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CASE REPORT

Treatment of a Class I Malocclusion with Severe Crowding using Passive Self-Ligating Brackets

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ABSTRACT

Presently, dental crowding is the most common problem among orthodontic patients. The prevalence of crowding in the dental arch is significantly increased in modern dentitions, and it is the most common reason why patients pursue orthodontic treatment. **Objective**: To report an advanced bracket systems, namely self-ligating brackets, to increase the efficacy of orthodontic treatment especially in patients with severe crowding. **Case Report:** A 22-year-old female patient presented with severe crowding of the maxillary and mandibular arches. In the upper arch, both second premolars were palatally positioned; in the lower arch, the lower right canine was lingually positioned and the lower left second premolar was extracted. The patient had a balanced facial profile with a straight profile and skeletal Class I relationship. Treatment was initiated using passive self-ligating brackets followed by extraction of the upper second premolars and the lower right first premolar. **Conclusion:** The use of passive self-ligating brackets proved to be effective and resulted in a significant improvement in the patient's dental and smile esthetics. The active treatment time was 11 months; this resulted in successfully alleviating the crowding of the maxillary and mandibular arches and significant improvement in the occlusal relationship.

Key words: class I malocclusion, passive self-ligating bracket, severe crowding

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INTRODUCTION

Malocclusion, characterized by crowding, can interfere with an individual's social relationships since facial esthetics is regarded as a determining factor in a society's perception of a pleasing countenance as well as an individual's perception of himself/herself. Crowding mainly occurs in places where there is a discrepancy between the arch dimension and the size of the teeth. The choice of treatment for crowding depends on the severity of the crowding, the patient's age, facial profile, and type of malocclusion.[1,2]

Crowding usually affects the anterior region; less frequently, it is seen in the posterior region. Its etiology is multifactorial, and it may be linked to decreased arch length, occlusion maturation, mesial force vector, muscle balance, morphology, tooth loss, and retention. In comprehensive orthodontics, two main therapeutic approaches are used to treat a Class I malocclusion: extractions and non-extractions.[3] The correction of dental crowding can be accomplished using a variety of orthodontic procedures. For example, the extraction of permanent teeth and the mesiodistal reduction of tooth size are procedures that are designed to fit less total tooth mass into a specific dental arch. Other treatment procedures, including palatal expansion and the use of certain functional appliances, are directed toward expanding the dental arches in order to accommodate the existing teeth.[4] In addition to facial esthetics, the position of the teeth in the space, their movement, and the stability of the final result are important conditions that must be considered in treatment planning.[5]

The appropriate therapy for dental crowding varies depending on the magnitude of the problem. Correction may occur spontaneously in patients with slight crowding (up to 2 mm); cases of severe crowding (>9mm) may require more extensive therapy with tooth extractions. The goal of extraction is to create space to enable the correct alignment and leveling of the teeth in the basal bone.[6] With advanced bracket systems,

such as self-ligating brackets, orthodontic treatment, especially for dental crowding, takes less time and is more efficient. Self-ligating brackets provide treatment with low friction so that the lip bumper effect can prevent the anterior teeth from flaring labially.[7]

This article reports on a case of a young adult patient with a Class I skeletal pattern with severe crowding in the upper and lower arches, who was treated with extraction using passive self-ligating rackets.

CASE REPORT

A 22-year-old female was referred to the Department of Orthodontics, Universitas Indonesia with a chief complaint of irregularly placed upper and lower teeth. The patient had no relevant medical history. Temporomandibular joint (TMJ) examination showed no history of pain and clicking while engaged in various jaw movements. Frontal and profile facial soft tissue evaluation revealed a symmetrical and balanced facial pattern with a straight profile (Figure 1). Dental analysis revealed an Angle's Class II malocclusion on the right side and a Class III malocclusion on the left side.

The overjet was 2 mm and the overbite was 4.5 mm. Traumatic bite with gingival recession in the left canine and a missing lower left second premolar was observed. Overall, the dentition and periodontium were in good health. Dental cast analysis showed severe crowding in both the upper and lower arches. The arch-length deficiencies were 15 mm in the maxillary arch and 11 mm in the mandibular arch. Both upper second premolars were palatally positioned and the lower right canine was lingually positioned.

The patient's lower dental midline was deviated 2 mm to the right; the upper dental midline was normal with reference to the facial midline. The panoramic radiograph results revealed horizontally impaction of the left and right mandibular third molars (Figure 2). The lateral cephalometric analysis revealed a skeletal Class I relationship with a balanced skeletal pattern in the anteroposterior direction between the maxilla, mandible, and other facial structures (ANB= 3°; Angle of Convexity= 4°). The vertical growth pattern and mandibular plane were normal (Y Axis= 61.5°; MMPA= 28°). The upper incisors were normal (1-SN= 108°; 1-NA= 3 mm); the lower incisors were retroclined (IMPA= 83°; 1-NB= 4 mm) (Figure 3).

Treatment objectives included maintaining the patient's pleasing profile; achieving the Class I molar and canine relationship, bilaterally; relieving the maxillary and mandibular crowding; achieving an ideal overjet and overbite and achieving ideal and stable dentoalveolar changes.

Figure 1. Pre-treatment facial and intraoral photographs.

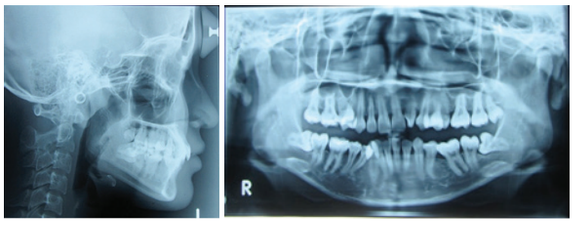

Figure 2. Pre-treatment cephalometric and panoramic radiographs.

Treatment Plan

Based on the information gathered from the clinical examination and the diagnostic records, the treatment plan included relieving the maxillary and mandibular crowding using a maxillary and mandibular fixed appliance with extraction of the second premolars in the upper arch and the first premolars in the lower arch. The following treatment plan was determined: oral hygiene control; extraction of the upper second and lower first premolars; alignment of the upper and lower teeth with passive self-ligating system brackets (Damon Q, Ormco, Glendora, CA, USA) and retention to achieve stabilization of the improved tooth alignment and facial esthetics.

Treatment Progress

The maxillary and mandibular first and second molars were bonded with Damon Q snap-link. The maxillary and mandibular teeth were bonded with Damon Q brackets. Treatment was started using 0.014" CuNiTi in both arches with an open coil spring, loosely tied to the upper left lateral incisor and lower right canine. Alignment and leveling procedures were followed by installing a 0.016" wire on both arches. During this period, the upper left canines and lower right second premolar underwent distalization, which provided

space for the upper left lateral incisor and the lower left canine teeth. Distalization was performed with an open coil spring. The upper lateral left incisor and the lower left canine were fully engaged to the main archwire after proper space was obtained. Alignment and leveling were completed with the use of CuNiTi 0.018"x0.025". Based on the patient's clinical examinations, especially the molar relationship and cephalometric exams, the clinician decided to conclude residual space closure in the upper left and lower right segment by mesially moving the posterior teeth to achieve molar Class I relationships using elastomeric chains from the posterior teeth to the crimpable hooks that were added to the main archwire, which was 0.017"x0.025" stainless steel. Meanwhile, the patient's anterior teeth were tied together using metallic ligature acting as an anchorage unit.

Based on the clinical and radiographic findings, the brackets were repositioned to improve the occlusal relationship. Treatment completion included first-order bends in the mesial upper molars to improve the occlusal relationship, particularly in the transversal direction. Case finishing was performed by intercuspation with a 0.018"x0.025" stainless steel archwire with the aid of 5/16" medium Class III intermaxillary elastics. After assuring that the esthetic, occlusal, and functional outcomes were achieved, the orthodontic appliance was removed. The retention phase included a vacuum formed retainer in the upper and lower arches that the patient used during the night over the remaining period. Treatment outcomes were achieved within 12 months, which comprised the active phase.

Treatment Results

The final treatment outcomes were considered highly satisfactory and met the objectives set at the treatment onset. Class I molar and canine relationships with a normal overjet (2 mm) and overbite (2 mm) were achieved. Both arches showed good alignment. The lingually blocked lower left canine was corrected. For the upper lip, the lip position relative to the E-line improved from 2 mm to 1 mm behind the E-line; for the lower lip it improved 1 mm to coincide with the E-line. The patient was satisfied with the tooth alignment and facial profile outcomes. The facial alterations occurred in response to movement applied to the incisors. The upper incisors were protracted in 2 mm, with 4° of labially tipping in relation to the NA line; whereas the lower incisors were protracted in 2 mm, with 9° of labially tipping in relation to the NB line (Figure 3).

With regard to occlusion, case finishing was achieved with the canines and the first molars in the key to occlusion and good intercuspation of posterior teeth (Figure 3 and Figure 4). From a functional standpoint, proper adaptation of the anterior overjet and overbite, as well as torque control for all the teeth, made it possible to achieve incisal guidance in the protrusion and lateral canine guidance without any occlusal interference.

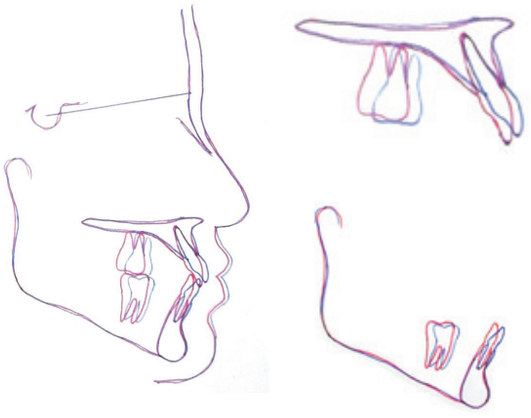

Figure 3. Total and partial superimposition of the maxillary and mandibular initial (red line) and final (blue line) cephalometric tracings.

Figure 4. Post-treatment facial and intraoral photographs.

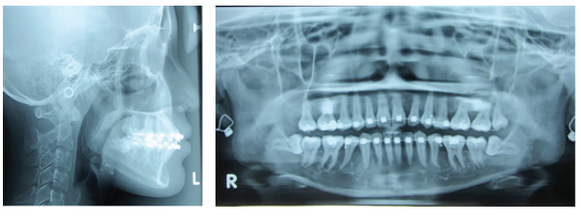

Figure 5. Post-treatment cephalometric and panoramic radiographs.

DISCUSSION

Crowding can occur as a result of genetically determined factors or environmental factors, but more

commonly it is a combination of both inherited and environmental factors acting together. Based on the patient's history and examination, it can be concluded that the malocclusion was caused by dental factors. Crowding in the upper jaw and lower jaw is thought to be caused by a discrepancy between the tooth size and width of the dental arch on the maxilla and mandible.[8] Tooth size is known to be influenced by genetic factors, whereas the shape and width of the dental arch are known to be influenced by genetic and environmental factors.[9] Premature loss of upper second molar deciduous teeth is thought to cause mesial drifting of the first upper molar teeth. This condition causes deficient placement of the upper second premolar teeth, which grow in the palatal direction according to the position of the germs. In the lower jaw, a missing lower second premolar causes mesial drifting of the lower left first molar so that the molar relationship becomes Class III (1/2 unit).

Orthodontic treatment of a Class I malocclusion with crowding may be performed either by extraction or non-extraction with interproximal reduction, dental expansion, distalization of molar teeth, and proclination of incisors. The choice of the treatment plan generally depends on the degree of crowding and the patient's profile.[10] According to Cobourne et al., for moderate dental crowding cases (5–8 mm), extraction of the first premolars or second premolars may be the selected treatment approach; for severe dental crowding cases (>8 mm), extraction of the first premolar teeth is commonly selected.[11] In the case reported in this article, based on the results of the space requirement analysis using the Kesling method, deficiencies in the upper arch space were found on the right side (7.5 mm) and the left side (5 mm). Calculations on the lower arch indicated a 7 mm lack of space on the right side. Therefore, in this case, the treatment choice was premolar extraction in the upper and lower arches, which aimed at correcting both the dental crowding and the molar relations. The overjet was maintained by not altering the anterior arch of the upper and lower teeth

The extraction of the premolar teeth in the upper jaw and lower jaw is based on a space requirement analysis and by considering the type and position of the malposition tooth on the arches.[12] The extraction of upper second premolar teeth was selected based on the crowding site. In this case, the upper second premolars were palatally blocked while the upper first premolars were relatively aligned in the dental arch. This is in agreement with Mitchell's statement on cases with second premolars growing in the palatal portion of the maxilla and lingual portion of the mandible. The extraction of palatally blocked second premolars in the maxilla is generally indicated. Meanwhile, in the lower jaw, it was indicated to remove the first premolar tooth because it is relatively easy to remove and because spontaneous correction of the lingually blocked second premolar can occur.[11] In the lower jaw, tooth extraction is selected based on the degree of crowding in the right arch, which, in this case, was severe. Moreover, first premolar extraction in the lower arch is intended to correct the lingually blocked canine teeth by considering the importance of canine teeth in patient esthetics and mastication with canine guidance.[13]

In this case, an overbite of 4.5 mm indicated that the patient had a deep bite. The deep bite was corrected by intrusive maxillary incisors using a step-down bend on a 0.018x0.025 stainless steel wire. This method was chosen because intrusion and proclination of the incisors are methods used to correct deep bite cases that are known to produce stable treatment results in adult patients.[14] In this case, the overbite correction improved from 4.5 mm to 2 mm due to the effects of maxillary incisor intrusion and mandibular incisor proclination, characterized by increasing incisive inclination of the mandible to the mandibular plane from 83° to 92°.

At the end of treatment, gingival attachment on the upper left canine appeared to increase. The gingival recession of the upper left canine, which resulted from premature contact with the antagonist's tooth, improved at the end of treatment due to improved canine position in the dental arch. This is in agreement with the finding reported in Alkan et al., who observed that orthodontic treatment can correct gingival recession by improving the attachment of the gingival epithelium, which is obtained by improving the position of the teeth on the alveolar bone.[15] The use of a passive self-ligating system, in this case with light and continuous force, resulted in the movement of the teeth by frontal resorption of the alveolar bone and bone remodeling that lasts for a longer period. Thus, the movement of orthodontic teeth took place more quickly when suing this system.[16,17]

After 12 months of treatment, lateral cephalometric evaluation showed no significant changes in the horizontal or vertical skeletal parameters. The dental parameters indicated a significant change in incisor inclination of the mandible from retrusive to normal. This is due to the use of the 0.018x0.025" stainless steel wire, which resulted in torque expression of the brackets, so the incisor inclination value became normal. In the maxillary incisors, increases in the UI-SN and UI-MxP values were observed, indicating that the upper incisor became more protrusive even within normal limits. This was thought to be due to the side effects of the dental crowding correction of the maxillary teeth, which caused flaring of the anterior region. The improvement in the inclination and position of the upper incisors was favorable for the patient's soft tissue profile with the improvement of lip position to the E-line.

CONCLUSION

After active treatment, a good facial profile and occlusion were achieved in this case. The use of passive self-ligating brackets proved to be effective, and it resulted in a significant improvement in the occlusal relationship as well as in the patient's dental and smile esthetics. The active treatment time was 11 months, which resulted in successfully alleviating the crowding of the maxillary and mandibular arches and correcting the deep bite; it significantly improved the occlusal relationship as well as the patient's dental and facial esthetics. After treatment, all of the patient's chief complaints were relieved. Vacuum formed retainers were placed after debonding, and the patient was instructed to wear them for the remaining period.

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