twice a day and flossing are recommended for daily care. One advantage of a porcelain surface is that there is less plaque and calculus deposition compared to a natural tooth surface.[16] Therefore, it is not necessary to use an ultrasonic scaler to clean the veneers. Dentists should also be aware that the ultrasonic scaler's tip may create roughness, scratches or chips on the porcelain surface.[20] Patients should take special care when biting on hard foods.[20] The gingival margin area is important; if gingival recession occurs, the veneer margin will be exposed and contribute to unesthetic outcomes. In addition, the veneers should be inspected regularly.[20]

For veneer preparation, the peg-shaped lateral incisors are already undersized. They only need minor preparation because there is already enough space for creating the porcelain veneers. However, preparation of the teeth is necessary to define the veneer margins during fabrication, so that they can be created with the proper thickness. In addition to mimicking the translucent area of the natural teeth, incisal reduction may be needed. Thus, restoring the peg-shaped lateral incisors with veneers is appropriate due to the conservative treatment aspect, longevity, and highly esthetic results compared to resin composite filling.[16]

Communication between the dentist and laboratory technician is an important issue. Simply selecting a shade tab is inadequate for creating the desired restorations.[21] In addition to effective communication with the laboratory technician, a drawing describing all the characteristics and color mapping should be sent to the laboratory in combination with pictures of the adjacent teeth and matched shade tab.[16] In our case, a drawing of tooth 12, which also simulated the characteristics of tooth 11, was sent to the laboratory technician. Pronounced vertical and horizontal lines with some white spots were indicated in the drawing. Highlighted edges with gray area at the incisal third showed the translucent area of the teeth. A photograph with shade tab 2M1 from the Vita 3D-Master Shade Guide was sent at the same time.

Marginal gingival recession is caused by many factors, including inflammatory periodontal disease, ageing, faulty tooth alignment, traumatic toothbrushing injury, orthodontic forces, pressure (bands, arch wires, clasps or denture bars) and deleterious habits.[22] The most common cause is traumatic toothbrushing injury.[23] The defect dominantly occurs on left canine area in right handed patients.[22] And it was found more frequent at facial surface than palatal side.[23] Moreover, the traumatic toothbrushing habits often relate to good oral hygiene.[23] In the present case, small gingival defects were shown at marginal gingiva of teeth 22 to 24. Faulty toothbrushing technique may be the cause, as noticed by good oral hygiene and the area of the defects. Proper oral hygiene instruction was given, however, the defects persisted after the treatment was completed. The patient was reinstructed and informed about disadvantages of toothbrush injury. The patient understood and attempted to follow the oral hygiene instruction.

Although the restorations look natural and achieve a highly esthetic result, their function and the patient's oral health are the most important issues. The patient must be informed of the entire treatment plan prior to the beginning of the treatment, including oral hygiene instruction. The patient must be aware that the focus needs to be not only on the restored area, but also on the entire mouth, in order to maintain the esthetic appearance and the longevity of the veneers.

Conclusion

The use of a simple removable orthodontic appliance combined with porcelain laminate veneers can be used to manage spacing in the maxillary anterior area with peg-shaped lateral incisors. This conservative treatment can achieve a highly esthetic outcome, with healthy gingival tissue. The treatment principles described in this case report can be extended to the treatment of other small spacing issues present in other cases.

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การใช้เครื่องมือจัดฟันแบบถอดได้เพื่อจัดการช่องว่างร่วมกับการบูรณะฟันเพื่อความสวยงาม: รายงานผู้ป่วย

พสุมนต์ สว่างนิมิตรกุล ท.บ.[1]
เฉลิมพล ลี้ไวโรจน์ ท.บ., MSD, ABOD, ส.ร.ท.พ.ท.[2]

[1]นิสิตบัณฑิตศึกษา หลักสูตรทันตกรรมบูรณะเพื่อความสวยงามและทันตกรรมรากเทียม คณะทันตแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
[2]หลักสูตรทันตกรรมบูรณะเพื่อความสวยงามและทันตกรรมรากเทียม คณะทันตแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

บทคัดย่อ

รอยยิ้มที่ไม่สวยงามอาจมีสาเหตุจากช่องว่างระหว่างซี่ฟันหน้า มีการนำความรู้องค์รวมมาประยุกต์เพื่อใช้ในแก้ไขปัญหานี้ ยกตัวอย่างเช่น การปิดช่องว่างบริเวณฟันหน้าโดยการจัดฟันร่วมกับการบูรณะฟันเพื่อความสวยงาม แต่อย่างไรก็ตาม การวางแผนการรักษาที่ดีควรยึดหลักการอนุรักษ์เนื้อฟัน ควบคู่ไปกับผลการรักษาที่สวยงามและคงทน ซึ่งการจัดฟันร่วมกับการบูรณะฟันเพียงบางซี่เป็นอีกทางเลือกหนึ่งที่จะได้ผลการรักษาที่ดีกว่าการบูรณะฟันทุกซี่เพื่อปิดช่องว่างทั้งหมด เนื่องจากฟันได้เคลื่อนที่ไปอยู่ในตำแหน่งที่ถูกต้อง และเนื้อฟันจะถูกกรอแต่งน้อยลงหากต้องมีการบูรณะฟัน แผนการรักษาผู้ป่วยรายนี้เพื่อปิดช่องว่างบริเวณฟันหน้าบนที่เกิดจากฟันรูปหมุด จะรักษาด้วยการจัดฟันโดยใช้เครื่องมือจัดฟันแบบถอดได้เพื่อปิดช่องว่างระหว่างฟันตัดกลางทั้งสองซี่ และทำให้ช่องว่างสำหรับฟันตัดข้างทั้งสองซี่มีขนาดเท่ากัน จากนั้นจึงบูรณะฟันตัดข้างทั้งสองซี่ด้วยพอร์ซเลนวีเนียร์ ผลการรักษาที่ได้พบว่าลักษณะฟัน เหงือก และรอยยิ้มของผู้ป่วยมีความเป็นธรรมชาติ เหงือกบริเวณฟันหน้าบนยังคงอยู่ในสภาพที่ดี ในช่วงระยะเวลาการติดตามผลเป็นเวลา 8 เดือน การรักษาด้วยวิธีนี้สามารถนำไปประยุกต์ใช้ในกรณีผู้ป่วยรายอื่นที่มีช่องว่างบริเวณฟันหน้าได้

(ว ทันต จุฬาฯ 2555;35:131-40)

คำสำคัญ: *การรักษาแบบสหวิทยาการ; เครื่องมือจัดฟันแบบถอดได้; ช่องว่าง; พอร์ซเลนวีเนียร์; ฟันรูปหมุด; สวยงาม*