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Diastema Closure Using A Removable Orthodontic Appliance With Finger Spring And Labial Arch: Case Report

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Abstract

Diastema is a condition characterized by the presence of a space or gap between two adjacent teeth. Diastema closure can be performed using removable orthodontic appliance with active components that deliver forces to the teeth. This case report aimed to describe the management of maxillary midline diastema using a removable orthodontic appliance combining finger springs and a labial arch. A 20-year-old female patient presented to Soelastri Dental Hospital, Surakarta, with complaint of a space between the maxillary anterior teeth affecting her appearance. Clinical examination revealed a midline diastema between teeth 11 and 21, accompanied by anterior tooth malpositions. Treatment was performed using a maxillary plate equipped with finger springs on teeth 11 and 21 and a labial arch with an inverted U-shaped loop. The appliance was activated and progress was evaluated periodically. The midline diastema measured 0.7 mm at appliance insertion, decreased to 0.6 mm at the second follow-up and 0.3 mm at the eighth follow-up, and was completely closed by the tenth follow-up. Overjet decreased from 3 mm to 2.5 mm, while overbite decreased from 3 mm to 2.6 mm. The combination of finger springs and labial arch achieved closure of the maxillary midline diastema with controlled tooth movement.

Keywords: Diastema/ Diastema Closure/ Finger Spring/ Labial Arch/ Removable Orthodontic Appliance.

INTRODUCTION

Diastema is a condition characterized by the presence of a space or gap between two adjacent teeth. It can occur in various regions of the dentition; however, diastema in the anterior region, particularly between the maxillary central incisors, is of greater concern because of its association with dental aesthetics and harmony. The size of a diastema may vary, and it can occur as either a physiological or pathological condition depending on the patient's age, location, and underlying etiological factors. The presence of diastema may also be influenced by changes in tooth position during dentofacial growth and development (Anggaraeni et al., 2023). The etiology of diastema is multifactorial and may involve dental, skeletal, soft tissue, and behavioral factors. Contributing factors include tooth-size and arch-length discrepancies, abnormal tooth size or morphology, tooth loss, supernumerary teeth, a high or thick labial frenum, certain oral habits, and an imbalance between the teeth and their supporting structures (Diandra et al., 2021). Therefore, determining the underlying cause of diastema is an important component of treatment planning. Identification of the etiology is necessary to select an appropriate treatment approach and reduce the likelihood of space reopening following treatment (Cousineau et al., 2022).

In addition to its effects on appearance, diastema may affect oral function in certain conditions. A relatively wide diastema may influence speech articulation, particularly the pronunciation of certain consonants, and may alter tooth contact patterns and the distribution of occlusal forces. The resulting interdental space may also predispose to food impaction, which can cause discomfort and increase the risk of inflammation of the gingival tissues and interdental papilla when oral hygiene is inadequate (Darwis & Fadhilah, 2024). Nevertheless, not all cases of diastema require treatment. Treatment is generally considered when the patient has aesthetic concerns, functional disturbances, periodontal tissue changes, or other clinical indications. Several studies have reported a prevalence of maxillary midline diastema ranging from 9.7% to 15% among young adults aged 18–25 years (Toumaj et al., 2026).

Removable orthodontic appliances may consist of active and retentive components supported by an acrylic base, designed according to the specific treatment requirements. Active components generate the forces required to move teeth, whereas retentive components maintain appliance stability during use. The selection and placement of these components must be carefully planned to ensure that the generated forces are appropriately transmitted to the teeth in the intended direction of movement. Periodic evaluation is also necessary to assess changes in tooth position, periodontal tissue condition, patient comfort, and the need for appliance activation or adjustment throughout treatment (Wardana et al., 2023).

One of the active components that can be incorporated into a removable orthodontic appliance is a *finger spring*. This component can deliver force to individual teeth and facilitate tooth movement according to the treatment objective. In diastema closure, a *finger spring* can be used to move the teeth adjacent to the space, thereby gradually reducing the interdental gap. In addition to the active component, a *labial arch* can contribute to appliance stability and retention while maintaining tooth position according to the planned appliance design. The combination of these components should be designed based on the patient's clinical condition and the desired direction of tooth movement (Wardana & Salsabila, 2026).

The success of diastema closure is determined not only by the ability of the appliance to move the teeth but also by accurate diagnosis, identification of the underlying etiology, treatment planning, periodontal status, control of orthodontic forces, and patient compliance. Once the space has been closed, the retention phase is essential for maintaining tooth position and minimizing the risk of relapse. Regular follow-up is necessary to evaluate treatment outcomes and ensure that the treatment objectives are achieved optimally (Novianty et al., 2025). Based on these considerations, diastema closure using a removable orthodontic appliance is a treatment approach that may be considered in appropriately indicated cases. This case report describes the management of anterior diastema using a removable orthodontic appliance combining a *finger spring* and *labial arch*, including clinical examination and diagnosis, treatment planning, appliance design, appliance use and activation, and evaluation of treatment outcomes.

Case Report

A 20-year-old female patient presented to Soelastri Dental Hospital in Surakarta with a chief complaint of a gap between her upper anterior teeth, which she perceived as significantly affecting her appearance. The patient reported feeling less confident when interacting with others. She had previously undergone fixed orthodontic treatment; however, following completion of the treatment, relapse occurred and the space reopened. Regarding oral hygiene, the patient reported brushing her teeth regularly twice daily, in the morning after breakfast and at night before going to bed.

Extraoral examination revealed a convex facial profile and a brachycephalic head shape, with a cephalic index of 92.4 mm, and a mesoprosopic facial type with a facial index of 87.6 (Figure 1). Simon's line examination of the maxilla showed that the right and left maxillary canines were positioned at the canine midline. In the mandible, the right and left sides were within normal limits in the interdental areas between the canines and first premolars. The freeway space was within the normal range, measuring 2.3 mm.

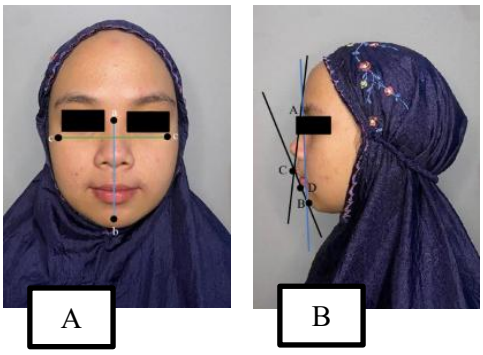


Figure 1. (A) Patient's facial profile from the frontal view; (B) facial profile from the lateral view.

Intraoral examination revealed an interdental space between the maxillary central incisors (teeth 11 and 21), measuring 0.7 mm. The patient had a moderate labial frenulum attachment, with a positive blanch test (Figure 2). An open bite was also observed between teeth 13 and 43, 14 and 44, and 15 and 45, with an overjet and overbite of 3 mm. The right first molar and canine relationships were Angle Class I, whereas the left first molar and canine relationships were Angle Class II (Figure 3).



Figure 2. (A) Initial occlusal view of the maxillary arch; (B) initial occlusal view of the mandibular arch.



Figure 3. (A) Right canine and first molar occlusion; (B) left canine and first molar occlusion.

Study model analysis showed that the maxillary and mandibular arch forms were parabolic. Several individual tooth malpositions were identified. Tooth 23 showed mesiolabiotorsiversion, while teeth 13, 11, 21, and 23 exhibited diastemas. Tooth 32 showed mesiolabiotorsiversion, whereas tooth 41 showed distolabiotorsiversion. The study model also demonstrated a maxillary midline diastema between teeth 11 and 21 measuring 0.7 mm (Figure 4).

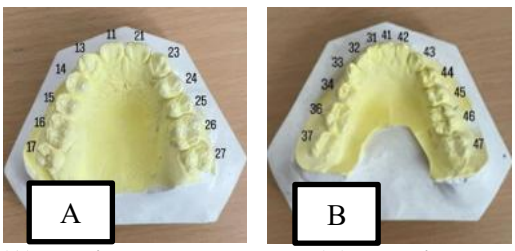


Figure 4. (A) Maxillary study model; (B) mandibular study model.

Based on the study model measurements, Pont's index indicated moderate lateral expansion in the first premolar region, with a value of +9.9 mm, and severe expansion in the first molar region, with a value of +12.2 mm. Howes' analysis showed a premolar index (P) of 41%, indicating that the dental arch could not accommodate the teeth under ideal and stable conditions. The basal arch index (FC) was 38.7%, indicating that the basal arch was also unable to accommodate the teeth under ideal and stable conditions. However, the canine fossa index was lower than the premolar index, indicating posterior tooth inclination with

occlusal divergence, which represents a contraindication for arch expansion. The arch length discrepancy (ALD) analysis showed a space excess of +1.1 mm in the maxilla and a space deficiency of −1.3 mm in the mandible.

Panoramic radiographic examination revealed that the periodontal tissues were within normal limits, with no evidence of periapical lesions or other significant pathological findings. The surrounding alveolar bone appeared to be well-maintained, and no obvious abnormalities were observed in the supporting structures of the teeth. The radiographic examination also showed no apparent signs of bone loss or other abnormalities affecting the surrounding dental structures (Figure 5).



Figure 5. Panoramic Radiographic

Cephalometric radiographic analysis was performed to evaluate the skeletal, dental, and soft-tissue relationships prior to orthodontic treatment. Steiner analysis showed an SNA angle of 78°, indicating the position of the maxilla relative to the cranial base, and an SNB angle of 73.5°, indicating the position of the mandible relative to the cranial base. The ANB angle was 4.5°, indicating a skeletal Class II relationship. The interincisal measurements showed an INA angle of 31° and an INB angle of 41°, indicating a tendency toward bidental protrusion. Soft-tissue analysis revealed that both the upper and lower lips were positioned anterior to the Steiner line, indicating a protrusive lip profile (Figure 6).

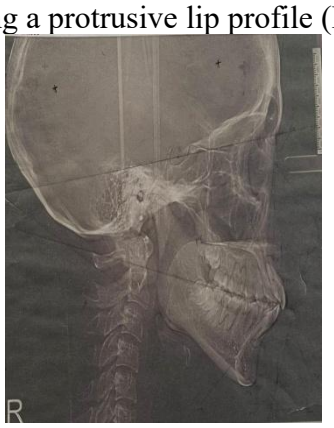


Figure 6. Cephalometric Radiographic

Based on the analysis, the Steiner diagnosis indicated a skeletal Class II relationship with bilateral retrusion and a protrusive interincisal relationship, accompanied by a convex lip profile. The final diagnosis in this case was Angle Class III malocclusion according to Dewey's modification, with a skeletal Class II pattern accompanied by bidental protrusion, a convex lip profile, and an open bite between teeth 13 and 43, 14 and 44, and 15 and 45, as well as individual tooth malpositions. The identified malpositions included distolabiotorsiversion of teeth 13 and 41, mesiopalatoversion of teeth 23 and 33, and linguoversion of tooth 32. A maxillary midline diastema measuring 0.7 mm was identified between teeth 11 and 21. A contributing oral habit was pencil biting, which the patient had practiced since childhood. The prognosis for midline diastema closure in this patient was good. Treatment success largely depended on patient compliance, appropriate appliance design and activation, and control of the etiological factors. The risk of treatment failure or

relapse may increase in cases of poor compliance or persistence of contributing factors, particularly the patient's parafunctional habit.

Case Management

The treatment plan for this case involved a single-phase removable orthodontic appliance, specifically an active plate. The maxillary appliance consisted of an acrylic plate with active components, including a labial arch with inverted U-loops at teeth 14 and 24 and finger springs at teeth 11 and 21, along with retentive components consisting of Adams clasps on teeth 16 and 26. Closure of the maxillary midline diastema was primarily achieved using finger springs, which were activated by adjusting the spring arms toward the target teeth using half-round pliers, generating a mesial force to close the space. In the mandibular arch, the active components consisted of a labial arch with inverted U-loops at teeth 34 and 44 and a Z-spring at tooth 32, with Adams clasps on teeth 36 and 46 for retention.

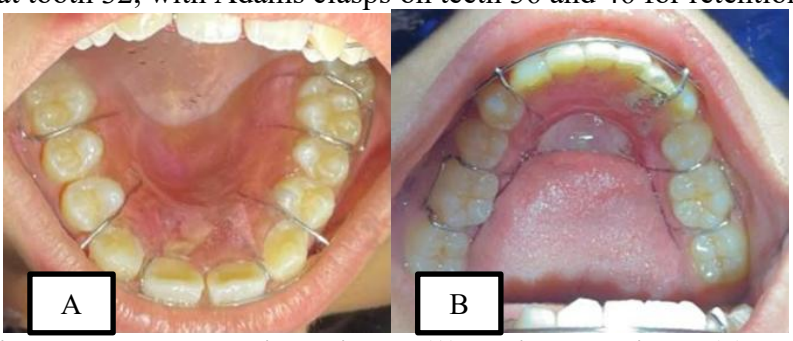


Figure 5. Patient's removable orthodontic appliances. (A) Maxillary appliance; (B) mandibular appliance.

The maxillary and mandibular removable orthodontic appliances were inserted on December 22, 2025. At the time of insertion, the maxillary midline diastema between teeth 11 and 21 measured 0.7 mm, with individual tooth malpositions involving teeth 13, 23, 32, 33, and 41. At appliance insertion, retention, stabilization, occlusion, soft-tissue condition, and the presence of any sharp components were evaluated. The patient was then instructed regarding appliance use, including a minimum wearing time of 12 hours per day, cleaning procedures, storage methods, and the follow-up schedule. The patient was also given hands-on instruction on how to insert and remove the appliances using a mirror.

At the first follow-up visit, the finger springs on teeth 11 and 21 were activated to move the teeth mesially, and the labial arch was activated to assist in reducing the diastema and correcting anterior tooth malpositions. The springs were activated by opening the coil by 1–2 mm or by moving the spring arm in the desired direction. For distal movement, the coil was positioned on the mesial side of the tooth, whereas for mesial movement, the coil was positioned on the distal side of tooth 11. Activation was continued gradually. At the second follow-up visit, the diastema had decreased to 0.6 mm, although several tooth malpositions remained.

At the second follow-up visit, the diastema remained at 0.6 mm and showed no significant change. Subsequently, during the third and fourth follow-up visits, tooth movement was evaluated and the finger springs on teeth 11 and 21, labial arch on teeth 13 and 23, Z spring on tooth 32, and labial arch on teeth 33 and 41 were reactivated. Appliance stabilization and retention were also assessed to ensure that the appliance remained properly seated and delivered orthodontic forces as intended. During the fifth to seventh follow-up visits, the patient reported no complaints, and no sharp wires or traumatic components or oral ulcers were observed. The active components, including the finger springs, labial arches, and Z spring, were periodically activated, accompanied by evaluation of appliance stabilization and retention. Tooth movement showed favorable progress throughout the follow-up period, characterized by gradual reduction of the diastema and improvement in the position of the anterior teeth.

At the eighth follow-up visit, the maxillary midline diastema was reassessed using a digital caliper. The measurement showed that the diastema had decreased to 0.3 mm, and most of the anterior tooth malpositions had been corrected. At the ninth follow-up visit, the patient reported no complaints, and no sharp wires or oral ulcers were observed. The appliance condition was evaluated, followed by reactivation of the active components, including the finger springs on teeth 11 and 21, labial arch on teeth 13 and 23, Z spring on tooth 32, and labial arch on teeth 33 and 41. Stabilization and retention were subsequently evaluated to ensure that the appliance remained properly seated and functioned optimally in maintaining the achieved tooth movement. At the tenth follow-up visit, the maxillary midline diastema was reassessed and was found to be completely closed. The next stage involved fabrication of retainers to maintain the treatment results, considering the patient's history of maxillary midline diastema and the potential for reopening if adequate retention is not provided (Figure 6).

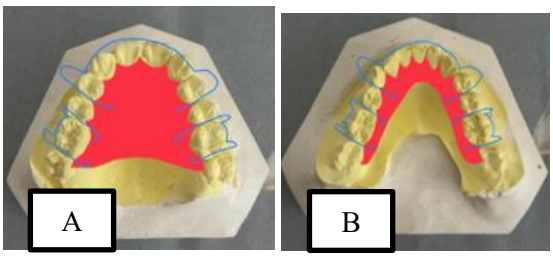


Figure 6. Retainer design. (A) Maxillary retainer; (B) mandibular retainer.

Discussion

Midline diastema is a condition that may be managed with orthodontic treatment when aesthetic or functional indications are present. Orthodontic closure of a diastema involves moving the teeth adjacent to the space toward their planned positions. In cases involving a relatively small space and limited tooth movement, a removable orthodontic appliance may be considered because force can be selectively delivered through active components. Successful space closure depends not only on the magnitude of the applied force but also on the direction of force, point of force application, control of tooth movement, and periodontal tissue condition (B. A. Paryontri, 2023). One of the active components that can be used for diastema closure is a *finger spring*. This component utilizes the elasticity of orthodontic wire to generate force following activation. Unlike components that apply force more broadly to several teeth, a *finger spring* can be designed to deliver force individually to a specific tooth. This characteristic makes the *finger spring* suitable for diastema cases involving a localized space between two specific teeth, as the force can be directed precisely to bring the teeth adjacent to the space closer together (Wardana & Salsabila, 2026).

For closure of the diastema between teeth 11 and 21, the *finger springs* were positioned so that the generated forces directed the two teeth toward each other. Activation of the springs produced elastic deformation of the wire, after which the restorative force generated by the wire was transmitted to the teeth through the active arms of the springs. Tooth movement occurred gradually in response to the applied orthodontic force and periodontal tissue remodeling. Therefore, *finger spring* activation should be carefully controlled to generate sufficient force for tooth movement without placing excessive load on the supporting tissues (Ray et al., 2025). The amount of activation is an important consideration when using a *finger spring*. Excessive activation does not necessarily produce faster tooth movement and may increase patient discomfort while generating forces that are inappropriate for the intended biomechanics. Conversely, insufficient activation may produce inadequate force for the desired tooth movement. Therefore, gradual activation and periodic evaluation are necessary to maintain the force within an appropriate range throughout the diastema closure process (B. Paryontri et al., 2025).In addition to the *finger*

spring, the *labial arch* was an important component of the removable orthodontic appliance design in this case. The *labial arch* primarily functions to provide control over the position of the anterior teeth and may help maintain the desired tooth relationship during treatment. Its presence also provides additional appliance stability, allowing the force generated by the active components to be transmitted more effectively to the target teeth. Thus, the *finger spring* and *labial arch* have complementary roles in treatment, with the *finger spring* serving as the primary component for generating tooth movement, while the *labial arch* contributes to anterior tooth-position control and appliance stability (Soni et al., 2024).

The combination of these two components is also related to the principle of anchorage in removable orthodontic treatment. The force generated by the *finger spring* produces a reciprocal force on the appliance base and anchorage teeth. Therefore, the appliance must have adequate retention and stability to prevent the generated forces from producing undesirable movement of other teeth. In this case, the *labial arch*, acrylic base, and retentive components functioned as an integrated system to support the effectiveness of the force generated by the *finger spring*. Adequate retention is important because an unstable appliance may reduce the effectiveness of the applied force and compromise control over the direction of tooth movement(Demir et al., 2026).

Diastema closure using a *finger spring* should also take into consideration the type of tooth movement produced. When force is applied to the crown of a tooth, the initial movement may be predominantly tipping rather than bodily movement or translation. Therefore, control of tooth position should be carefully monitored throughout space closure. The *labial arch* may contribute to control of the anterior tooth position, ensuring that treatment focuses not only on reducing the width of the space but also on maintaining harmonious tooth alignment (Koaban et al., 2024). Evaluation of crown position, occlusal relationships, and periodontal tissue condition remains necessary to ensure that treatment outcomes are not assessed solely based on space closure. In the present case, the combination of a *finger spring* and *labial arch* resulted in gradual closure of the diastema (Halley, 2024). The space between teeth 11 and 21, initially measuring 0.7 mm, was completely closed at the end of treatment, with the overjet decreasing from 3 mm to 2.5 mm and the overbite decreasing from 3 mm to 2.6 mm (Figure 7). These changes indicate that the application of directed force through finger springs can produce effective tooth movement in cases involving a relatively small space. However, the treatment outcome cannot be separated from other factors, including appliance design, accuracy of activation, appliance retention, periodontal condition, and patient compliance with appliance use.

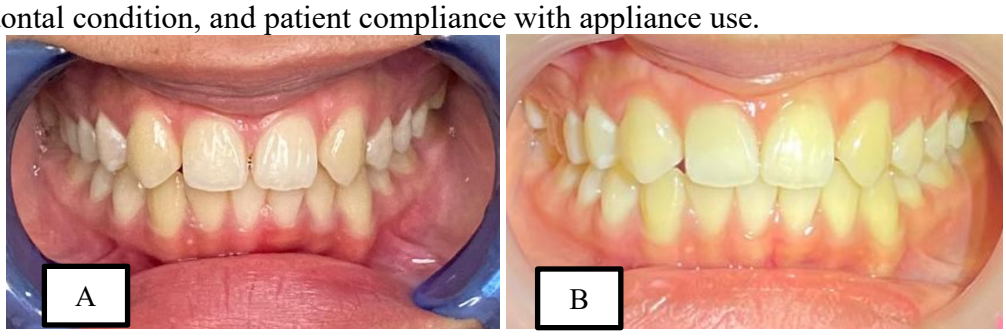


Figure 7. Diastema condition before and after treatment. (A) Before treatment; (B) After treatment.

Patient compliance is an important factor in treatment with removable orthodontic appliances. Unlike fixed orthodontic appliances, which remain active continuously while in the oral cavity, the effectiveness of removable appliances is strongly influenced by the duration of appliance wear. Adherence to the prescribed wearing schedule allows orthodontic forces to act consistently, enabling tooth movement to proceed according to the treatment plan. Therefore, patient education regarding the prescribed duration of appliance

wear and proper appliance care is an important component in supporting successful diastema closure (Mei & Jiang, 2022).

Another important consideration following successful diastema closure is the stability of the treatment outcome. Diastema may have a tendency to relapse; therefore, space closure should not be regarded as the endpoint of treatment. After teeth are moved into their new positions, the periodontal tissues require time to adapt to the positional changes. In addition, the underlying etiological factors contributing to diastema formation should be considered because persistence of these factors may increase the risk of space reopening. Therefore, retainer use is necessary to maintain tooth position after completion of the active treatment phase (Alshammery et al., 2022).

CONCLUSION

Diastema can be closed using a removable orthodontic appliance combining a *finger spring* and a *labial arch*. The *finger spring* serves as an active component that generates a directed orthodontic force to move teeth 11 and 21 mesially toward each other, thereby reducing and eventually closing the space between the two teeth. Meanwhile, the *labial arch* functions to control the position of the anterior teeth, maintain the direction of tooth movement, and enhance appliance stability throughout treatment. The combination of these two components allows the application of controlled and directed forces in cases requiring relatively limited tooth movement. Successful diastema closure is influenced not only by appliance design but also by the accuracy of component activation, appliance stability, periodontal tissue condition, and patient compliance with the prescribed appliance wear.

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