SPECIAL ARTICLE

Rapid palatal expansion in the absence of crossbites: Added value?

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As noted in a recent article,[1] interest in rapid palatal expansion (RPE), which has traditionally been used to resolve crossbites, has increased markedly in the past 2 decades. Orthodontists using this procedure might be seeking to gain arch perimeter to avoid extractions. This treatment, which is most often started in the mixed dentition, raises some interesting questions. One question is this: In the absence of a crossbite, is RPE necessary to gain arch width to avoid extraction treatment? If so, then is the maxillary arch perimeter the determinant in the extraction-nonextraction decision?

These questions are fundamental, because using the maxillary arch to decide whether to extract challenges the concept of mandibular arch-based diagnosis and treatment planning. For this reason, it might be useful to evaluate the rationale for RPE treatment in the correction of crowding. RPE increases the perimeter of the maxillary arch and can provide space to correct moderate (3-4 mm) amounts of crowding.[2] Because no treatment occurs in the mandibular arch, a logical question is this: How is space to be gained to resolve crowding in the mandibular arch? One view is that expansion of the maxillary arch is accompanied by spontaneous transverse expansion of the mandibular arch, with the implication that space would be available to resolve any lower arch-tooth size discrepancy.[3] This supposition is easy to assess because there are adequate data; the conclusion is that any spontaneous expansion provides almost no space to resolve crowding. Brust and McNamara,[2] in a 2-phase treatment protocol, evaluated both mandibular intercanine and intermolar expansion and noted that, immediately after RPE, both dimensions increased approximately 1 mm. However, the intercanine distance decreased before phase 2 treatment, and the net intercanine gain was only 0.3 mm. The 1-mm intermolar increase remained stable. These results are similar to those noted by others who recorded spontaneous mandibular arch change incident to RPE treatment.[4-8] The increase in intercanine width in these studies was less than 1 mm. As an example, the increase observed by Grayson[5] was only 0.22 mm and led the author to conclude that "the use of rapid palatal expansion as a method of increasing lower arch length cannot be justified." Interestingly, Brust and McNamara[2] observed that the mandibular arch perimeter decreased 1.3 mm from phase 1 to the beginning of phase 2 treatment.

In an investigation of 17 subjects whose comprehensive treatment included RPE, the intercanine dimension increased 2.2 mm during treatment and relapsed 50% postretention, to yield a net long-term gain of only 1.1 mm.[9] In this study, there were no recordings of the intercanine width immediately after RPE to indicate the amount of spontaneous expansion that occurred. Also, variation in response was remarkable, ranging from −0.3 to +3.8 mm. (This large variation is a reason that anecdotal information can be misleading—if one cites only the extreme positive response.)

One motive for focusing on the mandibular intercanine dimension in the preceding descriptions is that, in the transverse plane of space, an increase in this area provides the most space to resolve mandibular incisor crowding. Specifically, Germane et al[10] determined that a 1-mm increase in intercanine dimension provides 0.73 mm of space to correct incisor position. In contrast, 1 mm of molar expansion provides only 0.27 mm of space. (Subsequent increases in width provide slightly more space per millimeter. For instance, expansion of 2 mm yields 0.27 mm for the first millimeter and 0.31 mm for the second millimeter, for a total of 0.58 mm.)

Clearly, the available data indicate that spontaneous expansion of the mandibular arch usually does not supply adequate space to align crowded incisors.

Because spontaneous expansion of the mandibular arch is extremely limited, appliances, such as the Schwartz appliance, have been placed to expand it

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actively, in part to gain space for alignment[11] and in part to avoid creating any Brodie syndromes. This treatment raises other questions because of the instability of transverse expansion of the mandibular intercanine dimension. For example, Burke et al[12] performed a meta-analysis of 26 articles in which the stability of the mandibular intercanine dimension treatment change was evaluated in 1233 patients; they concluded that the most prudent course is to maintain the original intercanine dimension. The authors list 26 studies and their findings, and the inability to expand the intercanine dimension more than 1+ mm is readily apparent. This might help to explain why the postretention intercanine dimension is not enlarged more than 1.1 mm[13-16] in studies that emphasized long-term mandibular incisor stability. Also, relapse of expanded intercanine dimension has been correlated with mandibular incisor instability.[17,18] One conclusion is that the use of the maxillary arch as the template for the mandibular arch might jeopardize the stability of the mandibular arch by expanding it in areas that are known to be unstable. Admittedly, expansion in the posterior zones of the arch might be more stable[14]; however, the space gained for alignment is small, because a 4-mm increase in the intermolar distance would yield only 1.31 mm of space for alignment.[10]

Are there alternative treatments to solve a tooth size-arch size discrepancy in the mixed dentition? The answer is yes. One is maintenance of arch length during the transition from mixed to permanent dentition. An evaluation of 107 subjects in the mixed dentition with an average of 4 to 5 mm of incisor crowding indicated that arch length maintenance provided adequate space to resolve crowding in 68% of them.[19] If arch length were increased up to 1.0 mm per side, 87% of all patients would have adequate space to resolve crowding, and this gain can generally be accomplished in 6 months by the use of a lip bumper.[20] This indicates that lip bumper placement can be delayed until after the loss of the primary first molars. If one elects this strategy, the maxillary arch would be conventionally fit over the aligned mandibular arch. If the malocclusion is Class I, arch length preservation in the maxillary arch and appropriately coordinated archwires should suffice. This type of arch coordination seems to be stable: No reports indicate that crossbites developed in the posttreatment observation period in patients who were treated to resolve crowding and who did not have a crossbite before treatment.[17] In fact, a crossbite in posttreatment patients who did not have a crossbite at the start of treatment has never been the focus of a study concerning stability of treatment results. One deduction is that a crossbite in these patients is so rare that it does not merit study.

Another reason for the increased interest in RPE is the observation that, in mixed dentition patients with Class II Division 1 malocclusions, RPE can sometimes lead to spontaneous correction of the Class II malocclusion.[11] An explanation for the conversion is that the mandible moves forward after maxillary expansion, just as a foot in a narrow shoe will move forward after the shoe is widened.[21] One implication of this view is that the mandible, in centric occlusion, is in a distal position relative to centric relation because the "constricted" maxilla prevents it from assuming the centric relation position. This analysis suggests that the condyles are in a distal position and is similar to the belief that the conversion of a Class II Division 2 malocclusion to a Class II Division 1 will result in forward movement of the mandible and, at times, correct the Class II molar relationship. Haas has written, "Many orthodontists who have treated a patient with a Class II Division 2 malocclusion by changing it to a Class II Division 1. . .contend that they have observed the mandible move forward as much as one half premolar width. . .virtually every time and the author concurs."[3]

There are no data concerning the forward movement of the mandible after RPE. However, the hypothesis that the conversion of a Class II Division 2 malocclusion to a Class II Division 1 will allow the mandible to move forward has been tested and has not been validated. Demisch et al[22] moved incisors forward in 22 subjects with Class II Division 2 malocclusions and tracked the movement of the mandible cephalometrically and gnathologically. No forward movement was noted. Similarly, Erickson and Hunter[23] used the distance from basion to articulare (Ba-Ar) to quantify the forward movement of the mandible and determined that the increase in the Ba-Ar distance in a control group was the same as that observed in patients who were treated to correct Class II Division 2 malocclusions. Also, Cohlmia et al[24] measured condylar position tomographically in 232 subjects and found no significant differences in condylar position in all types of Class I and Class II malocclusions. Although there was large variation, the centered condylar position was the most common location observed. By association, then, the explanation that a constricted maxilla restrains the mandible from assuming a more forward position might be difficult to document.

A second explanation is that the effects of RPE disrupt the occlusion, and thus the patients are inclined to posture the mandible forward.[11] Presumably, subsequent mandibular growth will make this initial postural change permanent. "If not," McNamara writes, "defini-

Table I. Maxillary dental expansion (mm) noted with use of FR2 and headgear-edgewise treatment

	FR2			*Headgear-edgewise*			
Region	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*Significance*
3-3	24	1.2	1.0	27	1.1	1.2	NS
4-4	38	2.5	1.6	38	1.7	.3	$P < .05$
5-5	39	2.3	1.7	37	2.2	1.1	NS
6-6	39	2.4	1.5	39	1.9	1.4	NS

NS, Nonsignificant.

Table II. Maxillary alveolar expansion (mm) noted with FR2 and headgear-edgewise treatment

	FR2			*Headgear-edgewise*			
Region	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*Significance*
3-3	26	0.7	1.0	27	1.4	2.3	NS
4-4	37	1.9	1.4	37	1.3	1.2	$P < .05$
5-5	39	1.8	1.3	38	1.6	1.1	NS
6-6	38	1.9	1.1	39	2.2	1.5	NS

NS, Nonsignificant.

tive. . .Class II correction can be undertaken" later.[11] This analysis indicates that the transient forward position of the mandible is not acceptable, and condylar fossa relationships should be restored.

At present, no data indicate the percentage of stable and unstable (those in need of further correction) conversions. These data would be important, because Bishara et al[25] noted that 56% of terminal plane Class II occlusions in the mixed dentition converted to Class I. Is the stable conversion rate noted after RPE greater than 60%? If not, RPE to convert Class II malocclusions spontaneously to stable Class I occlusions might be without merit.

Also, in conventional (non-RPE) Class II treatment, transverse expansion of the maxillary arch is a necessity, because a posterior crossbite will develop unless expansion occurs in the maxillary arch.[26] This suggests that maxillary arch expansion is similar in all Class II treatment protocols (unless RPE is used or the transverse dimension of the mandibular arch is intentionally expanded). This hypothesis was tested by a comparison of the maxillary arch and dentoalveolar expansion noted in Class II treatment induced by the Fränkel 2 appliance (FR2) with the expansion after nonexpanded headgear and edgewise treatment. Both groups comprised 39 subjects. The expansion was the same in all areas except for the inter-first-premolar distance.[27] In this area, the expansion with the FR2 was 0.8 mm (dental) and 0.6 mm (alveolar) larger than the comparable expansion in the headgear-edgewise group (Tables I and II).

Therefore, it is not necessary to use RPE, in the absence of a crossbite, to expand the maxillary arch in Class II treatment. It occurs normally during treatment. And the excellent stability of well-treated Class II malocclusions treated by nonextraction procedures, including the use of a headgear,[28] inferentially indicates that the expansion is stable.

In the final analysis, what can be gained by early RPE treatment in non-crossbite patients?

1. Treatment of crowding: The maxillary perimeter can be increased by 3 to 4 mm, providing space for any necessary alignment. Because there is negligible effect on the perimeter of the mandibular arch, some space-gaining procedure is necessary to "coordinate" the treatment effect. Yet, the data indicate that transverse expansion of the mandibular arch in selected areas is unstable. An alternate, more conservative and less demanding strategy to resolve crowding is simply to maintain arch length during the transition period. As cited, under these conditions, 68% of patients with crowding will have adequate space for alignment, and another 19% will have adequate space with only marginal arch length increase (up to 1 mm per side). In these patients, the maxillary arch can be comfortably fit over the mandibular arch without RPE to complete treatment. Therefore, any added benefit of RPE treatment for these patients might be challenging to define.
2. Class II treatment: Until data are available to document the frequency of a stable change in molar relationships from a Class II to a Class I, it is difficult to assess the hypothesis that RPE can lead to a stable anteroposterior change with adequate frequency to justify its use for this purpose. As discussed, with no treatment, 56% of terminal plane molar relationships will convert to Class I during the transition from mixed to permanent dentition. The frequency noted with RPE should be significantly higher for RPE to confer value to the patient, particularly because there are many predictable, routinely successful procedures, such as the use of nickel-titanium coil springs to move molars distally,[29] that can be done in the late mixed, early permanent dentition to produce a stable conversion in almost all patients. Also, Class II treatment requires expansion of the transverse dimension of the maxillary arch, and this expansion, which is apparently stable, occurs spontaneously or with

coordinated archwires. Because conversion of molar relationships can readily be produced in the late mixed dentition, and the maxillary arch is expanded during conventional Class II treatment, it might be a demanding task to justify the use of RPE in the absence of crossbites, particularly because any correction of the molar relationship could be unstable.

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