

ORTHODONTIC RETREATMENT WITH CLEAR ALIGNERS IN A PATIENT WITH OPEN BITE AND SEVERE ROOT RESORPTION: CASE REPORT

Retratamiento ortodóncico con alineadores en paciente con mordida abierta y reabsorción radicular severa

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ABSTRACT

Introduction: External apical root resorption (EARR) is a multifactorial orthodontic complication influenced by treatment duration, appliance type, and the magnitude of applied forces. Clear aligners have been shown to reduce the risk of EARR compared to fixed appliances by applying lighter and more controlled forces.

Case Report: This report describes retreatment with clear aligners in an adult patient with relapse of anterior open bite and severe EARR diagnosed through CBCT. The rate of tooth movement was reduced from 0.25 mm to 0.18 mm per aligner to preserve root integrity.

Conclusions: The controlled biomechanics of clear aligners, combined with an interdisciplinary approach, enabled esthetic and functional outcomes in a patient with severe EARR, demonstrating that this therapy represents a safe option in complex retreatment scenarios.

Keywords: *Orthodontic appliances; Removable; Open bite; Root resorption; Tooth movement techniques; Retreatment; Case report*

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RESUMEN

Introducción: La reabsorción radicular apical externa (RRAE) es una complicación ortodóncica multifactorial, influenciada por la duración del tratamiento, el tipo de aparatología y la magnitud de las fuerzas aplicadas. Los alineadores transparentes han demostrado reducir el riesgo de RRAE en comparación con la aparatología fija, al aplicar fuerzas más ligeras y controladas.

Reporte de Caso: Se describe el retratamiento con alineadores en una paciente adulta con recidiva de mordida abierta anterior y RRAE severa diagnosticada mediante CBCT. La tasa de movimiento dental fue reducida de 0,25 mm a 0,18 mm por alineador para preservar la integridad radicular. Al finalizar el tratamiento, se obtuvo cierre de mordida abierta mediante intrusión molar y extrusión relativa de incisivos, logrando neutroclusión bilateral y mejora de la armonía facial. Se evidenció disminución de la proinclinación incisiva, aumento del ángulo interincisivo y reducción de la protrusión dentaria mediante reducción interproximal (IPR). Radiográficamente, se observó detención de la RRAE y reparación apical. Se utilizaron retenedores fijos y Vivera®, favoreciendo la estabilidad postratamiento.

Conclusión: La biomecánica controlada de los alineadores, sumada a un enfoque interdisciplinario, permitió obtener resultados estéticos y funcionales en una paciente con RRAE severa, evidenciando que esta terapia representaría una opción segura en escenarios complejos de retratamiento.

Palabras clave: Aparatos ortodóncicos removibles; Mordida abierta; Reabsorción radicular; Técnicas de movimiento dental; Retratamiento; Reporte de caso

INTRODUCTION

Root resorption is a pathological process characterized by the loss of dental tissue due to osteoclastic activity. Among its variants, external apical root resorption (EARR) represents one of the most frequent complications of orthodontic treatment and is defined by the progressive loss of the apical portion of the root.¹ Its clinical classification is generally based on the extent of root loss observed radiographically.²

The etiology of EARR is recognized as multifactorial, involving biological, genetic, and mechanical factors, as well as a history of trauma and pre-existing clinical conditions. Among the factors related to orthodontic therapy, treatment duration, the magnitude and direction of

applied forces, and the type of appliance used are particularly relevant.^{3,4}

Several studies report a lower incidence and severity of EARR in treatments using aligners compared to fixed appliances, attributed to their ability to deliver lighter, more controlled, and intermittent forces.³ Imaging analysis using cone-beam computed tomography (CBCT) has been shown to be the most reliable tool for diagnosing EARR.⁵ Li *et al.*,⁶ using CBCT, observed that the prevalence of EARR was significantly lower in the aligner-treated group (56.3%, mean root loss of 0.13 ± 0.47 mm) compared to the fixed appliance group (82.1%, mean of 1.12 ± 1.34 mm).⁶ Similarly, Fang *et al.*,⁷ and Gandhi *et al.*,¹ reported consistent findings in systematic reviews and meta-analyses, confirming that

aligners produce a lower magnitude of root resorption, particularly in maxillary incisors.

This biomechanical behavior allows for physiological pauses that promote recovery of damaged root cementum and reduce the risk of progressive resorption.^{3,8,9}

Additionally, Aman *et al.*,⁵ and Krieger *et al.*,¹⁰ in retrospective CBCT studies, demonstrated that the magnitude of EARR in aligner treatments rarely reaches severe levels, whereas fixed appliances may significantly compromise root integrity.

This clinical advantage is associated with “unloading” periods between aligners, which may allow physiological pauses for cementum repair and reduced periapical inflammation.¹¹ Despite advances in the understanding of EARR and the development of less invasive orthodontic therapies, clinical evidence regarding the management of patients with severe root compromise remains limited.⁹ In this context, this report presents the retreatment with aligners in an adult patient with open bite and severe EARR, highlighting the biomechanical considerations and outcomes achieved.

CASE REPORT

Diagnosis

A 31-year-old female patient, with no relevant systemic history, presented with aesthetic concerns regarding her smile and gingival recessions in the lower incisors associated with Grade I tooth mobility (Figure 1 and Figure 2). She reported a history of orthodontic treatment during adolescence. Clinical and cephalometric examination revealed a skeletal Class II relationship, evidenced by increased ANB and Wits values, a dolichofacial pattern with a reduced facial axis (Figure 3), anterior open bite, and altered tongue posture both at rest and during swallowing. Bilateral Class II canine relationship and a maxillary midline deviation to the left were observed,

along with bimaxillary protrusion and incisor proclination on a thin periodontal phenotype (Figure 2). Radiographically, CBCT revealed severe root resorption, with critical involvement of teeth 1.4, 2.5, and 4.6, and a crown-to-root ratio close to 1:1 in the maxillary incisors (Figure 4).

Given the periodontal and functional compromise, interdisciplinary referrals were made to a speech therapist due to altered tongue posture, and to a periodontist for the placement of a free gingival graft (FGG) in teeth 3.1 to 4.1, as well as for periodontal phenotype assessment.

In this case, CBCT demonstrated more severe root compromise in the right hemiarch, particularly in tooth 1.4, which showed almost complete loss of the buccal root. Tooth 2.5 exhibited no remaining root structure. The maxillary first molars presented significant resorption of the mesiobuccal roots, without evidence of furcation involvement.

In the maxillary anterior region, the canines were partially outside the basal bone. However, they maintained an adequate crown-to-root ratio. The maxillary incisors exhibited a crown-to-root ratio of approximately 1:1, indicative of severe EARR (Figure 4).

Treatment Objectives

The treatment plan was established in conjunction with prosthodontics, endodontics, and periodontics, with the following objectives:

1. To close the anterior open bite through vertical control (molar intrusion and relative incisor extrusion).
2. To achieve retroclination of maxillary and mandibular incisors using interproximal reduction according to the ClinCheck® planning.
3. To obtain bilateral Class I canine relationship and a neutral molar relationship.
4. To improve overjet and overbite.
5. To achieve functional and stable occlusion.
6. To preserve periodontal integrity and crown-to-root ratio.
7. To control symptoms and tooth mobility.

Treatment Planning and Progress

Eight months prior to orthodontic treatment, a palatal-derived free gingival graft (FGG) was performed in teeth 3.1–4.1. Clear aligner therapy (Invisalign) was selected, with a requested reduction in the standard rate of tooth movement from 0.25 mm to 0.18 mm per aligner, in order to minimize orthodontic forces on compromised roots. This modification extended the active phase from 24 to 48 aligners, resulting in a total treatment time of 12 months.

The patient demonstrated high compliance, wearing the aligners for an average of 22 hours per day with weekly replacement. At aligner 3, interproximal reduction (IPR) of 0.5 mm per tooth was performed in the maxillary incisors to facilitate retroclination. In the mandibular arch, IPR of 0.4 mm was carried out between teeth 3.3 and 3.2, and 0.3 mm from 3.2 to 4.3.

Additionally, attachments were placed to optimize tooth movements according to the

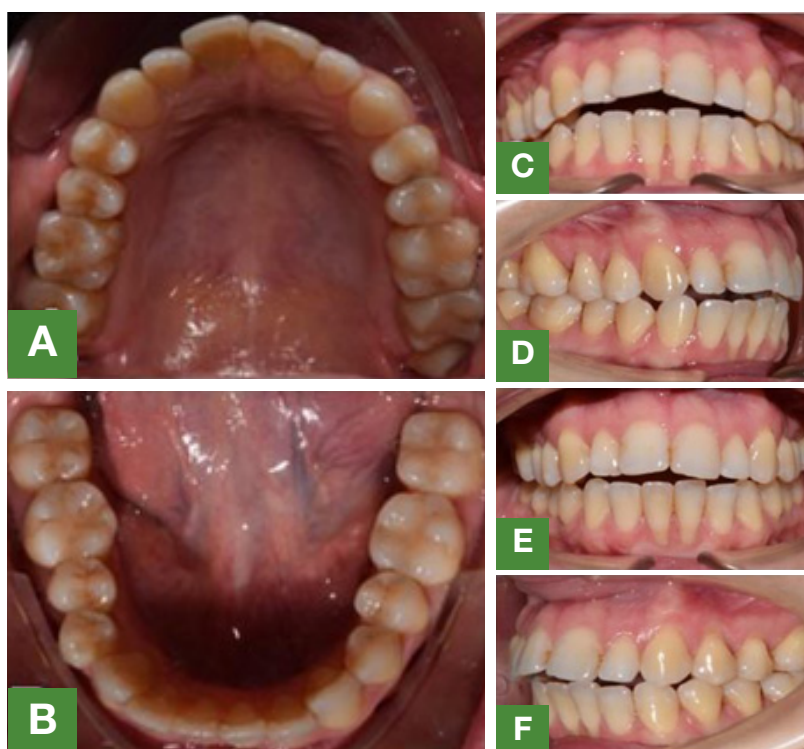
Figure 1

Initial extraoral photographs



Figure 2

Pre-treatment photographs



A: Upper arch. **B:** Lower arch **C:** 45° frontal view **D:** Right lateral view. **E:** Frontal view. **F:** Left lateral view.

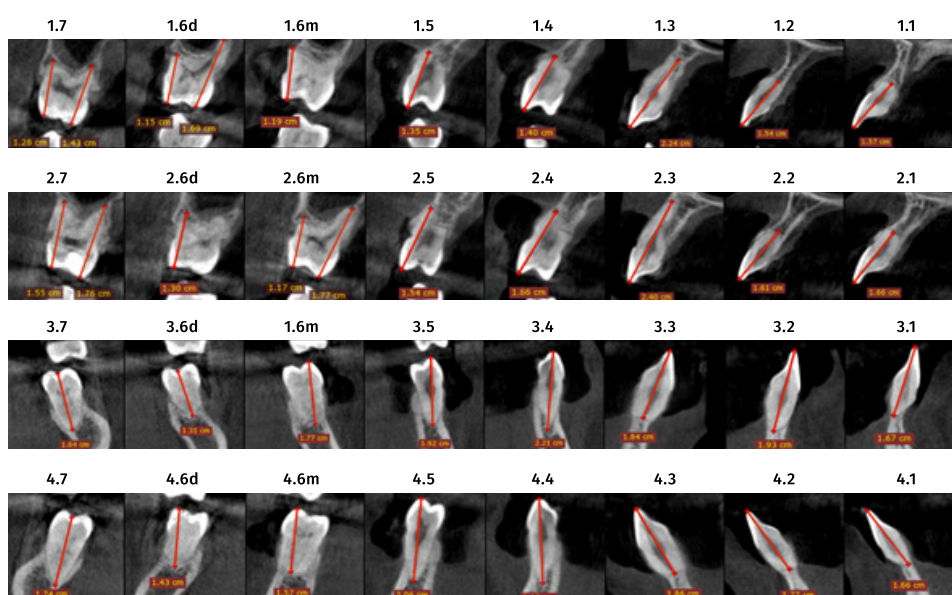
Figure 3

Pre-treatment lateral cephalogram



Figure 4

Initial CBCT, 2022. Cuts along the long axis of the tooth. Severe root loss is observed in upper incisors and teeth 1.4, 2.5.



aligner system planning. Following the initial phase, a refinement stage with 12 additional aligners was indicated to optimize overbite, correct the rotation of tooth 1.2, and improve the bilateral canine relationship. At the end of treatment, an improvement in facial harmony was observed, evidenced by an increase in the facial convexity angle from 164° to 170°. Additionally, adequate lip com-

petence was achieved, with a final nasolabial angle of 98°, which falls within normal parameters for female patients (Figure 5). These outcomes were achieved through incisor retraction and open bite closure, accomplished by molar intrusion and relative incisor extrusion, along with the establishment of bilateral molar and canine neutroclusion (Figure 6).

Ricketts cephalometric analysis (Table 1) showed a decrease in incisor proclination (U1–NA from 34° to 24°, IMPA from 108° to 93°) and an increase in the interincisal angle from 104° to 124°, with a slight reduction in lower facial height (Figure 8). Interproximal reduction (IPR) improved incisor positioning, reducing protrusion by 2 mm in the maxillary arch and 1.16 mm in the mandibular arch (Table 1), which correlates with the reduction in proclination.

Serial root measurements using Radiant DICOM Viewer® confirmed the absence of EARR progression. Previously compromised teeth (1.6, 1.4, 2.5, 2.6, and 4.6) showed resorption arrest and apical repair (Figure 7). Maxillary canines were repositioned within the alveolar bone housing, and incisors regained a crown-to-root ratio close to 1:1. All teeth exhibited physiological mobility at the end of

treatment, suggesting a guarded prognosis due to the severity of EARR. Consistently, in this case, once treatment was completed, and consequently, upon cessation of orthodontic forces, EARR progression ceased. Furthermore, it remained within expected limits at the end of treatment, with no evidence of additional progression, reinforcing the safety of this therapeutic approach in patients with severe root compromise.

For retention, fixed appliances and removable Viverra® retainers were placed, fabricated digitally using CAD-CAM technology. These retainers, produced through three-dimensional digital processes, provide greater standardization of fit and adequate clinical stability compared to conventional thermoplastic retainers, resulting in improved precision in post-orthodontic retention.¹²

Table 1

Cephalometric changes between pre and post-treatment records. Improved incisor positioning is observed, along with slight vertical control associated with reduced lower facial height and a decrease in the facial axis

Mesurements	Rule	Pre-treatment	Post-treatment
SNA	82°	75.88°	78.46°
SNB	80°	71.27°	74.03°
ANB	2°	4.61°	4.43°
Wits Appraisal Prett	0 mm	4.20 mm	1.20 mm
Facial axis (°)	90°	78.22°	80.79°
Facial Deep (°)	80.7°	87.39°	87.82°
Mandibular plane (°)	26°	29.09°	29.70°
Facial cone (°)	68°	64.19°	65.90°
Mandibular arch (°)	26°	39.25	39.46°
Facial convexity (mm)	0.2 mm	0.60 mm	2.17 mm
Palatal plane inclination (°)	1°	-3.95°	-3.31°
Altura facial inferior (°)	47°	49.19°	48.24°
U1 – NA (°)	22°	34.36°	24.49°
U1 – N (mm)	4 mm	7.08	4.96 mm
L1 – A Pog (mm)	2 mm	7.25 mm	6.09 mm
L1 – A Pog	22°	43.62°	38.52°
Interincisal angle	130°	104°	124°
IMPA (°)	90°	107.81°	93.28°

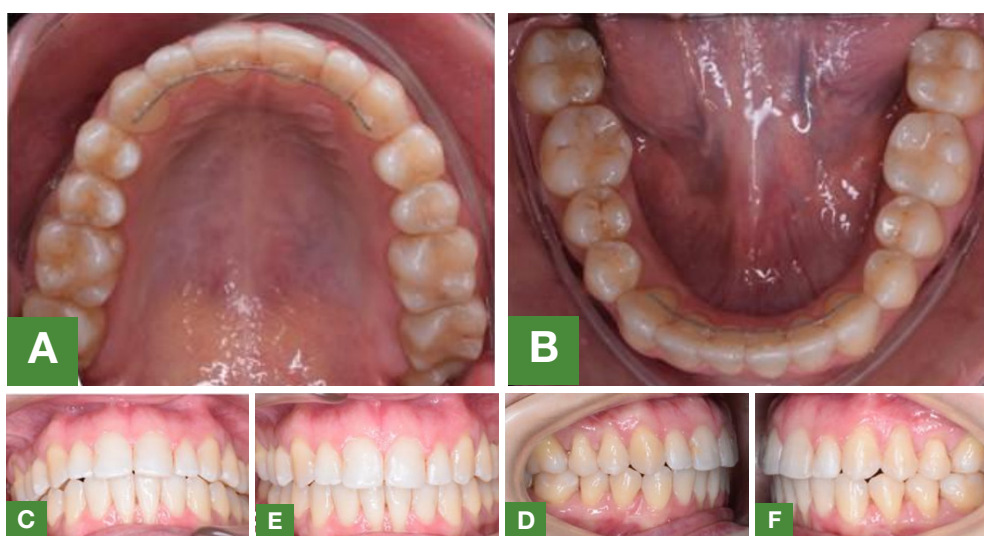
Figure 5

Final extraoral photographs



Figure 6

Final intraoral photographs



A: Upper arch. **B:** Lower arch **C:** 45° frontal view **D:** Right lateral view. **E:** Frontal view. **F:** Left lateral view. Successful closure of the open bite, molar and canine neutroclussion, is observed

Figure 7

CBCT scans taken during orthodontic treatment in 2024. Good tooth positioning in the bone overgrowth is observed, in addition to apical repair and inactivation of EARR in both arches.

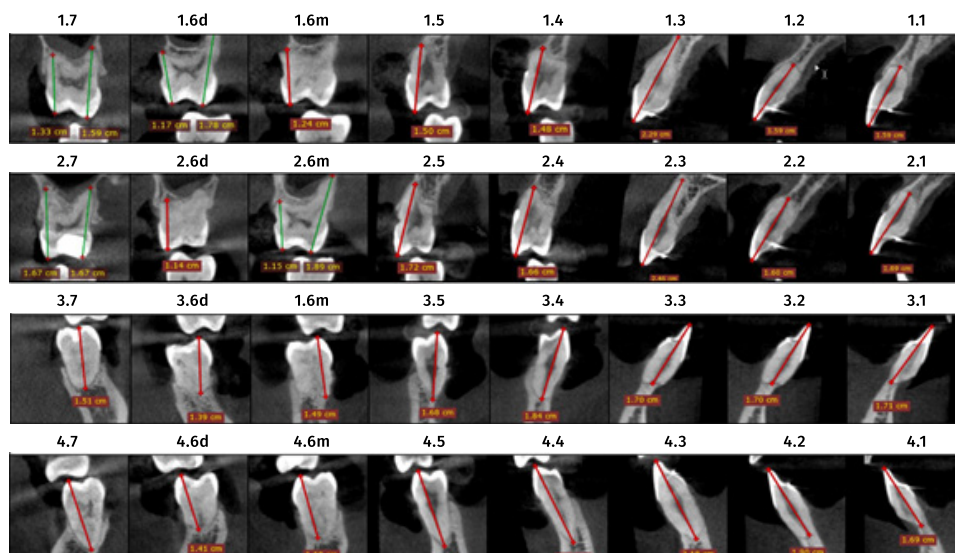
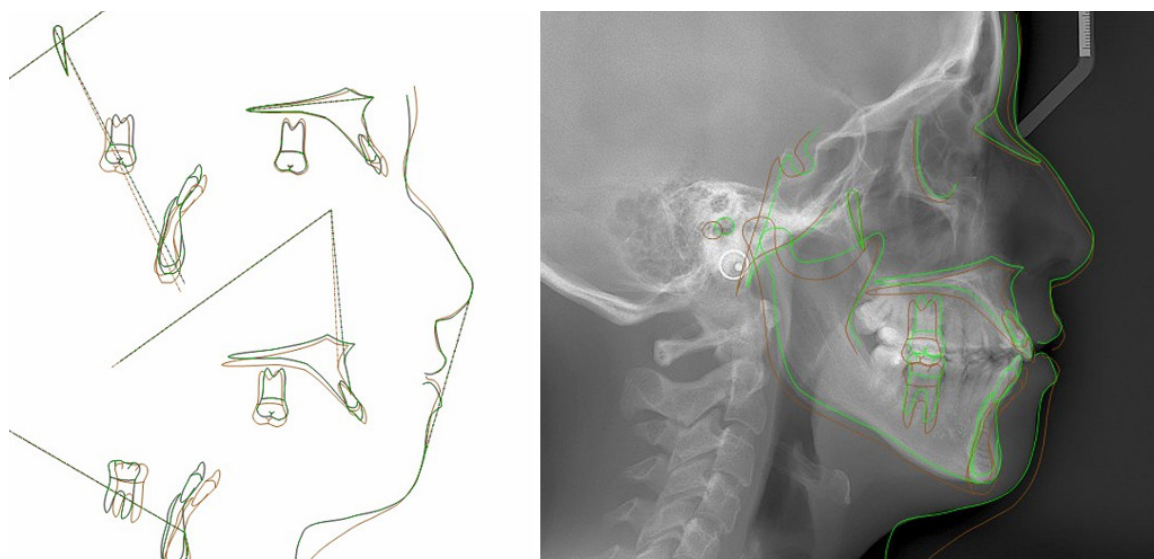


Figure 8

Superimposition of pre-treatment (brown) and post-treatment (green) lateral cephalometric tracings. The improvement in incisor position and bite closure is evident.



DISCUSSION

EARR represents one of the most significant complications associated with orthodontic treatment, with important functional implications and long-term prognostic consequences.¹³ The application of mechanical forces to the periodontal ligament triggers the release of pro-inflammatory cytokines (such as IL-1, TNF- α , and PGE2) and the activation of the RANK/RANKL/OPG pathway, promoting the differentiation of osteoclasts and odontoclasts responsible for the resorption of mineralized tissues, thereby facilitating tooth movement.

EARR is described as a consequence of excessive activation of osteoclastic mechanisms and is explained as part of the inflammatory process associated with orthodontic tooth movement.¹⁴ Orthodontically induced root resorption occurs in most patients, although its severity varies depending on the tooth and type of movement.^{3,9} According to the literature, maxillary incisors and premo-

lars show a higher susceptibility to resorption, particularly when subjected to extensive movements.^{15,16}

In the present case, the selection of clear aligners was determined by the extent of root compromise evidenced on CBCT. No progression of root resorption was observed during retreatment; on the contrary, some teeth exhibited signs of apical repair in radiographic follow-ups. This may be explained by the cessation of orthodontic forces and the transition toward a reparative microenvironment characterized by the predominance of M2 macrophages and anti-inflammatory mediators.¹⁷

This clinical finding is particularly relevant, as it demonstrates the possibility of preserving—and even improving—the crown-to-root ratio in patients with severe EARR, a phenomenon that has been scarcely reported in the literature.

Most available studies describe severe EARR as an infrequent event, affecting approximately 1–5% of teeth treated with aligners.¹⁸

For instance, Li *et al.*,⁶ using CBCT, reported a prevalence of EARR of 56.3% in patients treated with aligners (mean root loss of 0.13 ± 0.47 mm), compared to 82.1% in the fixed appliance group (mean root loss of 1.12 ± 1.34 mm).⁵ Similarly, Fang *et al.*,⁷ and Gandhi *et al.*,¹ confirmed these findings in systematic reviews and meta-analyses, highlighting a lower magnitude of root resorption, particularly in maxillary incisors. These outcomes have been attributed to the application of lighter and more controlled forces, as well as to the intermittent nature of aligner therapy, which allows periods of tissue repair between activations. However, existing evidence is largely limited to cases of mild to moderate EARR, whereas the present report provides clinical data in a scenario of already established severe root resorption, emphasizing the importance of individualized biomechanics and adjustments in the rate of tooth movement in high-risk patients.

The correction of anterior open bite with clear aligners takes advantage of their ability to combine incisor extrusion, molar intrusion, and mandibular autorotation, allowing vertical dimension control without overloading the roots.^{19,20} Unlike fixed appliances, clear aligners do not produce undesirable extrusive effects on molars and may facilitate open bite closure without the need for auxiliary appliances.²¹

From a periodontal perspective, the therapeutic objective was to protect a reduced periodontium associated with a thin gingival phenotype and pre-existing mandibular recessions. In this context, a free gingival graft was performed eight months prior to initiating tooth movement, with the aim of increasing the width of keratinized gingiva and improving biofilm control, thereby reducing the risk of further gingival recession during orthodontic treatment. Clinical evidence supports this therapeutic sequence,

as in sites with ≤ 1 mm of keratinized gingiva, augmentation with a free gingival graft improves plaque and bleeding indices, while also enhancing gingival margin stability during orthodontic treatment.^{22,23}

The cephalometric changes observed in this case are consistent with those reported in the literature for open bite correction with clear aligners. Recent studies have confirmed that open bite closure is primarily achieved through molar intrusion and relative incisor extrusion, accompanied by favorable mandibular autorotation and improvement in overbite.^{19,24} Regarding external apical root resorption, current evidence indicates that clear aligners are associated with a lower prevalence and severity of resorption compared to fixed appliances.^{6,25}

An interdisciplinary approach was also essential for achieving therapeutic success. Speech therapy intervention allowed correction of dysfunctional tongue posture, while periodontal treatment reinforced the gingival phenotype through free gingival grafting, optimizing periodontal stability throughout treatment. This integration of specialties, combined with the controlled biomechanics of aligners, enabled the achievement of functional and esthetic outcomes without exacerbating pre-existing EARR, which may help explain the success of this treatment.

One limitation of this report is its single-case design, which restricts the generalizability of the findings. Nevertheless, it provides valuable clinical evidence in a scarcely documented field: orthodontic retreatment with aligners in patients with severe EARR. Future prospective studies with larger sample sizes and long-term follow-up are needed to confirm these findings.

CONCLUSION

Orthodontic retreatment with clear aligners in patients presenting anterior open bite and severe external apical root resorption (EARR) may represent a viable treatment alternative. The application of light and intermittent forces, combined with adjustments in the rate of tooth movement and an interdisciplinary approach, allowed the achievement of functional and esthetic outcomes without exacerbating pre-existing root compromise.

The observed findings of stability, and even partial apical repair in this case, suggest that clear aligners may offer a more favorable prognosis than fixed appliances in complex clinical scenarios. However, given the limitations inherent to this descriptive study, further prospective studies with larger sample sizes are required to confirm these observations.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTIONS

Erica Bustamante Olivares: Conceptualization, Project Administration, Writing - Review and Editing, Investigation, Methodology, Writing - Original Draft, Software, Supervision, Validation, and Visualization.

Cecilia Muñoz Sandoval: Data Curation, Writing - Review and Editing, Investigation, Methodology, Writing - Original Draft, Supervision, Validation, and Visualization.

Javiera Erbetta Cremades: Conceptualization, Data Curation, Writing - Review & Editing, Investigation, Methodology, Writing - Original Draft, Software, Supervision, Validation, and Visualization.

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