"Case Report"

Correction of Maxillary Multiple Diastem and Mandibular Crowding with Removable Orthodontic

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Abstract

Crowding and diastema are common malocclusion conditions that occur due to a discrepancy between tooth size and jaw size. The treatment that can be done is based on the severity of the case. Mild cases of malposition can be treated with removable orthodontic appliances. This article aims to show the analysis how an active plate device with a simple spring was used to treat multiple maxillary diastemas and anterior crowding of the mandible. The patient complained that his upper front teeth gap and his lower teeth were crowded. It does not interfere with the appearance, but sometimes open food is tucked between the front teeth. The patient has never used an orthodontic appliance before. Molar relation: Malocclusion Angle class 1 type dental with mild individual tooth malposition.

INTRODUCTION

Malocclusion is a condition of discrepancy or deviation of the relationship of teeth or jaws from the ordinary.1 Factors that can cause malocclusion include genetic factors, developmental disorders, trauma, and chronic factors that can affect the shape of the jaw and the arrangement of teeth, including sucking fingers, tongue thrusting, biting nails or pencils, mouth breathing and bruxism.2-4 Malocclusion can cause speech disorders, jaw developmental disorders, mastication disorders, TMJ and periodontal tissue disorders, and psychosocial problems.4,5

Malposition conditions that are often encountered are crowding and diastema. Crowding can occur due to wider tooth size, narrow jaw size, a combination of both, and soft tissue pressure such as the cheek and tongue that can affect inclination, mandibular anatomy, overjet, and overbite.6,7 The treatment that can be done depends on the severity of the case. In mild-moderate cases (4-6 mm), interproximal expansion or reduction can be performed, while in severe crowding (>6 mm), extraction can be achieved.6

A multiple diastema is a space between both maxillary and mandibular teeth.8 This condition can interfere with appearance and reduce one’s self-confidence. Dental abnormalities, such as fewer teeth, teeth that are smaller in size or shape, agenesis, tooth loss, macroglossia, a wider jaw arch, high frenulum attachment, migration or movement of teeth, both physiological (such as the use of orthodontic devices) and pathological (such as the presence of cysts), genetics, and bad habits, can all contribute to multiple diastemas.9,10

Crowding and diastema conditions can be encountered in mild-to-severe malocclusion cases. Orthodontic treatment is required to correct the arrangement of teeth and jaw relationships to achieve occlusion and restore masticatory function and aesthetics. Removable orthodontics is an orthodontic treatment that can be performed in mild malocclusion cases.6 The advantages of removable orthodontic appliances are that they are easy to use, clean, simple to design, and economical.
The success of removable orthodontic treatment depends mainly on the patient's compliance with appliance use.\textsuperscript{11}

The active plate consists of active and passive components. The active component can be a spring to move the teeth or expansion screw, while the passive component is used to maintain the position of the teeth.\textsuperscript{11} The aims of this case report is to show the analysis how an active plate device with a simple spring was used to treat multiple maxillary diastemas and anterior crowding of the mandible.

**CASE REPORT**

The patient complained that her upper front teeth gap and her lower teeth were crowded. The complaint was made three years ago. It does not interfere with the appearance, but sometimes food is tucked between the loose front teeth. There was no pain or soreness in the teeth. The patient has never used orthodontic appliances before. The patient has never had the dentist to check the condition of her teeth. The patient brushes his teeth twice daily, in the morning before breakfast and at night before bed. The brushing techniques are vertical, horizontal, and roll, with duration approximately 2 minutes. Sometimes, patients also clean their teeth and oral cavity using floss and mouthwash.

History of dental growth and development: the patient said that the upper and lower deciduous teeth were arranged neatly, and all deciduous teeth fell out by themselves, none of which were extracted at the dentist. When the teeth were mixed, the patient said the upper and lower teeth were healthy, not crowded or gapped, and the permanent teeth erupted according to the time. At the time of permanent dentition, the patient said the arrangement of the maxillary front teeth was gapped, and the lower anterior teeth were not neat. The family history of the father, mother, and siblings was healthy; they had no history of systemic disease, and the teeth appeared normal. The patient has not been hospitalised in the last six months, has no allergies to food or drugs, and is not suspected of having a history of systemic disease that may interfere with orthodontic treatment. The patient consumes mineral water regularly (2 litres per day) and exercises by jogging three times a week. The patient consumes fruit once every two days by drinking juice and rarely consumes vegetables. The patient does not really like sweet food or drinks.

**CASE MANAGEMENT**

The patient first came to RSGM on 20 August 2022 for an indication. Subjective examination, objective examination, maxillary and mandibular moulding, extraoral measurements, and treatment documentation were performed.

A brachycephalic head shape (86.1 mm), a hypereuriprophy face shape (77.1 mm), a convex face profile with simon lines on the maxilla, and right and left mandibles that stick out were found during the extraoral exam. The patient's vertical-diameter rest position (VDRP) was 60.8 mm. The patient's Vertical Dimension Centric Occlusion (VDCO) is 58.5 mm, so the Free Way Space (FWS) is 2.3 mm (normal).

The patient's intraoral examination results showed an overjet 3.5 mm and an overbite 3.7 mm. The first right and left molar relations are class I Angles. The relationship between the right and left canines is class I. The maxillary central incisor midline is 1 mm to the right of the facial midline. The centre line of the mandibular incisor is 1 mm to the right of the maxillary centre line. The patient's facial profile photo is shown in Figure 1. The patient's centric relation photo is shown in Figure 2, while the occlusal view photo is shown in Figure 3. The shape of the maxillary and mandibular dental arches is parabolic-symmetrical. The malposition of the patient's teeth is as follows: 11
distolabiotorsiversi, 13 mesiolabiotorsiversi, 14 distopalatotorsiversi, 15 distopalatotorsiversi, 21 distolabiotorsiversi, 24 mesiobukutorsiversi, 25 distopalatotorsiversi, 31 mesiolingutorsi-versi, 34 bukoversi, 41 mesiolinguo-torsiversi, 43 mesiolinguotorsiversi.

![Images](72x554 to 155x665)

**Figure 1.** (a) front view without smile, (b) front view with smile, and (c) side view without smile.

![Images](186x555 to 269x665)

**Figure 2.** (a) right side view, (b) left side view, and (c) front view

![Images](115x404 to 231x524)

**Figure 3.** (a) maxillary occlusal view and (b) mandibular occlusal view

The calculations performed in this case are the Pont, Korkhaus, Howes method, and arch determination. The results of the Pont method calculation are: (1) the growth and development of the jaw laterally at the P1 interregion experienced a mild contraction of -0.2 mm; (2) the growth and development of the jaw laterally at the M1 interregion experienced a mild distraction of +1.3 mm. The result of the Korkhaus calculation is that the growth and development of the dental arch in the anterior direction have a retraction of 1.4 mm. The results of the Howes calculation are: (1) the P index obtained 45.4% (P> 43%), so it can be concluded that the dental arch can accommodate the teeth in an ideal and stable arch; (2) the Fossa canina index (FC) obtained 46.3% (FC> 44%), so it can be concluded that the basal arch can accommodate the teeth in an ideal and stable arch state. The results of the calculation of arch determination obtained are: (1) the discrepancy in the maxilla is correct +0.7 mm and left +1.4 mm; (2) the discrepancy in the mandible is right 0 mm and left 0 mm. The conclusion from these calculations indicated that the patient's condition could be treated with removable orthodontics by retracting the maxilla to close diastemas. The retraction arch determination calculation results show that by maxillary retraction by 1.3 mm, diastema on the right and left becomes 0 mm.

The diagnosis, in this case, was Angle class I type dental malocclusion with malpositioning of individual teeth: 11 distolabiotorsiversi, 13 mesiolabio-
torsiversi, 14 distopalatotorsiversi, 15 distopalatotorsiversi, 21 distolabiotorsiversi, 24 mesiobukotorsiversi, 25 distopalatotorsiversi, 31 mesiolinguotorsiversi, 34 bukoversi, 41 mesiolinguotorsiversi, 43 mesiolinguotorsiversi, accompanied by diastema on teeth 14 to 13, 13 to 12, 12 to 11, 21 to 22, 22 to 23, and accompanied by a shift of the central interincisivus line to the midline of the face to the right ± 1 mm and the habit of supporting the chin. The treatment performed on the patient was an active plate with a simple spring.

![Figure 4](image)

(a) upper jaw active plate design and (b) mandible active plate design

The plan treatment in this case is: (1) The operator explains the causes of tooth malposition, treatment procedures, costs required, and the possible length of treatment (6 months–1 year), the number of visits (1x a week), how to appliance, the possibility that occurs during treatment, and things that affect treatment. After treatment, the patient is asked to use a retainer. The operator explained that orthodontic treatment takes a long time, so it requires patience, diligence, and patient cooperation to comply with the operator's recommendations and the treatment plan that has been made so that treatment can be successful; (2) correction of individual tooth malposition and correction of diastema; and (3) maintaining the dental arch using retainers. The treatment was conducted for approximately nine months, with 22 control visits. During the third control visit, self-cured acrylic material was added because a mandible anterior plate had been lifted.

TREATMENT RESULT

There were diastema closures on interdental 14-13 and 21-22. There was also a diastema of 0.05 mm on interdental 13-12, 12-11, and 22-23. Correction of individual tooth malpositions in tooth elements: 13 mesiolabiotorversi (slightly corrected); 11 distolabiotorsi-versi (corrected); 21 distolabiotorsiversi (corrected); 31 mesiolinguotorsiversi (slightly corrected); 41 mesiolinguotorsiversi (slightly corrected); and 43 mesiolinguotorsiversi (corrected).

![Figure 5](image)

(a) right side view before treatment, (b) right side view after treatment, (c) left side view before treatment, (d) left side view after treatment, (e) front view before treatment and (f) front view after treatment.
DISCUSSION

The patient’s crowding and diastema conditions were classified as mild, so the treatment chosen used removable orthodontic appliance in the form of active plates. The advantage of removable orthodontic appliances is that they are accessible for the patient to use and remove. It is also easy for the patient to clean the appliances so that the health of the oral cavity is maintained. The success of treatment can be achieved if the patient cooperates in using the appliance. If the results of the point calculation obtained for the dental arch in the premolar and molar regions show mild contraction, Howes calculates that the dental arch can hold the teeth in an ideal and stable arch. In this case, the treatment is an active plate with a simple spring and a combination of grindings on the mandible. Diastemas in the maxilla will be used to distribute space to correct the malposition of teeth 11, 13, and 21. The space resulting from grinding the anterior teeth of the mandible is used to restore teeth 31, 41, and 43.

From the treatment results from the 1st control to the 22nd control visit, three teeth were corrected, which are teeth 11, 21, and 43. In addition, there is also a diastema closure on interdental 14-13 and 21-22.

In the Pont calculation, the P1-P1 distance was measured in the mandible because the maxillary premolar 1 was malpositioned. The point method shows that the dental arch grows and develops laterally in the P1-P1 region with a mild contraction, which can help support teeth that are crowded in the front of the mandible. One of the causes of crowding is the narrow shape of the jaw. Meanwhile, one of the causes of diastema is the presence of malpositioned teeth. Malposition of teeth 14, 13, 11, 21, and 24 can form multiple maxillary anterior diastemas.

In this case, an attempt was made to correct the diastema by activating the labial arch at each control visit. Active plate treatment for diastema correction was evaluated by measuring the change in diastema width or gap at each control visit for each tooth. Measurements were made using a sliding calliper at the predicted point of proximal tooth contact.

The treatment to correct individual tooth malposition and crowding was simple spring activation on teeth 13, 43, and interdental 31–41. Before activation, it is necessary to ensure space for tooth movement. Grinding or interproximal enamel reduction of 0.05 mm on teeth 14, 13, 32, 31, 41, 42, and 43 alternately and gradually in each control obtains the search for space. Grinding aims to create and maintain tooth alignment. Grinding can be performed in mild crowding conditions with a discrepancy of less than 5 mm under average tooth size, low caries risk, and good patient oral hygiene. The thickness
of enamel that can be reduced is recommended to be 0.25–0.5 mm on each side of the tooth to avoid the opening of dentin. After grinding, fluoride is applied to the teeth, which functions as a remineralizing agent to prevent caries and tooth hypersensitivity. The interproximal reduction will eliminate the external layer of enamel, which comprises a lot of calcium and phosphate. This makes room for fluoride ions to form fluorapatite, a substance that is more stable and resistant to acid attack.

The simple spring is activated by extending the wire arm in the labial direction so that the wire can push the teeth to the labial. Simple springs can be used for the correction of mild malpositions. The deflection that the spring produces affects the movement of the teeth. Deflection is how far the spring moves from its original position. Because the spring’s force is directly proportional to its deflection, as the teeth move or deflect, the spring’s strength gradually diminishes until it runs out. The smaller the deflection, the more the pushing force decreases, so activation is needed again. In the case of spring activation repetition is done for each control.

The labial arch in the maxilla was made to move anterior teeth (mesial 13, distal 11, and distal 21) in the palatal direction. Closing the multiple diastemas and maintaining the dental arch from the labial direction were also expected. In the mandible, the labial arch was in a passive position to maintain the dental arch of the mandible. When the labial arch in the maxilla is activated, teeth 11 and 21 move back towards the palatal direction. Some diastemas get smaller, and some even close up completely.

Tooth movement begins with the response of the periodontal ligament fluid, where the blood vessels in the periodontal ligament in the pressure area will be compressed, and the stretch area will experience dilation, so the ligament cells and fibres will be mechanically distorted. The process of bone remodelling in the socket by osteoclasts and osteoblasts occurs in the first two days after device activation, followed by a resorption process on days seven to twenty-eight so that the lamina dura in the area under pressure will be lost and produce tooth movement.

Single root tooth movement requires 25–40 gr/mm force. If the applied force is less than 25 gr/mm, tooth movement is impossible within the optimal time. On the other hand, if the applied force is more than 40 gr/mm, it may cause damage to the periodontal tissues, thus delaying tooth movement.

During every treatment control visit, the operator continuously checks the retentivity of the device, then proceeds with checking Oral Hygiene Index (OHI), cleaning the patient’s teeth using a brush and pumice paste, measuring the progress of diastema closure, measuring overjet, checking the plate by washing the plate using a brush, limiting the availability of space in the mandible, activating the maxillary labial arch, and simple spring on the maxilla and mandibles.

The treatment results from controls 1–22 showed good progress. Several diastemas on the maxillary dentition had closed completely, although there were still diastemas of 0.05 mm on teeth 13–12, 12–11, and 22–23. The malposition of teeth 11 and 21 has been corrected, and tooth 13 has started to move towards the ideal arch position. The malposition of tooth 43, and 31–41 has begun to lead to the ideal arch although not yet perfect.

The problem encountered during treatment was that an active plate was lifted in the anterior area of the mandible, so it had to be added using acrylic self-cure material, which was applied directly in the patient’s oral cavity during the 3rd control.
CONCLUSION
Active-plate removable orthodontics with a simple spring and grinding combination can be considered if there are mild cases of malposition of individual teeth in patients. Multiple diastemas can be overcome with labial arch activation, although some teeth with 0.05 mm diastemas still exist. Labial arch activation can also correct the malposition of teeth 11 and 21. The malposition of tooth 43 has been corrected with a simple spring, but it has not been perfectly corrected for teeth 13, 31, and 41.

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REFERENCE