KOREA J. ORTHOD. 2001 : 31(6) : 611-18

Crowding with no posterior crossbite treatment by rapid patatal expansion

Yoon-Ah Kook, Mojdah Akhavan, Joseph H. Zernik

This is a case report of a 12.5-year-old girl who presented with moderate to severe anterior dental crowding and rotations. Treatment involved no extraction, but expansion of both the maxillary and the mandibular arches. Maxillary expansion was assisted by rapid palatal expansion despite the fact that this patient did not present with posterior crossbite. Crowding and rotations in both arches were corrected and good occlusal function and improved facial esthetic were achieved, with acceptable overbite and overjet. The application of rapid maxillary expansion in cases with no posterior crossbite, which has increased in recent years, calls for re-evaluation of the diagnostic basis and indications for the use of this technique.

Key words : rapid palatal expansion, crowding

The current trends in the practice of orthodontics have shifted toward the principles of dentofacial orthopedics and non-extraction treatment modalities.[1] One of these modalities, rapid palatal expansion (RPE), produces a net increase in the transverse width of the maxillary basal bone. This procedure was initially described in relation to the correction of relative or absolute maxillary deficiency, typically expressed as posterior crossbites,[7] the advantages of this technique in increasing arch length and resolving arch length and resolving crowding have been recognized early on. However, it is not clear that it was initially intended for use in cases of dental crowding in the absence of maxillary deficiency and posterior crossbite. In recent years, the latter application of this technique is becoming increasingly popular, aiming at increasing arch length, correcting axial inclination of the posterior teeth, reducing nasal resistance, and broadening of the smile in the absence of posterior crossbite.[2,4] Thus, RPE has lately been the subject of renewed interest and apparently also increased in use in orthodontic treatment because of its potential for assisting in the correction of anterior crowding in conjunction with non-extraction orthodontic treatment, regardless of the presence or absence of posterior crossbite. This case report reviews RPE of a patient in the early permanent dentition with moderate to severe anterior crowding and no posterior crossbite.

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HISTORY AND INITIAL EXAMINATION

The patient, a 12.5-year-old girl presented with a chief complaint of mandibular dental crowding (Fig 1). The patient had no significant medical or dental history. Menarche was noted approximately 1 year prior to the onset of treatment.

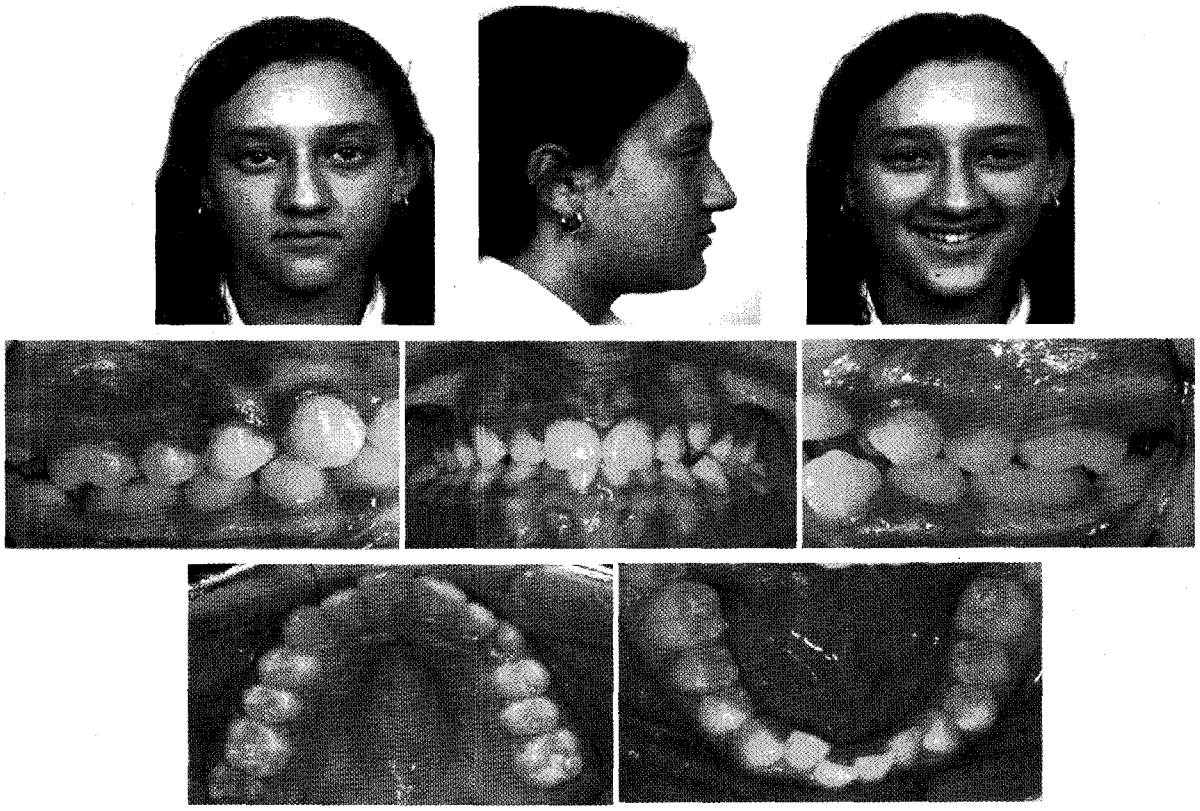

Fig. 1. Initial facial and intraoral photographs.

DIAGNOSIS

The patient's photographs showed an overall straight soft-tissue profile. The chin was slightly shifted to the right. Lip position and overall soft-tissue relationships were judged as acceptable.

Similarly, the patient demonstrated a straight hard tissue profile, with an A-N-B angle of 2, mandibular plane angle of 23 relative to Frankfort horizontal line and 29 relative to the S-N line. The upper incisor position was within normal limits at 4 mm and 23 to N-A. The lower incisors were slightly retroclined at 3 mm and 17 to N-B.

The patient demonstrated a Class I molar relationship with 3 mm overjet and 5 mm overbite. Moderate to severe dental crowding was present : 8 mm in the mandible and 3 mm in maxilla. The patient's oral hygiene and gingival health were good. No signs or symptoms of temporomandibular dysfunction were noted.

TREATMENT PLAN AND OBJECTIVES

The most significant problems in this case were dental crowding and rotations. In addition to correction of these problems, treatment aimed at correction of overbite and ovejet. After discussion with the patient and her parents, the plan was set for non-extraction treatment, based on expansion of both the maxillary and the mandibular arches, assisted by RPE.

TREATMENT

The maxilla was expanded with a banded Hyrax -type RPE device (Fig 2). The patient's parents activated the appliance one-quarter turn of the screw twice each day for 3 weeks, equivalent to 5.25-mm total expansion. The appliance was left in place for 4 additional months after completion of the rapid expansion phase in order to stabilize the expansion. During stabilization, preadjusted brackets (0.022″ × 0.028″)

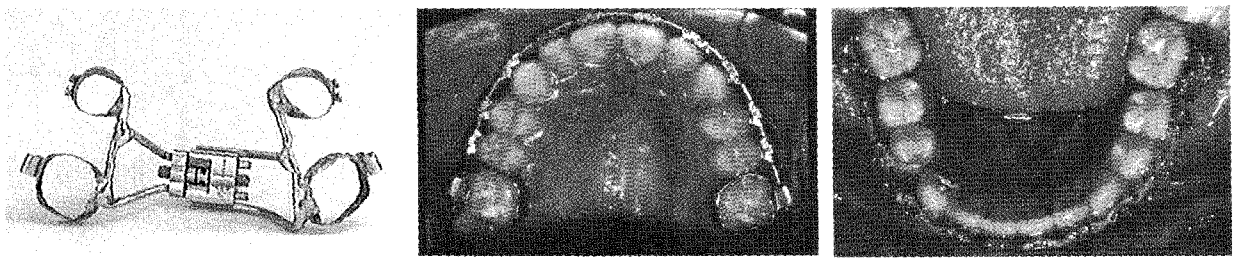

Fig. 2. A. Hyrax appliance as used in this patient. B, C. Intraoral photograph following rapid palatal expansion.

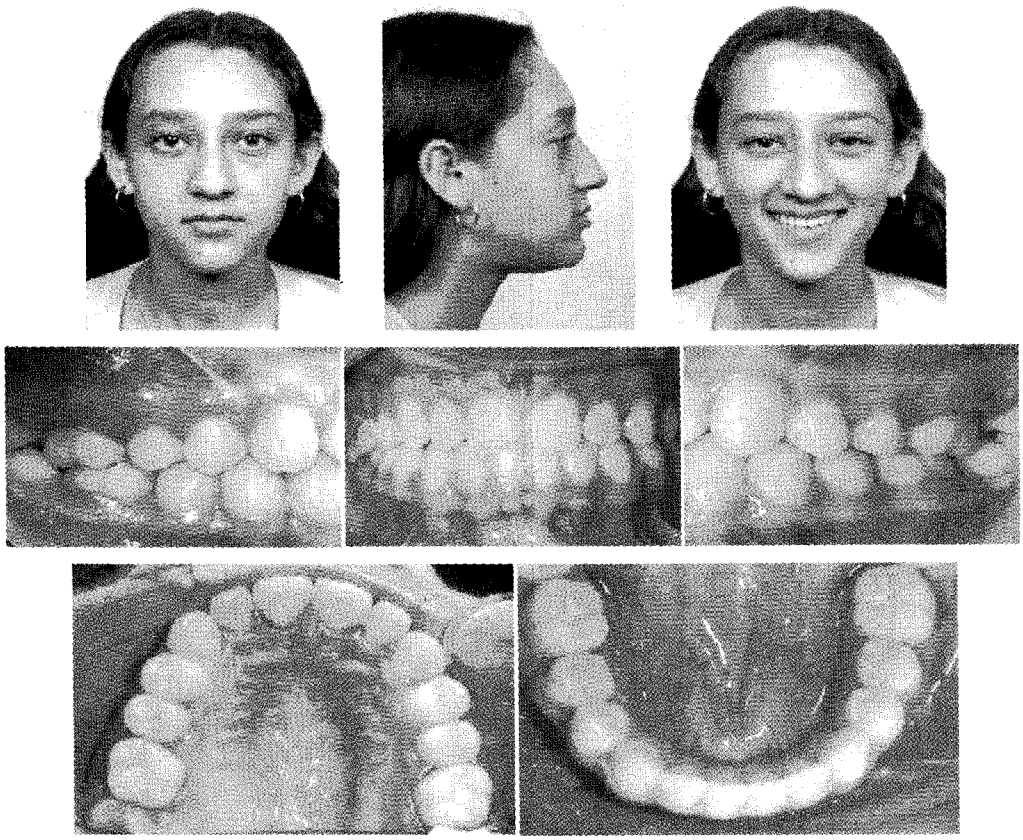

Fig. 3. Post-treatment facial and intraoral photographs.

were bonded. The arches were leveled with progressive nickel-titanium wires (0.016", 0.020" × 0.020"), and stainless-steel arch wires (0.020"). Space was gained for the lower left canine by using a compressed nickel-titanium open coil spring for 2 months.

Box-shaped elastics were worn for 3 months to achieve proper anteroposterior interdigitation of the buccal segments. Stainless steel wires (0.019" × 0.025") were placed as finishing arch wires and torque was increased on the maxillary anterior teeth (Fig 2B).

RESULTS AND DISCUSSION

The length of active treatment was 21 months. Crowding and rotations in both arches were corrected and a Class I molar and canine relationship was achieved with acceptable overbite and overjet (Fig 3). Good function with canine guidance during lateral excursions

Table 1. Interdental width measurements following the method of Adkins et al [2] derived From the initial, during treatment, post-treatment, and post-retention models T1 Initial: T2During Treatment: T3 Post-Treatment: T4 Post-Retention; T3-T1 initial to Post-treatment difference: T2-T1 initial to during-Treatment: T4-T1 initial to post-retention difference.

	MEASUREMENT	INITIAL T1	DURING TREATMENT T2	POST-TREATMENT T3	T2-T1	T3-T1	POST-RETENTION T4	T4-T1
Maxilla	Intercanine width	24.2	24.8	25.1	0.6	0.9	25.1	0.9
	Inter 1st premolar width	25.1	27.1	28.3	2.0	3.2	27.8	2.7
	Inter 2nd premolar width	29.2	32.6	33.1	3.4	3.9	33.0	3.8
	Inter 1st molar width	32.6	33.1	34.9	0.5	2.3	34.2	1.6
	Arch perimeter	75.8	78.8	79.8	3.0	4.0	78.6	2.8
Mandible	Intercanine width	17.1	20.0	20.2	2.9	3.1	19.6	2.5
	Inter 1st premolar width	24.6	25.7	26.6	1.1	2.0	26.5	1.9
	Inter 2nd premolar width	27.5	29.5	30.3	2.0	2.8	30.3	2.8
	Inter 1st molar width	30.1	30.9	30.9	0.8	0.8	30.8	0.7
	Arch perimeter	60.2	63.9	65.8	3.7	5.6	64.3	4.1

and a well-seated posterior occlusion with balancing interference were established. Facial photographs demonstrated improved esthetics when smiling due to better display of the maxillary anterior teeth, in conjunction with changes in arch form described below.

Our results, comparing initial, during treatment, end-of-treatment, and retention models are summarized in Table 1 and Fig 4. Result of the RPE phase itself showed maxillary expansion primarily in the premolar area, without any significant buccal tipping of the maxillary molars (Fig 5). These results were maintained and even furthered during the following fixed appliance phase, and maintained during retention. Overall, the maxillary V-shaped arch form was changed into a U-shaped arch form. Expansion was noted also in the mandibular canine and premolar area, which was also maintained throughout treatment and retention. Dental measurements reflecting anteroposterior position of the incisors and interincisor angle were not significantly changed during treatment.

In the occlusal plane, Wertz[5] described differential expansion of the maxilla ; the anterior opening appeared widest, with a 3 to 1 ratio compared to posterior opening. Our results showed maximal maxillary expansion at the premolar area.

Adkins et al[2] report increase in mandibular arch width perimeter following RPE, although mandibular teeth were not carrying any orthodontic appliance. Expansion averaged 6.5 mm at the first molars, 6.1 mm at the first premolars, and 2.9 mm at the canines. This change was attributed to uprighting of mandibular teeth as a result of in occlusal force pattern following RPE. However, Gryson[11] noted that there was no correlation between the change in mandibular inter

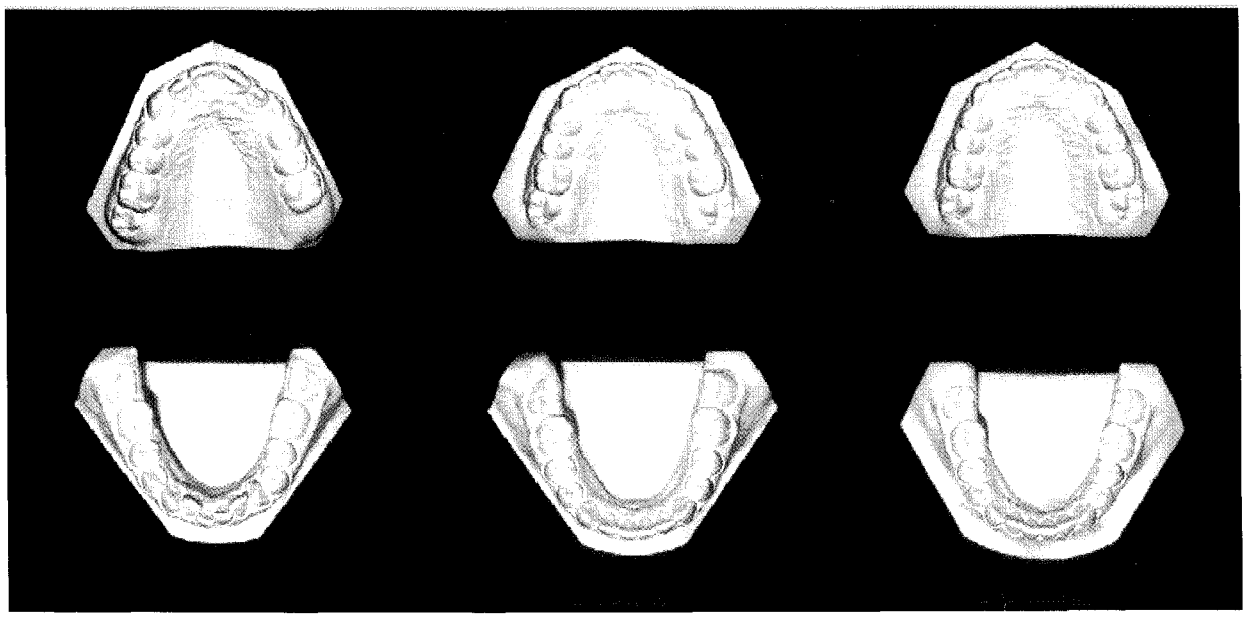

Fig. 4. A. Initial, B. Post-treatment and C. Post-retention study models.

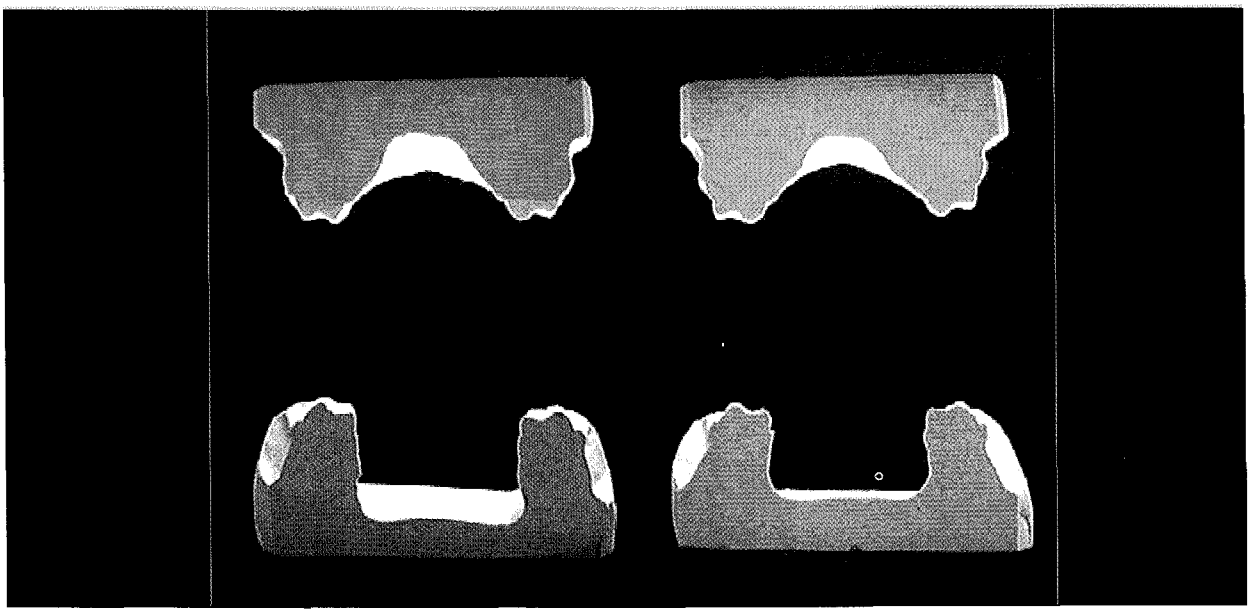

Fig. 5. Angulation of the 1st molars demonstrated on sectioned study models. A. Initial, B. Post-treatment

canine and intermolar distance with respect to the increase in maxillary intermolar distances. Therefore, one can conclude that in general RPE could influence the mandibular dentition but the accompanying changes are neither pronounced nor predictable.

Analysis of initial and final lateral cephalometric

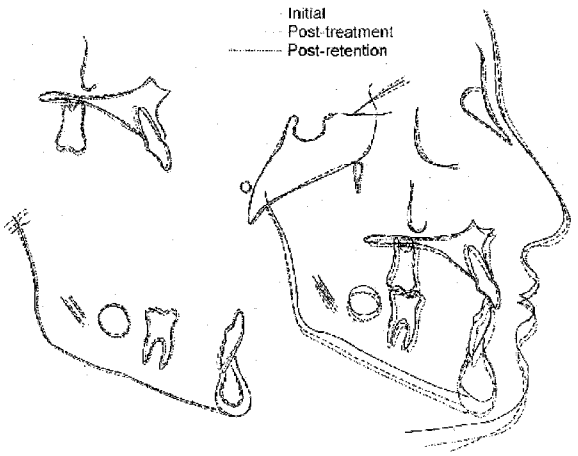

Fig. 6. Cephalometric tracing of pre- and post-treatment lateral radiographs. Solid line Initial: broken line Post-treatment: dotted line Post-retention.
The maxilla was superimposed on the ANS-PNS line and the mandible was superimposed on the symphysis and the mandibular plane.

radiographics (Fig 6), following Burstone's analysis,[15] indicated a small change in soft tissue convexity (G-Sn-Pg') at 159 initial measurement and 156 final. Similarly, skeletal convexity (N-A-Pg) remained within normal range (176 and 177 initial and final respectively). Measurements of maxillary and mandibular size remained within normal limits. These changes should be evaluated in the context of additional growth seen in this patient during treatment and further into retention. It was previously suggested that RPE treatment could lead to spontaneous forward posturing of the mandible,[4] or even increased growth of the mandible. However, these suggestions appear lacking in supporting data in the literature.

Mandibular plane angle relative to the constructed Frankfort Horizontal (MP-FH) was slightly increased (23 and 26 initial and final respectively). Lower facial height (ANS-Gn perpendicular to constructed FH) was relatively high at the onset of treatment, but remained within normal range following RPE (65 mm and 69 mm initial and final respectively).

Conflicting results regarding the effect of RPE on facial height appear in the literature. Some studies suggested an increase in lower facial height was seen in correlation with RPE. The maxillary suture was found to separate superoinferiorly in a nonparallel manner, and the separation was found to be pyramidal in shape with the base of the pyramid located at the oral side of the bone.[5,7,8] Wertz[5,6] demonstrated on mixed dentition skulls that the center of resistance of the maxilla was close to the frontomaxillary suture and the maxilla consistently moved inferiorly but rarely moved anteriorly to a significant degree. However, Isaacson and Zimring[12] showed that because of the resistance of the midpalatal suture and circummaxillary articulations to the expansion forces, microfractures within the buccal cortical plate were generated before the breakage of the suture, contributing to buccal tipping of posterior teeth.

Similarly, Majourau and Nanda[10] suggested that the major change in mandibular arch following RPE was related to downward and backward rotation of the mandible following vertical changes to the maxilla, and leading to or increase in lower facial height. However, Velazquez et al[7] showed no vertical or anteroposterior facial skeletal differences between the initial and the final records in conjunction with RPE. These divergent perspectives regarding changes in mandibular arch following RPE would need to be resolved in future studies.

No evidence of enamel decalcification and root resorption was noted. Good root parallelism was achieved. The temporomadibular joint function was normal. The second molars completed their eruption with no complications. Developing third molars were still present and continued to be monitored.

RETENTION AND FINAL EVALUATION

At the conclusion of the active treatment, the fixed appliances were removed. Maxillary and mandibular wrap-around Hawley retainers were also inserted. The patient was instructed to wear the retainers on a full-time basis. At the end of one year, the patient was instructed to reduce retainer use to nighttime only. Our record 2 years after the end of treatment demonstrate good retention of our treatment results (Fig 7, Table 1). Thus, The prognosis for continued stable results

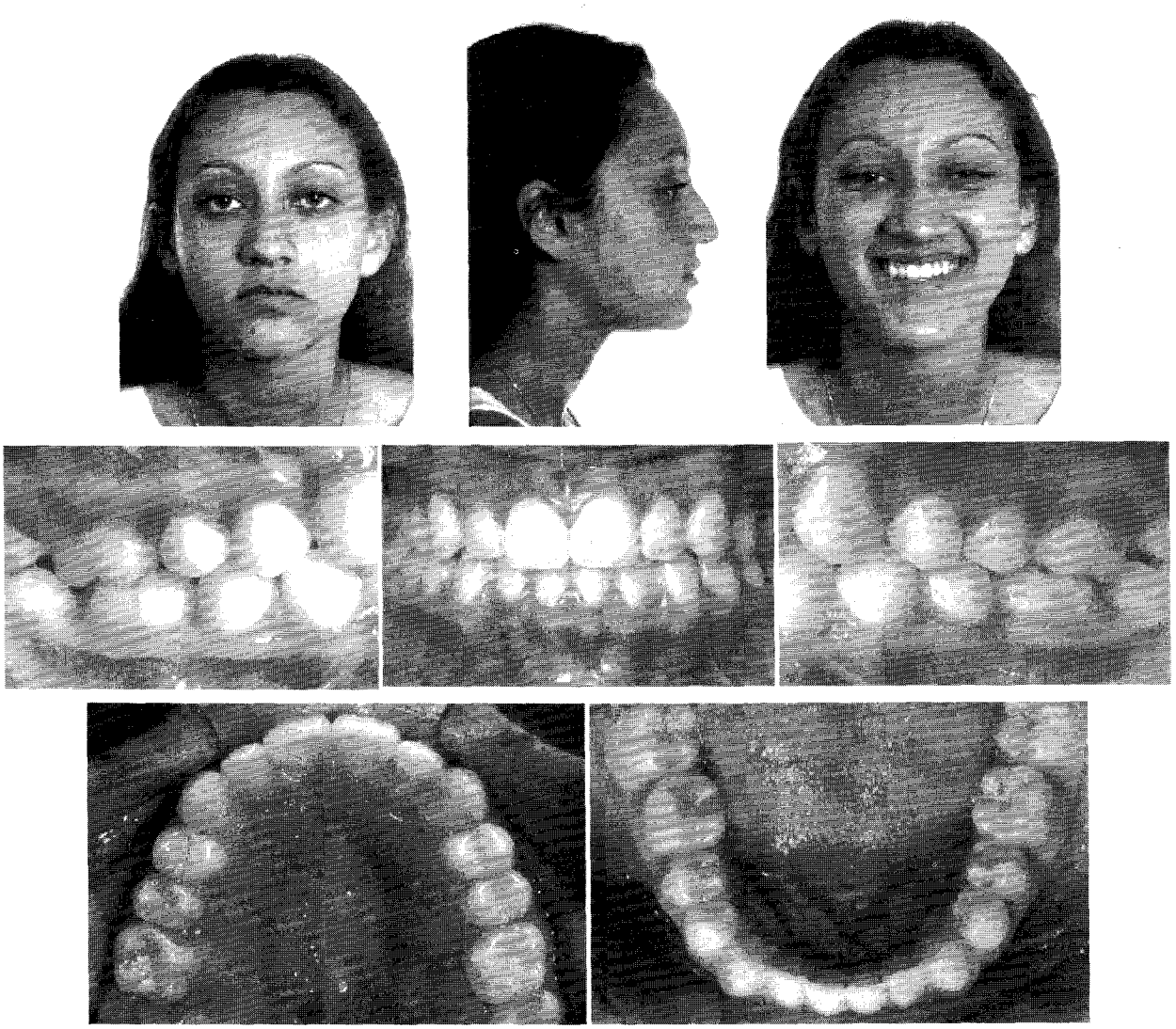

Fig. 7. Post-retention facial and intraoral photographs 2 years after end of active Treatment.

appeared good. Mew[13] advocated a total retention period of 1 to 4 years for RPE patients, depending on the extent of expansion. Krebs[14] found that the tendency of a substantial reduction in dental arch width after fixed retention continued for up to 5 years. Spillane and McNamara showed that majority of increased arch dimension in early mixed dentition patients are maintained at the end of transitional dentition.[3]

It is possible that non-extraction treatment of crowding by RPE produces results that are more stable than those produced by other methods of arch expansion, e.g. : dental arch expansion flaring or slow maxillary expansion, since RPE primarily produces an increase in the maxillary basal bone perimeter. However, these skeletal effects produced by RPE are seen only in the maxillary arch, whereas expansion of the mandibular arch remains dental in nature. Thus, one may expect that stability of mandibular expansion in this treatment modality would be similar to that reported in other non-extraction treatment modalities.[16] However, no studies are available of the stability of RPE treatment in the absence of posterior crossbite. Similarly, it is not clear whether or not RPE treatment of such case reduces treatment time.

CONLUSION

In the past, RPE was recommended primarily in cases of maxillary transverse deficiency. Currently, new application are seen for RPE and an increase in its use by orthodontists in conjunction with non-extraction treatment of crowding, regardless of the presence or absence at posterior crossbite. We presented the results of treatment with of RPE in a case with initial crowding, but no posterior crossbite.

Our results demonstrate small or minimal change in maxillary or mandibular intermolar width, but substantial changes in arch-shape and arch-perimeter, particularly noticeable as an increase in an intercanine width as well as maxillary and mandibular premolar width.

Thus, RPE has evolved in recent years toward increased use for bony expansion and for facilitating non- extraction orthodontic treatment in the absence of posterior crossbite. Additional clinical studies are necessary to evaluate the efficacy of such treatment modality, and to better define the appropriate indication for such treatment.

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국문초록

구치부 반대교합이 없는 총생 증례의 급속구개확장에 의한 치료

남캘리포니아대학교 치과대학 교정학교실

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중등도 내지는 심한 총생과 회전이 있는 12.5세 여자 환자의 증례에 대한 보고이다. 발치를 하지 않고, 상하악 치열궁의 확장에 의해 치료하였다. 구치부의 반대교합이 없었지만, 상악의 경우 급속구개확장을 시행하였다. 양악의 총생과 치아 회전이 해소되었으며, 교합기능과 안모 심미의 개선을 이루었으며, 적절한 수평 및 수직 피개교합을 이룩하였다. 최근에 많이 사용되는 구치부 반대교합이 없는 경우에서의 급속구개확장은, 진단학적 기반 및 적응증에 관한 재평가가 필요하다고 생각된다.

주요 단어 : 급속구개확장, 총생