
Effectiveness Of Finger Appliance Combined With A Z-Spring In The Management Of Maxillary Multiple Diastema And Midline Shift: A Case Report

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Abstract

Malocclusion can affect both oral aesthetics and function, one manifestation of which is multiple diastema, defined as spaces between two or more adjacent teeth. This condition is often accompanied by a maxillary midline deviation, which may compromise dental aesthetics and occlusal harmony. The management of multiple diastema requires a multidisciplinary approach aimed at closing interdental spaces, correcting midline deviation, and eliminating etiological factors. Removable orthodontic appliances may serve as a viable treatment option because they are simple, easy to fabricate, and more cost-effective than fixed appliances. This case report aims to describe the management of maxillary multiple diastema associated with midline deviation using a removable orthodontic appliance in the form of an active plate. A 24-year-old female patient presented with spacing between the anterior teeth of the maxillary arch. Clinical examination and supporting analyses revealed a skeletal Class III relationship with a maxillary arch excess space of 1.6 mm. The treatment plan focused on the closure of multiple diastema and correction of the maxillary midline deviation using an active plate. Periodic activation of the appliance was performed to achieve tooth movement for space closure and midline correction. Evaluation after three months of treatment demonstrated successful closure of the multiple diastema and improvement of the maxillary midline while maintaining normal occlusal relationships. This case report concludes that removable orthodontic treatment using an active plate is effective for diastema closure and midline correction in selected mild-to-moderate cases, particularly in cooperative adult patients.

Keywords: Multiple Diastema, Midline Shifting, Removable Orthodontic Appliance, Active Plate, Case Report.

INTRODUCTION

Orthodontic treatment is commonly performed to enhance smile aesthetics, as an attractive appearance plays an important role in both social and professional interactions. Smile aesthetics are influenced by several factors, including facial symmetry, appropriate tooth size proportions, minimal gingival exposure during smiling, a balanced buccal corridor, a smile arc that follows the contour of the lower lip, harmonious vertical tooth relationships, and the absence of diastema¹. The alignment of the dental midline with the facial midline is an important determinant of facial and smile aesthetics. Minor discrepancies between these two reference lines are generally considered acceptable; however, significant deviations may adversely affect dentofacial aesthetics. In clinical practice, discrepancies between the dental and facial midlines are frequently observed in patients with malocclusion. These discrepancies may arise from various etiological factors, including mandibular displacement associated with crossbite, dental arch asymmetry, tooth size discrepancies, displacement of the maxillary or mandibular incisors, unilateral mandibular deviation, or a combination of these factors².

Diastema is defined as a space or gap between adjacent teeth and may present as either a central diastema or multiple diastema. Central diastema occurs between the maxillary central incisors, whereas multiple diastema involves spacing in several regions of the maxillary and/or mandibular dentition. Although diastema is frequently observed during the mixed dentition period and often resolves spontaneously with the eruption of the permanent canines, it may persist into adulthood. Persistent diastema is considered an occlusal anomaly that compromises normal interdental contact and may adversely affect dental aesthetics and patient satisfaction with their smile^{3,4}. The etiology of multiple diastema is multifactorial and may include dental anomalies, such as abnormal tooth morphology and tooth agenesis, as well as parafunctional oral habits, including thumb sucking, prolonged pacifier use, and tongue thrusting⁵.

Cases involving midline deviation and multiple diastema can be effectively managed through orthodontic treatment. The primary objectives of orthodontic therapy are to eliminate etiological factors that contribute to abnormal dental and craniofacial growth and development, prevent the progression of malocclusion, and restore normal occlusal relationships².

Orthodontic treatment is considered an effective approach for correcting diastema and midline deviation, as it can provide favorable aesthetic and functional outcomes³. One commonly used treatment modality is the removable orthodontic appliance, which consists of an acrylic baseplate, active components, and retentive elements. This appliance offers several advantages, including ease of insertion and removal by the patient, thereby facilitating better maintenance of oral hygiene and appliance cleanliness. However, removable appliances have limitations in controlling tooth movement, as they primarily produce tipping movements along the long axis of the tooth. Unlike fixed orthodontic appliances, which allow three-dimensional control of tooth movement, the forces generated by removable appliances are applied through point contacts on the tooth surface, making them less effective in achieving bodily tooth movement and apical displacement⁶.

This case report aims to present the management of maxillary multiple diastema associated with midline deviation using a removable orthodontic appliance consisting of an active plate with a finger spring combined with a Z-spring.

RESEARCH METHODS

A 24-year-old female patient presented to the Dental and Oral Hospital of Soelastris Surakarta, with the chief complaint of spacing between her maxillary anterior teeth, which frequently caused food impaction. She sought orthodontic treatment to improve both function and aesthetics. The condition had been present for approximately four years since her college years. The patient's dental history revealed no complaints of dental caries or tooth wear during the primary dentition stage, and she had not received any dental treatment during early childhood. During the mixed dentition period, she underwent extraction of a retained maxillary anterior primary tooth. In the permanent dentition stage, she had received restorative treatment and underwent routine dental scaling. No history of dental or facial trauma was reported.



Figure 1. Pretreatment extraoral photographs.

Intraoral examination revealed a parabolic maxillary arch and a trapezoidal mandibular arch. The overjet was 2 mm, and the overbite was 2.7 mm. Molar relationships were Angle Class III on the right side and Class I on the left side. A maxillary dental midline deviation of 2.5 mm to the right relative to the mandibular midline was observed. Individual tooth malpositions included tooth 13 in mesiolabiotorsion, tooth 14 in mesiopalatotorsion, tooth 23 in mesiolabiotorsion, tooth 25 in distobuccotorsion, tooth 36 in linguoversion, tooth 35 in distolabiotorsion, tooth 34 in distobuccotorsion, tooth 33 in mesiolabiotorsion, tooth 44 in mesiobuccotorsion, and

tooth 45 in linguoversion. Spacing was present between teeth 11–12, 12–13, 13–14, 21–22, 22–23, and 23–24.



Figure 2. Pretreatment intraoral photographs.

Arch analysis using Pont's method demonstrated mild transverse expansion of the maxillary arch, with discrepancies of +1.38 mm in the premolar region and +1.85 mm in the molar region. Korkhaus analysis indicated a slight anterior retrusion of the dental arch of −0.9 mm. According to Howes analysis, the premolar index was 45.9% and the canine fossa index was 45.3%, indicating that the dental arch was adequate to accommodate the dentition ideally (premolar index >43%) and that the basal arch provided sufficient space for stable tooth alignment (canine fossa index >44%). Furthermore, the posterior teeth exhibited a divergent inclination pattern, as the canine fossa index was lower than the premolar index.



Figure 3. Pretreatment study model photographs.

Cephalometric skeletal analysis using Steiner's method showed normal skeletal relationships, with SNA, SNB, and ANB angles of 81°, 79°, and 2°, respectively, indicating a skeletal Class I relationship. Dental analysis revealed an upper incisor inclination (U1-NA) of 29°, indicating proclination of the maxillary incisors, and a lower incisor inclination (L1-NB) of 23°, which was within normal limits. The interincisal angle was 124°, suggesting a protrusive incisor relationship. Arch length Discrepancy (ALD) revealed a maxillary space discrepancy of +1.6 mm, whereas the mandibular arch exhibited a space deficiency of −2 mm.



Figure 4. Pretreatment cephalometric analysis.

The diagnosis and treatment plan were established based on the patient's chief complaint, subjective and objective examinations, dental cast analysis, facial profile assessment, and cephalometric evaluation. The final diagnosis was Angle Class III subdivision on the right side with a skeletal Class I dentoskeletal pattern, accompanied by a crossbite relationship between teeth 13 and 44, maxillary spacing, mandibular crowding, a 2.5 mm maxillary dental midline shifts to the right, and multiple individual tooth malpositions.

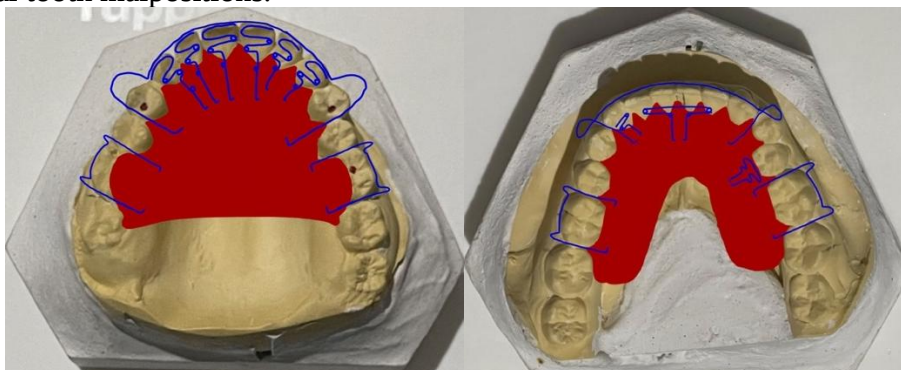


Figure 5. Design of the removable orthodontic appliance.

The treatment appliance used in the maxillary arch was a removable active plate designed to correct the midline deviation and the malpositions of teeth 11, 12, 13, 21, 22, and 23 using a finger spring combined with a Z-spring. A medium labial arch was incorporated to facilitate anterior tooth retraction and alignment. In the mandibular arch, a removable active plate was fitted with a short reverse labial arch for anterior retraction and correction of tooth 44, a continuous spring for correction of the malpositions of teeth 32, 31, 41, and 42, a T-spring for tooth 45, and a Z-spring for tooth 33. Mandibular arch analysis revealed a space deficiency of 2 mm; therefore, space gaining was planned through interproximal reduction on the mesiodistal surfaces of teeth 32, 33, 42, and 43.

RESULTS AND DISCUSSION

Orthodontic treatment aims to correct irregular tooth positions, improve occlusal relationships, and enhance dentofacial aesthetics. Diastema, defined as a space between adjacent teeth, is a common aesthetic concern that may negatively affect a patient's smile and self-confidence. In selected cases of mild to moderate malocclusion, removable orthodontic appliances remain a viable treatment option because of their simplicity, affordability, ease of fabrication, and ability to be adjusted extraorally. However, the success of treatment with removable appliances is highly dependent on patient compliance, as adequate wear time is essential for achieving the desired tooth movement⁷.

The present case report describes the management of multiple maxillary diastemas associated with a maxillary dental midline shifts using a removable orthodontic appliance. Diagnosis was established based on the patient's chief complaint of spacing in the anterior maxillary region and the findings of the clinical examination, which revealed multiple diastemas distal to teeth 11, 12, 13, 21, 22, and 23, accompanied by a 2.5-mm deviation of the maxillary dental midline. The etiology of diastema is multifactorial and may include hereditary factors, abnormal frenulum attachment, discrepancies between tooth size and arch dimensions, supernumerary teeth, congenital absence of teeth, and oral habits³.



Figure 6. Insertion of the removable orthodontic appliance.

In the present case, the multiple diastemas were considered to be associated with the persistence of primary teeth during the mixed dentition period. Retention of primary teeth may interfere with the normal eruption pattern and alignment of the permanent dentition, potentially resulting in residual spacing. The maxillary dental midline shifts was attributed to parafunctional habits, particularly habitual chin resting and unilateral mastication on the left side. Such habits may contribute to asymmetrical muscular forces and altered occlusal function, which can influence dental alignment and midline position over time⁵.

The primary treatment objectives were to close the multiple diastemas and correct the maxillary dental midline shifts to improve dental aesthetics and occlusal harmony. Removable orthodontic appliances were selected because they provide a conservative and cost-effective treatment approach for mild dentoalveolar discrepancies. In addition, these appliances offer advantages such as ease of activation, adjustment, and repair. A removable appliance typically consists of active components that generate orthodontic forces, retentive components that ensure appliance stability, and an acrylic baseplate that serves as the supporting structure⁸.

The appliance used in this case incorporated 0.6-mm stainless steel finger springs positioned distal to teeth 11, 12, 13, 21, 22, and 23, combined with Z-springs as active components. A 0.7-mm medium labial arch extending from 14 to 24 was used to provide controlled retraction of the anterior segment. Retention and stability were achieved with 0.7 mm Adams clasps on 16 and 26 and an acrylic baseplate. The combination of finger springs and Z-springs was designed to facilitate correction of the maxillary dental midline shifts by moving the anterior teeth toward the desired position. Furthermore, movement of 13 through 23 created space mesial to 13 and 23, thereby allowing subsequent retraction of the anterior segment and closure of the multiple diastemas.



Figure 7. Posttreatment extraoral photographs.



Figure 8. Posttreatment intraoral photographs.

The reduction in spacing and improvement of the maxillary midline observed during treatment demonstrate the effectiveness of the biomechanical system produced by the finger springs combined with a Z-springs and labial arch. Finger springs and Z-springs generate light, continuous forces that primarily induce tipping movements of the teeth. These forces are particularly suitable for correcting individual tooth positions and achieving minor transverse and mesiodistal movements⁶. Meanwhile, activation of the labial arch produces a controlled retractive force on the anterior segment, facilitating progressive closure of interdental spaces⁹. Orthodontic tooth movement occurs through remodeling of the alveolar bone and periodontal ligament, involving coordinated processes of bone resorption on the pressure side and bone apposition on the tension side¹⁰.

After three months of treatment, the total spacing was reduced from 2.6 mm to 1.5 mm, while the maxillary dental midline shifts decreased from 2.5 mm to 1.3 mm. These findings indicate a favorable biological response and effective force delivery by the removable appliance. The observed improvements suggest that the appliance design was capable of achieving the planned tooth movements despite the relatively limited treatment duration.

Nevertheless, the treatment outcome was influenced by the patient's level of compliance. The effectiveness of removable orthodontic appliances depends largely on consistent appliance wear and regular follow-up visits for activation. Previous studies have reported that mild diastema cases can often be corrected within approximately three to six months when patient cooperation is adequate³. In the present case, although partial correction of the maxillary midline and closure of the multiple diastemas were achieved after three months, complete correction had not yet been attained. This outcome was likely related to insufficient patient compliance with appliance wear and limited opportunities for regular appliance activation. Therefore, patient motivation, education, and adherence to treatment instructions remain critical factors in determining the success of orthodontic treatment using removable appliances.

CONCLUSIONS

This case demonstrates that removable orthodontic appliances with active plate components can be an effective treatment modality for the correction of multiple diastemas and maxillary midline deviation. Although significant clinical improvement was observed, complete correction was not achieved within the treatment period. Limited appliance activation and inadequate patient compliance were identified as the primary factors affecting treatment outcomes. Therefore, patient cooperation and regular follow-up visits remain essential for maximizing the effectiveness of removable orthodontic treatment.

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