

Article

Does Modifying a Palatal Expander with a Lingual Acrylic Block Create Asymmetric Dental Expansion? A Retrospective Study

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Abstract

Asymmetric dental expansion is a preliminary goal in the treatment of a true unilateral crossbite (CB). The aim of this study was to investigate transverse dental changes following modified asymmetric rapid palatal expansion (ARPE) based on cone-beam computed tomography (CBCT) records. The dataset consisted of CBCT records obtained before and after treatment with a modified ARPE appliance in patients presenting with unilateral skeletal posterior CB and class I skeletal relationship. Eighteen linear and four angular measurements were analyzed based on CBCT images. The Shapiro–Wilk test, paired-samples t-test and Wilcoxon signed-rank test were used for statistical analyses. Maxillary interdental widths showed significant increments on both sides ($p < 0.05$). Maxillary posterior dental expansion was greater on the CB side compared to the non-crossbite (NCB) side. A significant increase was detected in the mandibular inter-first premolar width ($p < 0.05$). In addition, the inter-side difference in maxillary first molar inclination between the NCB and CB sides was also significant ($p < 0.05$). Modified ARPE may be beneficial for treatment of a unilateral CB.

Keywords: asymmetric rapid palatal expansion; cone beam computed tomography; dental expansion

1. Introduction

Maxillary transversal deficiency is one of the most common anomalies in orthodontics. A posterior crossbite (CB) occurs as a result of a constricted maxillary dental arch, and is primarily treated by rapid palatal expansion (RPE) through mid-palatal suture splitting [1]. Unilateral posterior CB mostly arises from functional lateral deviation of the mandible, which is associated with transverse maxillary deficiency [2,3]. True unilateral maxillary CB is not associated with a functional mandibular shift; therefore, bilateral rapid palatal expansion can predispose the non-crossbite (NCB) side to unfavorable buccal non-occlusion [4].

To achieve a unilateral expansion, several appliances have been designed that reinforce anchorage of the mandible on the NCB side [4–6]. Toroğlu et al. [4] modified a quad-helix appliance by adding a vertically extending stopper to the NCB side. A bonded RPE appliance incorporating mandibular support and an acrylic occlusal lock on the NCB side was first introduced by Marshall et al. [6]. Furthermore, Ileri and Başçiftçi [5], and Baka et al. [7] modified a tooth- and tissue-borne RPE with a rigid locking system on the NCB side. The occlusal locking mechanism of their designs include an occlusal bite and a lingual acrylic block, which extends to the vestibule surface.



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The McNamara-type acrylic splint RPE appliance does not include anterior teeth or palatal coverage, which makes it more hygienic and comfortable [8,9]. Numerous studies have demonstrated the efficacy of McNamara RPE in the treatment of bilateral posterior CB [10–12]. Furthermore, by adding only a non-rigid acrylic block on the lingual section of the NCB side, the McNamara RPE appliance can be used to treat unilateral CB [13]. However, no study so far has investigated the transverse dental effects of this modification. The aim of this retrospective study was to evaluate the transverse effects of asymmetric RPE (ARPE) on dental structures through the analysis of cone beam computed tomography (CBCT) images.

2. Materials and Methods

Ethical approval for the study protocol was obtained from the Non-Interventional Clinical Research Ethics Committee of Gaziantep University (Decision No. 2025/372). The pre- and post-treatment CBCT records of patients who underwent modified ARPE at the Department of Orthodontics at Gaziantep University [13] were retrieved from the archives, and used for nasopharyngeal airway and cephalometric measurements.

Power analysis was conducted with G*Power software (version 3.1.9.7; Franz Faul, University of Kiel, Kiel, Germany). Effect size was calculated using the changes in the First molar-Y (occlusal) measurement as described by Baka et al. [7], and the result was 2.37. The error rate and its power were calculated as 0.05 and 80%, respectively, and the size was accordingly determined to be eight. The sample size was increased to enhance the statistical power of the study and mitigate the effects of potential attrition.

The inclusion criteria for the study were as follows: (1) implementation of the treatment procedure by the same clinician (MAY) was selected as an inclusion criterion to ensure the standardization of the treatment protocol; (2) the individuals were in the growth and development phase, exhibited a skeletal Class I relationship (ANB angle: 0–5°), and presented with normal vertical growth (SN-GoGn angle: 26–38°). Skeletal maturation was assessed using the Hassel and Farman method, and individuals with a cervical vertebral maturation index (CVMI) ranging from Stage I to Stage III were included [14]. (3) All premolar teeth had erupted. (4) Unilateral CB involving at least three posterior teeth (second molars included when erupted) without functional shift was present prior to treatment. Functional mandibular shift was ruled out clinically by a single examiner (M.A.Y.) through comparison of the mandibular position in centric relation and maximum intercuspation; patients showing a discrepancy between these positions were excluded. (5) The treatment was performed using a modified ARPE appliance. (6) CBCT measurements had been obtained using the same appliance, ensuring the head was positioned parallel to the Frankfurt horizontal plane. Patients presenting with any craniofacial anomalies or a previous orthodontic treatment experience were excluded.

A total of 19 archived patient records treated with the modified ARPE appliance by the same researcher (MAY) were initially screened. Following a thorough review of the available data, three patients were excluded due to increased vertical face height, two due to a skeletal Class II relationship, and two due to a functional mandibular shift, resulting in the exclusion of four males and three females overall. Consequently, 12 subjects (mean age: 13.92 ± 0.87 years; range: 12.5–15.2 years) met all inclusion criteria. Although no specific gender criterion was applied to control for gender-related differences in outcomes, the final study population consisted exclusively of males. Of these 12 subjects, five presented with a right-sided crossbite and seven with a left-sided crossbite.

Patients treated with an ARPE appliance were retrospectively included in the study if the appliance met the following specific manufacturing and clinical design criteria: The ARPE appliance was constructed by bonding the arms of a Hyrax-type expansion screw

(Leone, Florence, Italy) to a tooth-borne acrylic cap splint, and an additional lingual acrylic block was incorporated on the NCB side. The acrylic cap splint covered the occlusal surfaces of all the maxillary posterior teeth. It was adjusted to ensure full occlusal contact with the mandibular dentition. The splint's thickness varied according to each patient's individual occlusal anatomy. The lingual block was fabricated with a uniform thickness of 2 mm, positioned 2 mm clear of the mandibular dentition, and designed to terminate 3 mm apical to the mandibular gingival margin (Figure 1). The entire acrylic appliance, including the cap splint and lingual block, was fabricated from Imicryl O-80 orthodontic acrylic resin (Imicryl, Konya, Turkey) and polymerized under heat and pressure (60 °C, 2 bar). The appliance was then bonded to the teeth using 3M™ Ketac™ Cem Radiopaque glass ionomer cement (3M™ ESPE™, Seefeld, Germany). All appliances were fabricated in the same dental laboratory using the same protocol.

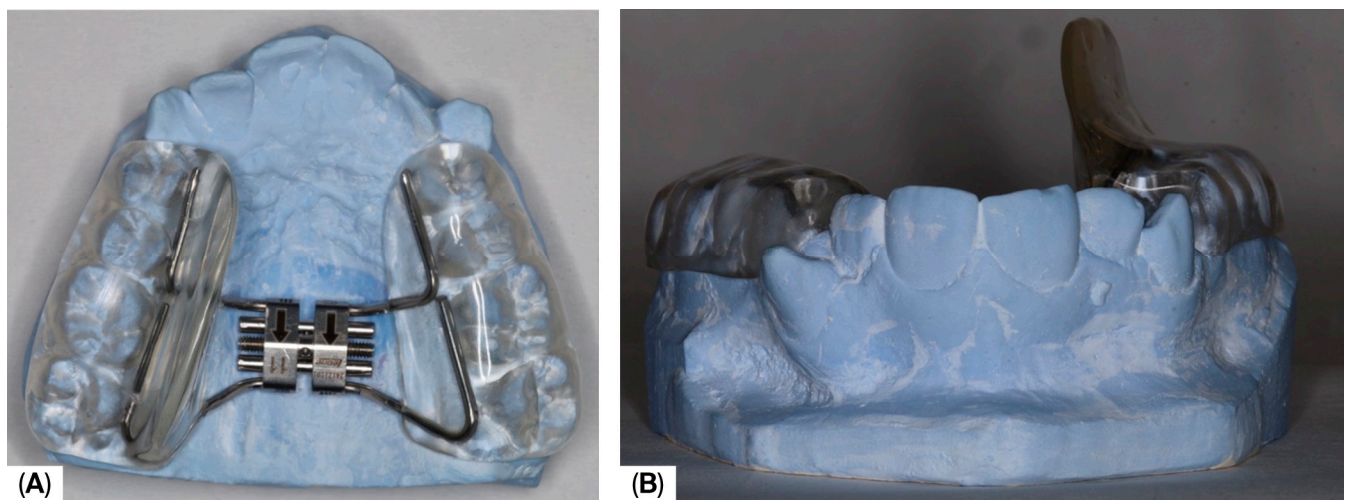


Figure 1. Modified ARPE appliance. (A) Occlusal view. (B) Frontal view.

The expansion protocol for the modified ARPE appliance was identical for all patients. Activation was performed twice daily (0.5 mm/day) until the midpalatal suture separation was radiographically and clinically confirmed by the development of a midline diastema. Thereafter, the activation schedule was reduced to one turn per day (0.25 mm/day). Active expansion was continued until overcorrection was achieved, defined as alignment of the buccal cusps of the mandibular molars on the CB side with the palatal cusps of the opposing maxillary molars in the same vertical plane. As the treatment endpoint was defined clinically rather than by a fixed duration, the total time for which patients received active treatment varied slightly (mean 3.80 ± 0.74 months, range 3.0–5.0 months).

The post-active treatment retention protocol was also the same for all patients. Once active expansion was completed, the screw was stabilized with light-cure composite, and the modified ARPE appliance was retained passively for 3 months to allow reorganization of the midpalatal suture, after which the appliance was removed. CBCT images were acquired with a Planmeca ProMax 3D Mid unit (Planmeca, Helsinki, Finland). Image orientation was standardized by setting the Frankfurt horizontal plane parallel to the floor, and scans were acquired while patients maintained maximum intercuspation without swallowing.

The CB and NCB sides were demarcated on the CBCT images along the midsagittal plane [5], and interdental measurements of the maxilla and mandible were taken from the mesiobuccal cusp tips of the first molars, the buccal cusp tips of the first premolars, and the cusp tips of the canines (Figure 2) using the Romexis software program (version 3.2.0; Planmeca, Helsinki, Finland). Linear measurements were performed on multiplanar reconstructed (MPR) images. For each measurement, the axial plane was adjusted to the

level of the dental cusp tips. Angular measurements were performed on the coronal plane. All linear and angular measurements were taken five weeks after the initial assessment by the same examiner (M.A.Y.) to evaluate method error. Intra-examiner reliability was assessed using intraclass correlation coefficients (ICC) according to the method proposed by Houston [15]. The ICC values for all measurements exceeded 0.942, indicating excellent intra-observer reproducibility.

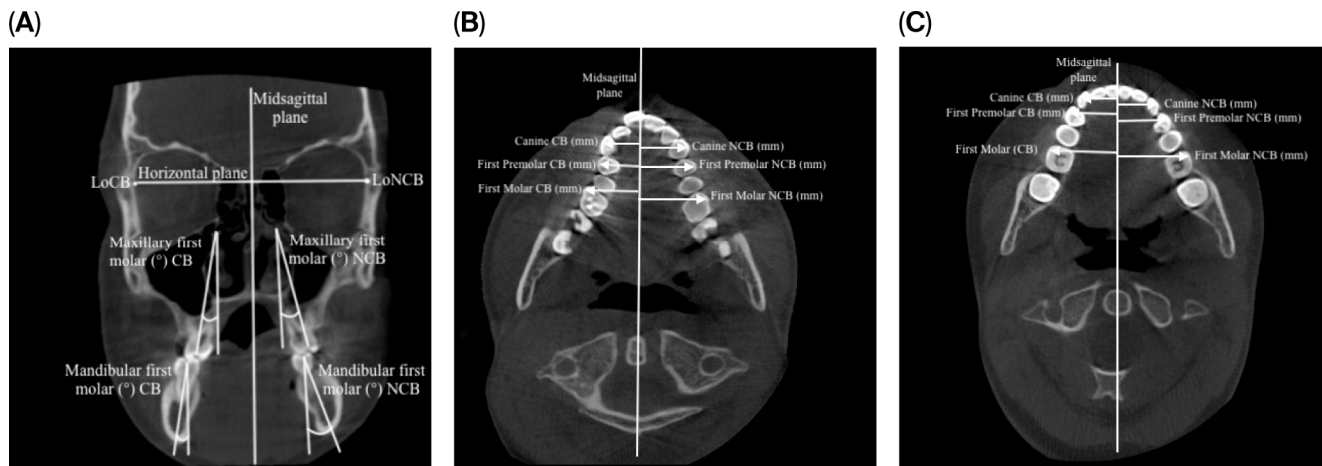


Figure 2. Linear and angular measurements on the CB and NCB sides employed in the present study. The horizontal reference plane was constructed by connecting the points LoNCB and LoCB. LoCB and LoNCB represent the latero-orbitale points (the most lateral point on the margin of the orbit) on the crossbite and non-crossbite sides, respectively, as previously described by Ileri and Başçiftci [5]. The midsagittal plane (MP) was defined as the plane passing through Crista Galli (CG) and oriented perpendicular to the horizontal reference plane. (A) Angular measurement: the angles between the long axis of the first molars and the planes parallel to the MP. (B) Maxillary dental measurements: distances are shown between dental points (mesiobuccal cusp tips of the first molars, buccal cusp tips of the first premolars, and cusp tips of the canines) and MP. (C) Mandibular dental measurements: distances are shown between dental points (buccal cusp tips of the first molars, buccal cusp tips of the first premolars, and cusp tips of the canines) and MP.

The Shapiro–Wilk test was applied to evaluate the normality of continuous variables. Paired-samples t-test was used to compare the normally distributed data, and the Wilcoxon signed-rank test was performed when the normality assumption was not satisfied. Descriptive statistics have been reported as mean $\pm$ standard deviation (SD). Exact p -values, 95% confidence intervals, and effect sizes were calculated for all comparisons. All analyses were conducted using IBM SPSS Statistics for Windows (version 22.0; IBM Corp., Armonk, NY, USA) and statistical significance was set at $p < 0.05$.

3. Results

Maxillary interdental measurements showed significant increases on both sides ($p < 0.05$) (Table 1); however, the maxillary posterior teeth on the CB side expanded significantly more than that on the NCB side ($p < 0.05$) (Table 2). Mandibular interdental measurements indicated a significant increase in the inter-first premolar width, driven primarily by a significant increase on the NCB side ($p < 0.05$) (Table 1).

The inclination of the maxillary first molar tooth increased significantly on the CB side ($p < 0.05$); however, no significant differences were observed on the NCB side ($p > 0.05$) (Table 1). There was also a significant difference in the maxillary first molar inclination between the CB and NCB sides ($p < 0.05$) (Table 2). No statistically significant difference was detected in the inclination of the mandibular first molar on the CB side ($p > 0.05$). A significant decrease in inclination was observed on the NCB side ($p < 0.05$). (Table 1).

Table 1. The maxillary and mandibular linear and angular measurements obtained before and after treatment with the modified ARPE appliance.

	T0 Mean (SD)	T1 Mean (SD)	Mean Diff (95% CI)	Effect Size	<i>p</i>
Maxilla					
Canine width CB (mm)	16.62 (2.44)	18.83 (3.37)	2.22 (0.97, 3.46)	1.13	0.0024^t
Canine width NCB (mm)	17.42 (1.51)	18.17 (1.39)	0.76 (0.21, 1.31)	0.88	0.0110^t
Inter-canine width (mm)	34.03 (2.85)	37.01 (3.45)	2.98 (1.67, 4.28)	1.45	0.0004^t
First premolar width CB (mm)	19.08 (2.20)	23.08 (2.98)	4.00 (2.85, 5.15)	2.21	<0.0001^t
First premolar width NCB (mm)	19.05 (1.07)	20.72 (1.46)	1.67 (1.19, 2.16)	1.00	0.0005^W
Inter-first premolar width (mm)	38.13 (1.77)	43.81 (2.93)	5.67 (4.39, 6.96)	2.81	<0.0001^t
First molar width CB (mm)	24.91 (1.94)	28.62 (2.64)	3.71 (2.71, 4.70)	2.37	<0.0001^t
First molar width NCB (mm)	25.60 (1.11)	27.45 (1.66)	1.85 (1.26, 2.44)	2.01	<0.0001^t
Inter-first molar width (mm)	50.51 (2.39)	56.07 (3.16)	5.56 (4.74, 6.37)	4.33	<0.0001^t
First Molar/MP (°) CB	5.14 (7.30)	8.73 (6.43)	3.59 (1.79, 5.40)	1.26	0.0011^t
First Molar/MP (°) NCB	9.01 (5.16)	10.08 (5.70)	1.07 (−0.39, 2.52)	0.46	0.1360 ^t
Mandible					
Canine width CB (mm)	14.80 (2.03)	15.08 (2.00)	0.28 (−0.41, 0.98)	0.26	0.3888 ^t
Canine width NCB (mm)	12.25 (1.73)	12.73 (1.67)	0.48 (−0.19, 1.14)	0.46	0.1433 ^t
Inter-canine width (mm)	27.05 (1.73)	27.81 (1.66)	0.76 (−0.18, 1.70)	0.51	0.1029 ^t
First premolar width CB (mm)	18.80 (2.18)	19.60 (2.41)	0.80 (−0.22, 1.82)	0.50	0.1113 ^t
First premolar width NCB (mm)	16.72 (1.56)	17.42 (2.20)	0.69 (−0.10, 1.48)	0.64	0.0488^W
Inter-first premolar width (mm)	35.53 (2.45)	37.02 (3.29)	1.49 (−0.12, 3.10)	0.67	0.0400^W
First molar width CB (mm)	26.43 (2.93)	26.44 (2.59)	0.01 (−0.77, 0.79)	0.01	0.9797 ^t
First molar width NCB (mm)	23.85 (2.28)	24.36 (2.24)	0.51 (−0.53, 1.54)	0.31	0.3025 ^t
Inter-first molar width (mm)	50.28 (2.99)	50.80 (3.30)	0.52 (−0.58, 1.62)	0.64	0.0625 ^W
First Molar/MP (°) CB	14.98 (12.50)	13.57 (9.40)	−1.41 (−5.66, 2.84)	0.00	1.0000 ^W
First Molar/MP (°) NCB	18.04 (8.74)	14.88 (7.83)	−3.16 (−5.85, −0.47)	−0.75	0.0255^t

CB: Crossbite side, NCB: Non-crossbite side, mm: millimeter MP: Midsagittal plane, 95% CI calculated using the t-distribution ($n = 12$, $df = 11$). Test: t = paired-samples t -test; W = Wilcoxon signed-rank test (used when Shapiro–Wilk $p < 0.05$ for the distribution of differences). Effect size: Cohen's d_z for t -test rows; matched-pairs rank-biserial correlation (r) for W rows. Bold values indicate statistical significance ($p < 0.05$).

Table 2. Comparison of changes in linear and angular measurements between the CB and NCB sides.

	CB Side Mean (SD)	NCB Side Mean (SD)	Mean Diff (95% CI)	Effect Size	<i>p</i> -Value
Maxilla					
Canine width (mm)	2.22 (1.96)	0.76 (0.86)	1.46 (0.05, 2.87)	0.66	0.044
First premolar width (mm)	4.00 (1.81)	1.67 (0.76)	2.33 (1.11, 3.54)	1.22	0.0015
First molar width (mm)	3.71 (1.56)	1.85 (0.92)	1.86 (0.44, 3.27)	0.83	0.0147
First Molar/MP (°)	3.59 (2.84)	1.07 (2.29)	2.53 (0.77, 4.28)	0.91	0.0090
Mandible					
Canine width (mm)	0.28 (1.09)	0.48 (1.05)	−0.19 (−1.17, 0.79)	−0.13	0.6729
First premolar width (mm)	0.80 (1.60)	0.69 (1.24)	0.11 (−0.75, 0.96)	0.08	0.7866
First molar width (mm)	0.01 (1.22)	0.51 (1.63)	−0.50 (−1.96, 0.96)	−0.22	0.4677
First Molar/MP (°)	−1.41 (6.69)	−3.16 (4.23)	1.75 (−2.37, 5.87)	0.27	0.3693

mm: millimeter, MP: Midsagittal plane, t : paired-samples t -test. Mean Diff = mean (CB change) – mean (NCB change); 95% CI calculated using the t-distribution ($n = 12$, $df = 11$). Effect size: Cohen's d_z . Bold values indicate statistical significance ($p < 0.05$).

4. Discussion

Asymmetric expansion is the treatment objective in cases of true unilateral CB. Various methods have been devised to selectively enhance expansion on the CB side while minimizing effects on the NCB side [4,5,16,17]. Toroğlu et al. [4] modified a quad-helix appliance by adapting a vertically extending “stopper” to the lingual surfaces of the mandibular posterior teeth on the NCB. İleri and Başçiftçi [5] designed the ARPE appliance, a teeth- and tissue-borne bonded RPE with an additional lingual acrylic block that extends to the vestibule surface, and the occlusal bite is formed on the NCB side for unilateral expansion.

These appliances are designed to limit unfavorable expansion on the NCB side and to reduce the risk of buccal non-occlusion.

Previous reports have indicated that only tooth-borne and tooth/tissue-borne RPE appliances show similar effects on dentoskeletal structures [9,18]. In the present study, a tooth-borne bonded rapid palatal expander of the McNamara type was modified to partially restrict rather than completely inhibit expansion on the NCB side, thereby preventing buccal non-occlusion while permitting limited expansion. To this end, a lingual acrylic extension was incorporated solely on the NCB side to enhance anchorage resistance. The 2 mm clearance between the lingual acrylic block and the mandibular dentition allows unrestricted initial transverse dental movement on the NCB side; as expansion progresses, the increasing buccal displacement of the mandibular teeth brings them into contact with the acrylic block, at which point the block begins to resist further buccal movement and caps the amount of dental expansion expressed on the NCB side, thereby preventing buccal non-occlusion with the mandibular dentition. The expansion screw itself applied a symmetric force to both halves of the appliance, as in a conventional Hyrax-type RPE; the asymmetric dental outcome therefore results from the acrylic block rather than from asymmetric force delivery. In contrast to the modification made by Ileri and Başçiftçi [5], our lingual acrylic block did not extend to the vestibule surface, and the occlusal bite did not form on the NCB side. This design difference may also provide a rationale for the divergent mandibular findings observed between the two studies. The continuous bilateral (vestibulolingual) engagement of the mandibular arch in the Ileri and Başçiftçi [5] design may have resulted in the transmission of greater reactive force to the mandible, contributing to the clockwise mandibular rotation and occlusal plane changes reported in that study. In contrast, the delayed, lingual-only contact mechanism employed in this study appears to minimize direct force transmission to the mandibular arch, which is consistent with the largely non-significant mandibular findings observed in the present study (Table 1). The inclusion of the mandibular dentoalveolar structure by a lingual acrylic block on the NCB side was considered sufficient for asymmetric expansion. It was hypothesized that the design would be more comfortable and tolerable for patients because of its reduced occlusal coverage.

The midsagittal plane was employed as the vertical reference plane for evaluating interdental width differences between the CB and NCB sides following activation of the ARPE appliance. This reference plane has been previously utilized in CBCT investigations to assess dentofacial asymmetry, and has also been applied in studies examining asymmetric maxillary expansion [5,7,19,20].

In this study, we achieved the desired unilateral maxillary expansion using this modified ARPE appliance. Significant increments were observed in all widths of the posterior teeth on both the CB and NCB sides. Nevertheless, maxillary dental expansion was significantly greater on the CB side compared to that on the NCB side. Likewise, previous studies have reported significant expansion on both sides, but more increments on the CB side than on the NCB side. Baka et al. [7] also showed a significant increase in linear measurements of the maxillary posterior teeth on the CB side in agreement with our findings. However, they reported no significant changes on the NCB side, which may be attributed to the rigid locked system on the NCB side which prevented expansion. Hoque et al. [21] conducted a finite element analysis study comparing the biomechanical effects of four different asymmetric rapid maxillary expansion appliances, and reported that the greatest degree of asymmetric expansion was achieved with the ARPE appliance.

Rapid maxillary expansion achieves an increase in the transverse dimensions of the maxillary arch through separation of the midpalatal suture, bending of the alveolar processes, and buccal tipping of the anchored posterior teeth [22–24]. In this study, the

buccal crown tipping of the maxillary first molar teeth was significantly higher on the CB side (3.59°) than on the NCB side (1.07°). These outcomes were consistent with that reported by Baka et al. [7], who found a significant tipping on the CB side (4.46°) and non-significant tipping (1.15°) on the NCB side. Toroğlu et al. [4] reported a significant buccal tipping on both sides, although the tipping on the CB side (7.3°) was significantly greater than that on the NCB side (2.5°). Numerous studies have shown that the rigidity of an appliance plays a key role in decreasing the rotational effects generated by forces acting along the long axis of the teeth [25,26]. Therefore, the higher tipping amounts reported by Toroğlu [4] may be explained by the quad-helix appliance that was used for unilateral expansion. In the finite element analysis study, Hoque et al. [21] further reported that the greatest amount of molar tipping—particularly on the CB side—was observed with the ARPE appliance, indicating a higher degree of uncontrolled buccal tipping compared to the other evaluated asymmetric expansion devices.

Haas [22] showed that changes in occlusion and muscle balance following maxillary expansion lead to an uprighting of the posterior mandibular teeth and a widening of the mandibular arch. In the present study, an increase in mandibular inter-first premolar width was observed, with no significant differences between the NCB and CB sides. The extent of uprighting of mandibular molars was not significant on the CB side (1.41° , $p > 0.05$); however, a significant uprighting of 3.16° was observed on the NCB side ($p < 0.05$). These outcomes demonstrated partial agreement with the findings of Baka et al. [7]. While a significant expansion was reported on the NCB side (2.20 mm), this was not mirrored by significant interdental width changes in the present study. However, both studies found significant mandibular molar uprighting on the NCB side, with a comparable magnitude (Baka et al.: 3.31° ; present study: 3.16°). In contrast, the uprighting on the CB side did not reach significance in the present study (1.41°), whereas Baka et al. reported significant uprighting of smaller magnitude on this side (1.11°). This discrepancy may reflect the greater variability observed on the CB side in the present sample. In Baka's study, the mandibular molar teeth were covered from the buccal, lingual, and occlusal parts with an acrylic block, and this occlusal locking mechanism was left for nearly four months. In the present study, despite a considerably shorter activation period (3–4 weeks) and a lingual-only block design, a comparable degree of NCB-side mandibular molar uprighting was nonetheless observed (3.16° vs. 3.31° in Baka et al. [7]), suggesting that even a delayed, partial-contact mechanism may be sufficient to transmit meaningful uprighting forces to the mandibular arch over time.

This study has several limitations. The retrospective, uncontrolled design does not allow us to fully distinguish appliance effects from growth, spontaneous dental compensation, or natural transverse development; controlled prospective studies are needed to confirm true treatment effects. All outcome measures were dental/interdental; skeletal (midpalatal suture) changes were not assessed, and cusp-tip measurements may reflect crown tipping as well as bodily movement. T1 records were obtained at appliance removal, after 3 months of passive retention, with no further follow-up; long-term stability of the asymmetric expansion could therefore not be assessed. Given the small sample size and multiple comparisons, findings should be interpreted as exploratory, and a linear mixed-effects model accounting for the correlated within-patient structure could not be reliably fitted. In future studies, long-term changes should be included to observe relapses over time.

In conclusion, the modified ARPE appliance was associated with significant interdental expansions without creating buccal non-occlusion in true unilateral CB cases. This modification resulted in more expansion on the maxillary posterior teeth on the CB side than on the NCB side. However, the confirmation of true treatment effects, stability, and

comparative benefit over conventional bilateral RPE is required by conducting controlled prospective studies.

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Institutional Review Board Statement: Ethical approval was obtained from the Non-Interventional Clinical Research Ethics Committee of Gaziantep University (Decision No. 2025/372), and the study was conducted in accordance with the Declaration of Helsinki. Permission for the use of archival material was obtained from the Department of Orthodontics, Faculty of Dentistry, Gaziantep University, and the required letter of commitment was signed.

Informed Consent Statement: The requirement for informed consent was waived by the Ethics Committee due to the retrospective nature of the study and the use of archival data.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to ethical and privacy restrictions.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

ARPE	Asymmetric Rapid Palatal Expansion
RPE	Rapid Palatal Expansion
CB	Crossbite
NCB	Non-crossbite
CBCT	Cone Beam Computed Tomography
ICC	Intraclass Correlation Coefficients

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