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Two-point rapid palatal expansion: an alternate approach to traditional treatment

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Abstract

Rapid palatal expansion (RPE) causes separation of the lateral halves of the palate and traditionally has used four maxillary teeth as anchorage. The purpose of this study was to introduce a rapid palatal expander that requires only two anchor teeth (two-point RPEe) and to compare the expansion obtained with that from a Hyrax® appliance. This study involved two groups of 25 children aged 7 to 15 years who were treated in a private orthodontist's office with either a Hyrax appliance or a two-point RPEe. Dental casts and occlusal radiographs were made before treatment and at least three months after stabilization of the appliance. Paired t-tests were performed to identify significant intragroup changes, and independent t-tests were performed to determine intergroup differences. The findings showed the two-point RPEe was as efficient as the Hyrax in obtaining dental expansion of the maxillary posterior teeth with less effect on the maxillary anterior and mandibular teeth. Therefore, the two-point RPEe may be useful in certain clinical situations.

Introduction

Rapid palatal expansion is an orthodontic procedure designed to induce a physical separation of the lateral halves of the bony palate. Many effects are evident as the midpalatal suture opens (Haas 1961; Haas 1965; Haas 1970). One of the most obvious initial changes is the diastema created between the maxillary central incisors. However, the incisors converge as a result of the tension in the transeptal fibers during retention.

A change occurs in the direction of the long axis of the maxillary posterior teeth during RPE. This change is due to both palatal separation and tooth movement (Starnbach et al. 1966; Bishara 1987). The most frequent types of tooth movement are tipping and extrusion.

As the maxillary arch width increases, the mandibular posterior teeth tend to upright and tip buccally. Haas (1961) theorized that the change in orientation of the mandibular posterior teeth is due to the tongue being forced downward by the palatal appliance. In addition, the buccinator muscle, due to the buccal movement of the maxillary teeth, would have less of a confinement effect on the mandibular molars. The changes in the position of the mandibular teeth are neither pronounced nor predictable (Gryson 1977).

Haas (1980) reported a minimum of five indications for RPE:

1. Real and relative maxillary deficiency
2. Class III malocclusion
3. Nasal stenosis
4. Mature cleft palate patients
5. Selected arch length problems in Class I skeletal patterns.

Several types of rapid palatal expanders (RPEe) have been developed to prevent or correct malocclusions in the child. The Arnold appliance and the Minne expander are RPEes that are cemented to four anchor teeth (Biederman 1973). The anchor teeth usually are the maxillary first permanent molars and either the maxillary first premolars or the maxillary first deciduous molars. Both appliances are activated by turning an adjustment screw that compresses a coil spring. The Hyrax® (OIS Orthodontics, 65 Commerce Dr., Aston, PA, USA) appliance (Biederman 1973) also is an RPEe which is anchored similarly, but is activated by means of a centrally located jackscrew (Fig 1a, next page). The Haas appliance (Haas 1961) is similar to the Hyrax in construction and activation, but includes acrylic that rests against the palatal soft tissues. An appliance that includes an acrylic embedded jackscrew is bonded directly to the posterior teeth (Cohen and Silverman 1973; Howe 1982).

RPEes have been used widely, but significant problems have been associated with their use. For instance, appliances containing acrylic may produce painful ulceration of the palatal mucosa during activation. Consequently, it may be necessary to remove the RPEe and delay treatment (Howe 1982). Also, anchor teeth have

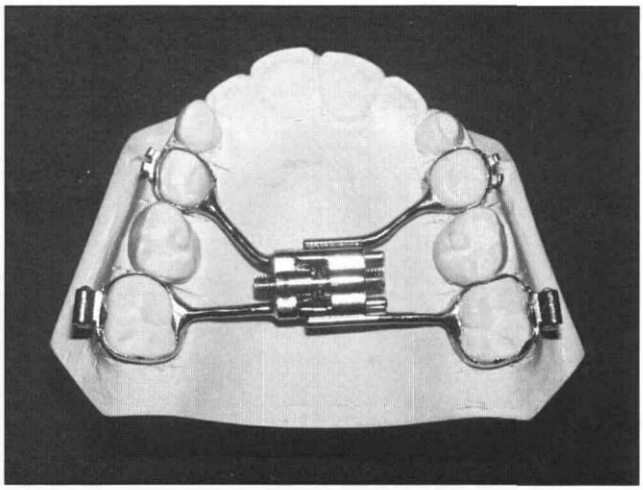

Fig 1a. A Hyrax appliance.

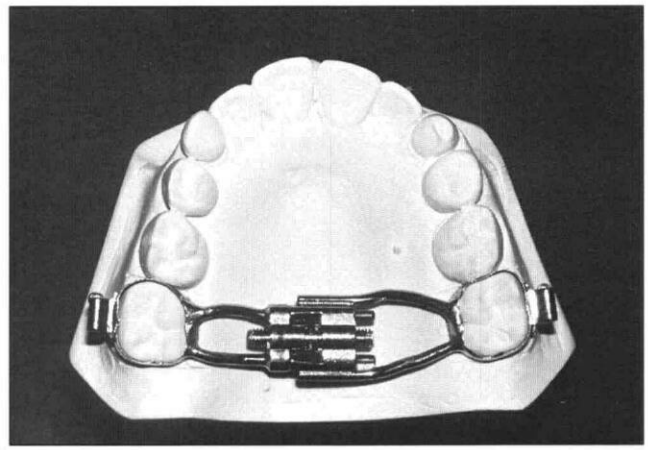

Fig 1b. A two-point rapid palatal expander (RPEe).

been associated with marked pulpal and root resorptive damage (Timms and Moss 1971; Barber and Sims 1981; Langford and Sims 1982). Most significantly, malaligned or missing teeth may make parallel insertion of an RPEe on four or more anchor teeth difficult or impossible (Howe 1982).

This paper presents a new appliance, a two-point RPEe (Fig 1b). It contains a centrally located jackscrew similar to the Hyrax appliance (Fig. 1a), but utilizes only two banded teeth as anchors, the first permanent maxillary molars. If sufficient expansion can be obtained and maintained, the two-point RPEe will provide the practitioner with an effective appliance for the transitional dentition that is simpler, less expensive, and lessens the chances of potential damage to the teeth.

The purposes of this study are to:

1. Introduce a two-point RPEe
2. Describe its dental changes
3. Describe the dental changes obtained from a Hyrax appliance (four-point RPEe)
4. Compare the dental expansion obtained from the two-point RPEe to that of a Hyrax appliance.

Materials and Methods

This prospective study involved 50 patients who were treated in a private orthodontist's office. Males and females who ranged in age from 7 to 15 years were treated. Twenty-five children were treated with a two-point RPEe (Group A) and 25 with a Hyrax appliance (Group B). The Hyrax appliance consisted of a Unitek Expansion screw (Unitek/3M; Monrovia, CA), and orthodontic bands cemented to maxillary first permanent molars and either the maxillary first premolars or maxillary first primary molars. The two-point RPEe had bands that were cemented to maxillary first permanent molars only and contained a similar jackscrew. RPE treatment was indicated for these children because of either a skeletal Class III pattern based on cephalometric analysis, an anterior or posterior crossbite, or mild to moderate dental crowding (> 4 mm), calculated by a space analysis.

Orthodontic records were obtained for all patients before any treatment (T0) including lateral cephalometric radiographs, study models, and standard intra- and extraoral photographs.

Activation of the appliances was initiated with two turns of the jackscrew on the day of cementation (T1). Each turn represented .25 mm of separation to the screw assembly. The patient's parent was instructed to turn the jackscrew one turn (.25 mm) in the morning and again in the evening of each day of expansion treatment. The patient was examined on a weekly basis, and expansion terminated (T2) when the lingual cusp tips of the maxillary first permanent molar were in contact with the corresponding buccal cusp tips of the mandibular first permanent molar. The number of days of active expansion was recorded, and the appliance was stabilized with acrylic placed in the screw area. Expansion was retained with the appliance for a minimum of three months (T3). After retention, the RPEe was removed and study models were obtained.

Occlusal radiographs were taken at T1 and T2 to demonstrate the separation of the midpalatal suture and to record the configuration of separation. Follow-up study models were taken when the RPEe was removed at T3. The dental casts were evaluated at two stages of treatment (T0 and T3) to determine the transverse change in the maxillary arch width, the transverse change in the mandibular arch width, and the degree of tipping of the maxillary teeth. The following measurements were made by the primary investigator with calipers (Boley Gauge) accurate to 0.1 mm (Fig. 2, next page):

1. Intermolar Cusp Tip Width — the distance between the mesiobuccal cusp tips of both maxillary

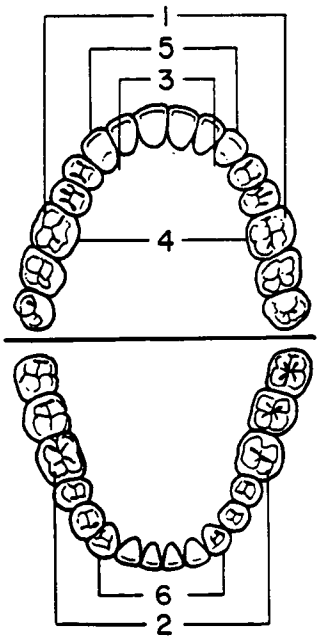

Fig 2. The measurements obtained from the dental casts.

1. Maxillary Intermolar Width (IMmax)
2. Mandibular Intermolar Width (IMmand)
3. Canine Arch Width (AWc)
4. Molar Arch Width (AWm)
5. Maxillary Intercanine Width (ICmax)
6. Mandibular Intercanine Width (ICmand)

permanent first molars (IMmax) and the distance between the mesiobuccal cusp tips of the two mandibular permanent first molars (IMmand)

2. Arch Width — the transverse diameter of the palate measured at the free gingival margin of the maxillary canines at their most lingual aspect (AWc), and at the free gingival margin of the maxillary first permanent molars at their most lingual aspect (AWm)
3. Intercanine Width — the distance between the cusp tips of the two mazillary canines (ICmax) and the distance between the cusp tips of both mandibular canines (ICmand), depending on the canine present at the time of treatment.

The amount of maxillary first permanent molar tipping (Mtip) was defined as the change in the distance between their mesiobuccal cusp tips (IMmax) minus the change in the distance between the transverse diameter of the palate measured at the free gingival margin of the first molars (AWm).

To determine reliability of the measurements, 25 models were remeasured without reference to initial measurements by the primary investigator. These measurements were compared to the original data, and a Pearson Product Moment Correlation Coefficient was used to determine the degree of association between measurements.

Paired *t*-tests were performed to determine any significant intragroup changes that occurred between the pretreatment and posttreatment measures (5 variables associated with the study models) for both groups. Independent *t*-tests were performed to determine any significant intergroup differences with respect to patient characteristics (sex, age, number of crossbites, and activation days) for the two groups (A and B). Independent *t*-tests were performed to determine any significant intergroup differences of the mean changes seen in the seven dental variables. The probability for statistical significance effect or change was set at 0.05.

Results

Patient Characteristics

Fifty children (23 males and 27 females) 7 to 15 years of age were involved in the study. There was no significant difference in the distribution of males and females between the two groups. The average age of the children was 10.1 years (also was the average age of both males and females). There was no significant difference in the distribution of age between the two groups (Table 1).

Of the 50 children, 43 had crossbites. They were evenly distributed between anterior, right posterior, left posterior, and bilateral crossbites. No significant differences between groups were noted in the distribution of crossbites (Table 2).

The average number of activation days (T1 to T2) of the RPEe was 15 days, with a range of 6 to 36 days. There was no significant difference in the distribution of activation days between the two groups.

Reliability of Measurement

The Pearson Product Moment Correlation Coefficients relating the two independent measurements of the dental variables were found to be greater than 0.96 for all variables.

Two-point RPEe (Group A)

Paired *t*-tests were performed on variables within Group A that compared pre- and postexpansion values (T0–T3). The two-point RPEe was retained for an average of 180 days, and changes obtained can be seen in Table 3. There was a significant increase in the distance between the maxillary first permanent molars (AWm = 5.5 mm), and maxillary cuspids (AWc = 2.2 mm). There also was a significant increase in the distance between the mandibular cuspids (ICmand = 0.8 mm), but a significant decrease in the distance was observed between the mandibular first permanent molars (IMmand

Table 1. Sex and Age (Years) Distribution Per Group.

	Males		*Females*		*Total*	
Group	*#*	*Age*	*#*	*Age*	*#*	*Age*
A (two-point RPEe)	15	10.8	10	10.1	25	10.5
B (four-point RPEe)	8	9.3	17	10.1	25	9.7
Total	23	10.1	27	10.1	50	10.1

TABLE 2. Distribution of Types of Crossbites Per Group.

Group	Ant	Rt Post	Lt Post	Bilat Post	None	Total
A (two-point RPEe)	6	6	4	4	5	25
B (four-point RPEe)	5	5	8	5	2	25
Total	11	11	12	9	7	50

TABLE 3. Group A vs. Group B.

Variable*	Group A	Group B	T value	d.f.	P value
AWm	5.5 mm	5.3 mm	0.35	48	.728
AWc	2.2 mm	3.4 mm	2.23	29	.033
IM-mand	−0.8 mm	0.8 mm	2.77	46	.008
ICmand	0.8 mm	0.6 mm	0.37	38	.714
Mtip	−0.5 mm	0.3 mm	2.88	48	.006

* AWm = Intermaxillary molar width. AWc = intermaxillary canine width. IMmand = Intermandibular molar width. ICmand = Intermandibular canine width. Mtip = Tipping of maxillary molar.

= -0.8 mm). There was a significant degree of lingual tipping of the maxillary first permanent molar (Mtip = 0.5 mm).

Four-Point RPEe (Group B)

Paired *t*-tests were performed on variables within Group B that compared pre- and postexpansion values (T0–T3). The four-point RPEe was retained for an average of 210 days, and the changes obtained can be seen in Table 3. There was a significant increase in the distance between the maxillary first permanent molars (AWm = 5.3 mm) and that of the maxillary canines (AWc = 3.4 mm). There was no significant increase in the distance between the mandibular canines, and no significant change was seen in the distance across the mandibular molars. The maxillary first permanent molar tipped toward the buccal an average of 0.3 mm, but this change was not significant.

Group A vs. Group B

Independent *t*-tests were performed to compare changes obtained from the two-point RPEe to those of the four-point RPEe (Table 3). There was no significant difference in the average number of days of retention between the two RPEes. There was no significant difference between the two RPEes with respect to change in distance across the maxillary first permanent molars and across the mandibular canines. There was, however, a significant difference with respect to change in distance across the maxillary canines and across the mandibular molars. There was significantly less change in both of these measurements with the two-point RPEe. A significant difference also was observed in the tipping of the maxillary first permanent molar. The molars in the two-point RPEe tipped toward the lingual an average of 0.5 mm, while those of the four-point RPEe tipped toward the buccal 0.3 mm.

Discussion

No significant difference was noted between the two groups with respect to the following patient characteristics: distribution of sex, age, crossbites, and days of activation (Tables 1 and 2). This suggests that the two groups were homogenous.

The even distribution between groups of males and females in this study reflects a normal population of orthodontic patients. The mean age of patients (10.1 years) is characteristic of the transitional dentition. During this period of arch and dental development, using a two-point RPEe may be more advantageous compared to a four-point RPEe because of the need for only two anchor teeth. The four-point RPEe requires four anchor teeth that are reasonably parallel to facilitate a path of insertion of the appliance. Also, in clinical cases that need orthopedic corrections (e.g.: skeletal crossbites), an orthodontic appliance, such as a quad helix, may not produce the desired effects.

The average number of activation days for both appliances was 15 days. Hypothetically, this would represent 30 turns of the activator jackscrew (two turns per day) and 7.5 mm of activation (.25 mm per turn). If the appliance is 100% efficient, 7.5 mm of expansion of the maxillary posterior teeth would be expected. The average expansion overall was 5.5 mm. This discrepancy between the ideal and actual expansion may be due to poor patient compliance, activation of the screw assembly, compression of the periodontal ligament, and different effects on craniofacial sutures other than the midpalatal suture (Haas 1961). There was no significant difference between appliances in terms of posterior expansion. Therefore, the two-point RPEe is as efficient as a Hyrax appliance in obtaining dental expansion.

Occlusal radiographs obtained when the RPEes were stabilized (T2) showed a similar triangular configuration of palatal separation. As described by Bell (1982), the greatest opening of the midpalatal suture was found anteriorly in the incisor region, with progressively less separation toward the molar area. The pattern of midpalatal suture separation was similar for both appliances. However, the radiographs that were taken to document palatal separation were not standardized with respect to operator and angulation, and no measurements were made.

According to Bishara et al. (1987), the maxillary posterior teeth should extrude and tip laterally before palatal separation occurs. After the midpalatal suture splits, the maxillary posterior teeth move bodily along with the palatal halves. Both the two-point RPEe and

four-point RPEe displayed a buccal expansion of the maxillary first permanent molar (Table 3). However, a major difference occurred with respect to the angulation of the tooth. With the four-point RPEe, the maxillary first permanent molar tipped buccally as expected. On the contrary, the maxillary first molars tipped lingually with the use of the two-point RPEe (Table 3). The reason for this finding is unclear; however, it seems reasonable to expect that the two-point RPEe had a different distribution of forces on the dentition and associated craniofacial suture sites than that of the four-point RPEe. For instance, the two-point RPEe may have imposed a significantly greater and more concentrated effect on palatal and other craniofacial sutures, the dentition, and on the appliance. It may be hypothesized that the major vector of force associated with the two-point RPEe is more apically directed. This would be manifested primarily as a lingual tipping of the crown. On the other hand, the major vector of force of the four-point RPEe may be more coronal, which would cause a buccal tipping of the crown.

There was an increase in the distance between the maxillary canines with both RPEes (Table 3). However, the four-point RPEe showed a significantly greater increase in the distance between the canines when compared to the two-point RPEe. This probably was due to the four-point RPEe having a greater effect on the anterior portion of the maxilla as compared to that of the two-point RPEe. Here again, this finding is congruent with the hypothesized difference in the distribution of forces between the two RPEe appliances.

The distance between the mandibular posterior teeth is expected to increase as they upright and tip buccally (Haas 1961). The mandibular first permanent molars treated with a four-point RPEe behaved in this fashion, but those of the two-point RPEe did not (Table 3). In the latter cases, the distance decreased between the mesiobuccal cusp tips of the mandibular first permanent molars. This finding is consistent with the different effects of the two appliances observed in the maxillary arch (viz., the forces associated with the lingually directed maxillary molars of the two-point RPEe would tend to tip the mandibular molars more lingually and vice versa with the four-point RPEe).

RPEes may cause degenerative pulpal and/or periodontal responses in anchor teeth (Timms and Moss 1971; Barber and Sims 1981). In this study, no attempt was made to evaluate soft tissue responses to the two RPEes. Nonetheless, there were no patient symptoms or clinical signs of any soft tissue or pulpal problems noted throughout this study.

Of the 25 children treated with a two-point RPEe, 14 had a posterior crossbite (Table 2). All of these crossbites were corrected with a two-point RPEe. Consequently, the primary indication for a two-point RPEe may be for the correction of a posterior crossbite in a patient during the late mixed dentition when the number of stable anchor teeth are limited, or if there is a difficult path of insertion for a four-point RPEe.

There may be other clinical indications for the two-point RPEe if it can be established that this appliance produces skeletal changes different from the four-point RPEe. Preliminary data from a secondary study suggests that the two appliances do cause different responses in the palatal plane angle. Further rigorous study is needed to determine the extent of skeletal influence associated with these appliances.

Conclusions

A significant amount of dental expansion was obtained from a two-point RPEe, especially of the maxillary posterior teeth. The expansion obtained from the Hyrax appliance in this study was similar to that reported in previous studies. Compared to the Hyrax appliance, the two-point RPEe has less effect on the maxillary anterior teeth and on the mandibular teeth. Therefore, the two-point RPEe is indicated and recommended in certain clinical situations:

1. During the late mixed dentition, when only two stable anchor teeth are present
2. In patients with malaligned dentition and a difficult path of insertion for a conventional four-point RPEe (e.g.: cleft palate patient)
3. When the desired effect of RPEe is expansion of the posterior maxilla without an effect on the anterior maxilla or on the mandibular teeth (e.g.: skeletal Class II malocclusion with a posterior crossbite).

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Dentists willing to treat AIDS patients

A Chicago survey contradicts the notion that few dentists are willing to treat patients who have AIDS or who are carriers of the human immunodeficiency virus (HIV).

Writing in the March/April 1989 issue of *General Dentistry*, journal of the Academy of General Dentistry, Robert J. Moretti, PhD, William A. Ayer, DDS, PhD, and Alix Derelinko, of Northwestern University's medical and dental schools, report that in their survey of 500 Chicago dentists, more than 60% of respondents said they would treat asymptomatic HIV carriers. Forty per cent said they were willing to treat patients who had progressed to AIDS or to AIDS-related complex (ARC), and 20% said they had treated known HIV carriers.

Most of these dentists, however, were unwilling to accept referrals of known HIV carriers or AIDS/ARC patients from outside their practices: only 16% of the survey group were willing to treat such referred patients.

Many respondents who said they would not treat HIV-infected persons said they believed that exposure to such patients would place them at risk of contracting the AIDS virus. The researchers report that this fear is greater among dentists who have never treated AIDS patients than among those whose patient population includes them.

Moretti and his colleagues write that dentists' fears in this regard are not based on scientific knowledge and reflect a poor understanding of HIV and the actual risk involved in treating HIV patients. The authors note that risks to dentists and their staff members can be reduced greatly by adherence to infection control procedures defined by the Centers for Disease Control and the American Dental Association.

One surprising finding was that few dentists in the sample even wore fresh gloves routinely with each patient. Even fewer reported wearing face masks and protective eye wear.

The researchers conclude that much additional continuing education is needed for dentists in the matter of infection control procedures.