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Early Transverse Treatment

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Expansion of the maxillary arch to improve transverse inter-arch relationships during the primary or mixed dentition stage is considered early transverse treatment as part of a two-phase treatment protocol. Traditionally, early expansion has been used to correct posterior crossbite. More recently, it has been suggested that early transverse treatment may be beneficial, in the absence of posterior crossbite, to improve arch length deficiency, and to facilitate correction of skeletal class II malocclusions. In this article, the rationale for early transverse treatment in the presence and absence of posterior crossbite is reviewed. Semin Orthod 11:130–139 © 2005 Elsevier Inc. All rights reserved.

Correction of posterior crossbite is the most common reason for early transverse treatment. Figure 1 displays the orthodontic records of a typical case with the following history: The mother states that their general dentist identified a crossbite in her daughter and recommended that she see an orthodontist. Past medical and dental history is noncontributory. Clinical and radiographic examination reveal an Angle Class I malocclusion in the primary dentition, maxillary midline coincident with the face, and a functional shift to the right from centric relation to centric occlusion with corresponding deviation of the chin and mandibular midline. You inform the mother of your findings, and she asks whether you would recommend treatment now or wait until her daughter is older. Should you attempt correction now or wait? And when you treat her, what is the most appropriate treatment? The purpose of this article is to address these and other topical questions, using the best available evidence, and to provide insights into the early treatment of transverse problems.

Background

Posterior crossbite can present as unilateral or bilateral malocclusions of the primary, mixed, or permanent dentitions. Canine involvement is often seen and considered part of a posterior crossbite even though canines are not, by definition, posterior teeth. Nomenclature is based on the position of the maxillary teeth. Posterior lingual crossbite, the most common posterior crossbite, exists when the buccal cusps of the maxillary teeth are lingual to the buccal cusps of the mandibular teeth. Posterior buccal crossbite occurs when the lingual cusps of the maxillary teeth are buccal to the opposing buccal cusps of the mandibular teeth.

What is the incidence of posterior crossbite in the deciduous and mixed dentitions? *Estimates range from 7% to 23% with a greater prevalence of unilateral crossbite coupled with a lateral shift of the mandible.*

In a sample of 898 four-year-old Swedish children, Thilander and coworkers identified crossbites in 9.6%.[1] Similarly, in a study of 238 nursery school and 277 second-grade children, Kutin and Hawes[2] found 8% of 3- to 5-year-olds (1:12) and 7.2% of 7- to 9-year-olds (1:13) had some form of posterior crossbite. The prevalence of crossbite was not greatly different between girls and boys. This finding is in contrast to the findings of Helm, who examined over 3000 children, ages 6-18 years, and reported significantly more crossbites in girls (14%) than in boys (9%).[3] Hanson and coworkers found that the percentage of 227 children, ages 3 to 5 years, who presented with posterior crossbites exceeded 23%.[4] In two studies, approximately 80% of observed crossbites were reported to be unilateral posterior crossbites associated with lateral functional shifts of the mandible.[1,5]

What are the etiologies of posterior crossbite? *A range of possible causes includes genetics, environmental factors, and habits.*

Posterior crossbite frequently results from transverse maxillary skeletal deficiency that may have an underlying congenital, developmental, traumatic, or iatrogenic (eg, cleft palate repair) basis.[6] Additional causes include asymmetric growth of the maxilla or mandible, discrepant widths of basilar maxilla and mandible, premature loss or prolonged retention of primary teeth, crowding, abnormalities in eruption sequence, impaired nasal breathing during critical growth periods, aberrations in tooth anatomy, and improper function of the temporomandibular joints.[2,6-9] Oral digit habits have also been implicated as an etiologic factor. However, at

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least one study found no difference in the prevalence of sucking habits when examining patients with or without spontaneous correction of a posterior crossbite.[1]

Can spontaneous correction of posterior crossbites occur? *Yes. However, controlled studies have reported wide variation in rates of spontaneous correction in the primary and early mixed dentition, ranging from 8% to 45%.*

Kutin and Hawes reported a spontaneous correction rate of only 8% in their sample of 515 children, 5 to 9 years of age.[2] However, Kurol and Bergland found 45% (9 of 20) spontaneous correction of posterior crossbite in untreated children ages 3 to 5.[5] Linder found 16% (6 of 38) spontaneous correction of posterior crossbite in untreated children aged 4 to 9.[10] Finally, Thilander and coworkers found 21% (6 of 28) spontaneous correction of posterior crossbite in a randomized clinical trial of 61 children ages 4 to 13.[1]

What is the rationale for early correction of posterior crossbite with a functional shift? *Evidence suggests that a lateral shift of the mandible into unilateral crossbite occlusion may promote adaptive remodeling of the temporomandibular joint and asymmetric mandibular growth. Favorable improvement of mandibular asymmetry associated with a mandibular shift is seen in patients treated in the early mixed dentition.*

Research has documented that when patients shift into a unilateral crossbite in maximum intercuspation, there is an asymmetric condylar position with the condyle on the noncrossbite side distracted relative to the glenoid fossa.[11-13] The fact that most unilateral crossbites do not spontaneously correct and that functional shifts are rarely detected in adults with unilateral crossbite suggests that adaptive remodeling of the temporomandibular joint occurs and that children with unilateral crossbite and functional shift develop an asymmetry of the mandible.[14] As such, even when adaptive change to posterior crossbite occurs, it may not provide freedom from temporomandibular disorders.[15] Some have suggested that for patients in the mixed dentition stage, adaptive remodeling in the temporomandibular joints may have already occurred.[16] However, there is still adequate time for growth modification in the early mixed dentition. A recent study[17] has shown that favorable improvement of a mandibular asymmetry associated with a mandibular shift is seen in patients treated in the early mixed dentition. That is, if the crossbite and functional shift are treated in a timely manner (early mixed dentition), the asymmetry can be largely eliminated.[17,18]

Diagnosis

What principles of diagnosis should be followed when examining the transverse dimension early in development? *Diagnosis in the transverse dimension includes a systematic evaluation of the face and dentition in the frontal view, the sagittal jaw relationships, and the transverse dental relationships on study casts.*

Frontal Examination

Chairside evaluation of facial symmetry and occlusal harmony are very important. Facial and intraoral photography should be used to support the chairside examination, but are not a substitute for findings made directly from the patient. In a frontal facial examination, lateral deviation of the chin can usually be noted. If this is noted, the underlying cause, be it a functional lateral shift from centric relation to unilateral crossbite occlusion or a true skeletal asymmetry, must be ascertained. If there is any doubt about a lateral shift being present it is prudent to disarticulate the occlusion for a week or two before reexamining. A bite plate can be used to disarticulate the occlusion. However, if patient compliance is a concern, especially in younger patients, insertion and mild activation of a fixed (Hyrax) expander will disarticulate the occlusion effectively to allow visualization of a lateral shift. The patient and parents should be informed that a definitive treatment plan may not be possible until the presence or absence of a lateral shift has been documented.

In the absence of a lateral shift, findings of chin asymmetry and unilateral crossbite establish the presence of a true unilateral skeletal asymmetry. Posteroanterior or submental radiographs are helpful in assessing the presence and magnitude of maxillary or mandibular asymmetry. Unilateral crossbite found in the absence of skeletal asymmetry and lateral shift is most commonly the result of aberration of transverse tooth positions. Study casts are needed to further analyze variation in transverse tooth inclinations and arch symmetry. Bilateral crossbite occlusion may be seen without lateral shift and without chin asymmetry. This transverse discrepancy requires further classification using knowledge of the patient's sagittal relationship and the patient's study casts.

Sagittal Relationships

Transverse interarch relationships change as sagittal interarch relationships change. That is, transverse discrepancies can be relative or absolute, and this determination is made by examining the patient's study casts. A relative transverse discrepancy exists when the posterior teeth do not show proper transverse cusp-fossa relationships in centric relation, but properly occlude (or will properly occlude with correct tooth alignment) when the canines of the casts are placed in Class I occlusion.[19] For example, some Class III malocclusions exhibit posterior crossbites that disappear when the casts (arches) are articulated into a Class I canine relationship. This would be considered a relative transverse discrepancy. In contrast, if a crossbite still exists when the casts are articulated into a Class I canine relationship, then the transverse discrepancy is absolute. Planning for treatment to correct improper sagittal interarch relationships (surgery or orthopedic differential jaw growth) will dictate if, and how, transverse interarch relationships should be adjusted in the overall plan.

Transverse Dental Relationships

In the presence of an absolute transverse discrepancy, study casts are used to determine whether the discrepancy is of dental or skeletal origin and to determine the magnitude of

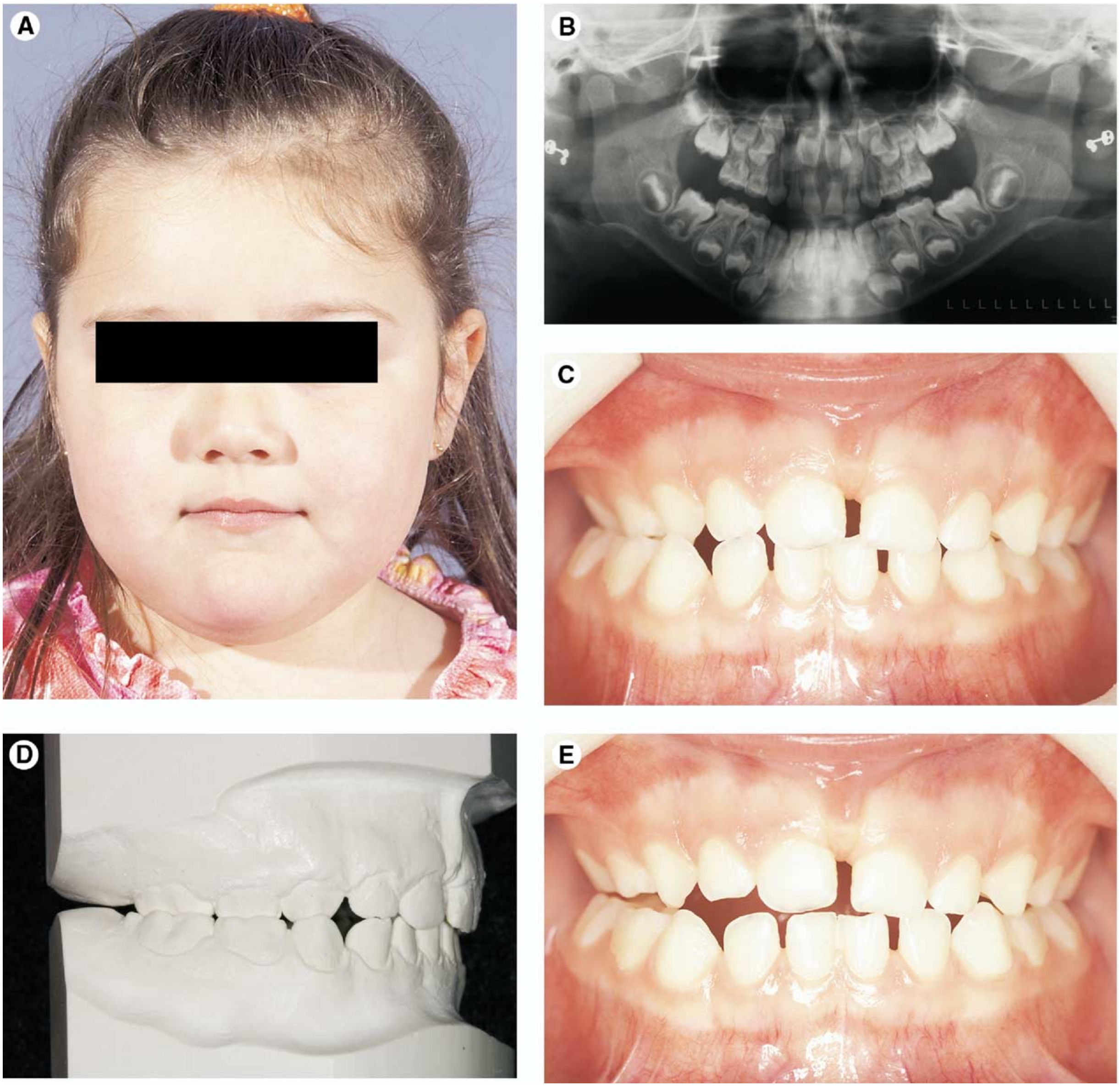

Figure 1 A 5-year-old girl in the primary dentition presents with a functional shift into a right unilateral crossbite. (A) Frontal view in centric occlusion. (B) Panoramic radiograph. (C) Intraoral frontal view in centric occlusion. (D) Right view of initial models in centric occlusion. (E) Intraoral frontal view in centric relation. (Color version of figure is available online.)

the discrepancy. The casts must first be examined for posterior dental compensations that are variations in transverse axial inclination of the permanent first molars (typically excessive maxillary buccal crown torque or mandibular lingual crown torque as viewed in the frontal plane). These compensations can be grossly estimated by viewing the casts or can be measured using the American Board of Orthodontics (ABO) measuring gauge (Fig 2). When the ABO gauge is placed across paired right and left first molars to define a transverse occlusal plane, it will simultaneously contact buccal and lingual cusps if the transverse axial inclination of the molar in question is perpendicular to the transverse occlusal plane. Any variation from this perpendicular inclination will show the buccal or lingual cusps away from the transverse occlusal plane. The amount can be estimated in 1-mm increments on the gauge. For molars of average width (5-6 mm distance between buccal and lingual cusps) 1 mm of distance away from the transverse occlusal plane is approximately 10° of buccolingual inclination. This method can also be used to evaluate buccolingual tilt of mandibular molars.

Has science established normal values of molar buccolingual inclination? A recent study was conducted relative to molar inclination in subjects with normal transverse and sagittal occlusion using subjects from the Iowa Facial Growth Study.[20] The molar inclination in subjects from ages 7 years to 26 years was examined. At about age 7 years, maxillary molars had an average of 10° of buccal crown inclination with a range of ±4°. Mandibular molars at the same age had 10° of lingual crown inclination with a range of ±5°. With later growth, both maxillary and mandibular molars

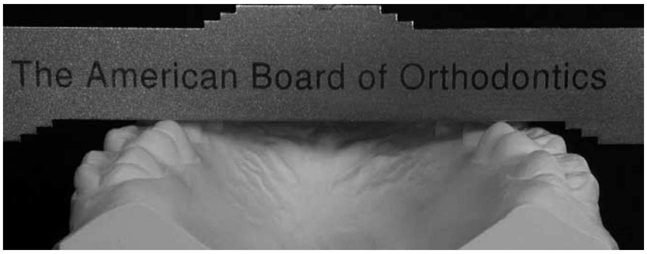

Figure 2 Determination of molar axial inclination by establishing a transverse occlusal plane using the measuring gauge supplied by the American Board of Orthodontics.

changed inclination and were more perpendicular to the transverse occlusal plane.

Posterior dental compensations can also occur as variations in arch form and symmetry, which are determined by viewing or measuring width differences between the midline of the dental arch and the right and left posterior teeth. Evidence suggests that posterior unilateral crossbites produce arch form variation in both the maxillary and the mandibular arch. The maxillary arch on the crossbite side is usually narrower than the noncrossbite side, and the mandibular arch on the crossbite side is broader than the noncrossbite side. Thilander and Lennartsson have proposed that the magnitude of mandibular dental compensations on the crossbite side may predict crossbite correction instability if these compensations are ignored during treatment (ie, treatment with maxillary expansion only).[21]

It has been suggested that posterior dental and skeletal discrepancies can be differentiated by counting the number of teeth in crossbite: that if two or more posterior teeth are in crossbite, then the discrepancy is skeletal.[22] Although simple to apply, such a rule can be misleading. Posterior dental compensations can mask severe skeletal transverse discrepancies even when no posterior teeth are in crossbite. If the clinician can visualize removing transverse compensations (uprighting the molars) on the casts and the posterior transverse interarch relationship improves, then the transverse discrepancy is probably of dental origin and can be treated with dental movement alone. However, if when visually removing these compensations on the casts and the posterior transverse interarch relationship worsens, then the discrepancy is probably of skeletal origin (Fig 3).

Additionally, comparing a patient's maxillary and mandibular intermolar width to published "norms" to determine the magnitude of a posterior transverse discrepancy can be misleading unless dental compensations have been removed first or at least visualized as being removed. It is only after the molars have been uprighted that the true amount of width discrepancy in each arch can be accurately ascertained when compared with average values.

Are posteroanterior (PA) cephalograms necessary in diagnosing transverse jaw relationships? *PA cephalograms are useful in quantifying skeletal asymmetries, but they have only very limited value in evaluating transverse discrepancies without asymmetries.*

The utility of PA cephalometric analysis in quantifying skeletal asymmetries has been established.[23,24] However, in the absence of overt skeletal asymmetries, PA cephalograms offer only very little in evaluating crossbites. The reason is because alveolar process bone reveals no discernible landmarks on PA films from which useful measurements can be made. It is the alveolar process bone that houses the roots of the posterior teeth and that is the bone of practical interest in evaluating crossbites.

Authors who advocate using PA films to routinely measure skeletal transverse discrepancies are therefore forced to use bony landmarks at a great distance from the dentition. Consider, for instance, the Ricketts' analysis[25] and its use in the diagnosis of transverse skeletal discrepancies.[26] This approach compares the left-to-right mandibular anteogonial width to the left-to-right maxillary jugal width in order to estimate skeletal transverse discrepancies. Allen and coworkers[27] used the ratio of these widths and found that the ratio alone accounted for only 4% of the variation in maxillary intermolar width. In other words, jugale and antegonion are landmarks far removed from the dentition, and evaluations based on these distant landmarks neglect the entire length of the alveolar process bone, bone that intimately defines posterior transverse relationships and bone that is profoundly affected by transverse treatment.

Figure 3 Determination of skeletal crossbite following removal of dental compensations. (Left) If transverse dental compensations, usually labial maxillary crown torque and lingual mandibular torque, are visualized as being removed, then the transverse interarch relationship usually worsens (Right) when the discrepancy is of skeletal origin. (Color version of figure is available online.)

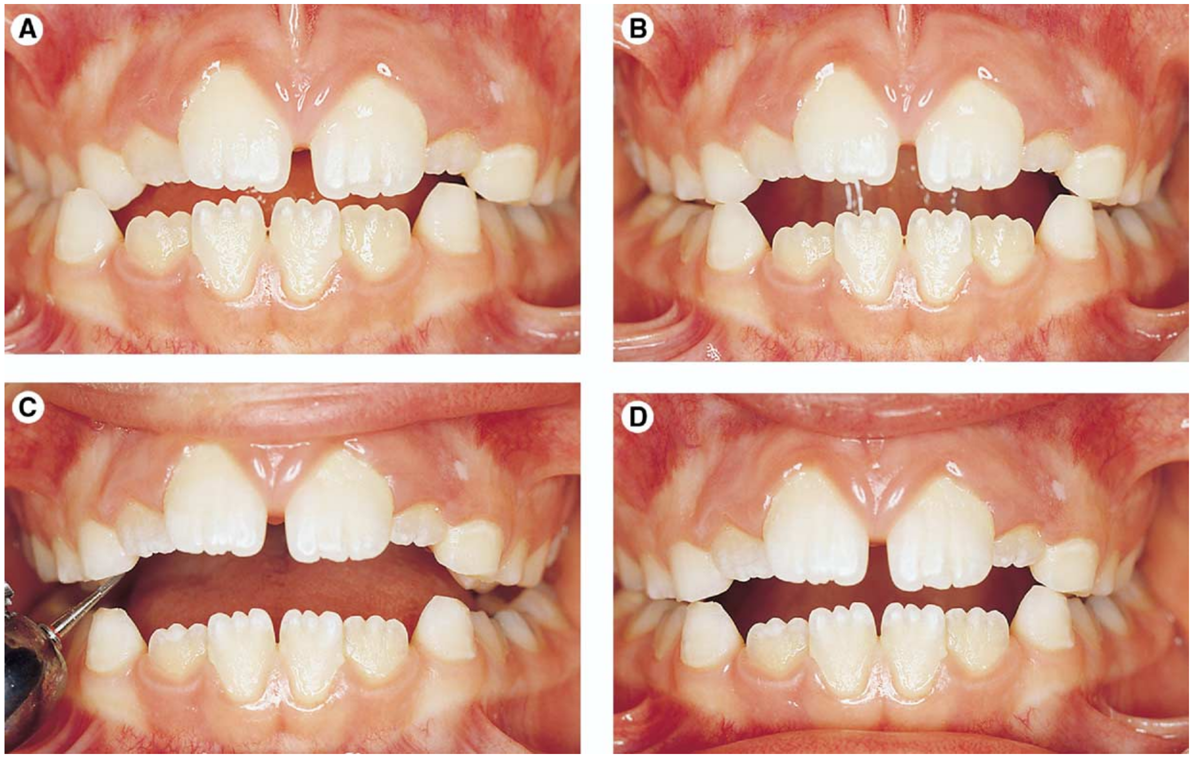

Figure 4 Enamelplasty to remove a functional shift. (A) Initial intraoral frontal view in centric occlusion. (B) Initial intraoral frontal view in centric relation. (C) Removal of occlusal interference. (D) Final intraoral frontal view with interference removed. (Color version of figure is available online.)

It is considered, therefore, that PA radiographs are not of value in diagnosing transverse problems other than asymmetries. The morphology of the alveolar process bone is far more clearly evident on dental casts.

Treatment

When should early treatment for crossbite begin? *Other than attempting to correct functional shifts in the primary dentition by selective occlusal adjustment, it is recommended that treatment be postponed until the early mixed dentition.*

Assuming good balance in sagittal and vertical jaw relationships, selective enamelplasty of 1 or 2 deciduous teeth to eliminate an occlusal interference, mandibular shift, and crossbite is appropriate in the primary dentition (Fig 4). However, high failure rates (30-50%) have been reported when using this technique.[1,5] Although other treatment and appliances can be employed in the primary dentition (expansion plates, rapid maxillary expanders, Porter W appliances, and so on), cooperation may be lacking in very young children, and unsatisfactory results or relapse can occur necessitating retreatment in the mixed dentition.[1,28,29] Additionally, with the eruption of the first permanent molars, transverse relationships can be assessed more thoroughly. There is still adequate time for growth modification in the mixed dentition, and a recent study has shown that favorable improvement of mandibular asymmetry associated with mandibular shift is seen in patients treated in the early mixed dentition.[17]

For these reasons, other than limited occlusal adjustment to correct mandibular shifts, it is recommended to postpone crossbite correction until the permanent first molars erupt. It is further recommended that fixed appliances are used to make the correction in the early mixed dentition to avoid problems of patient cooperation.

How should crossbites be treated? *There is no single treatment approach for every patient. A range of treatment options exists, and the choice is based on the diagnostic findings and other factors.*

The treatment decision is made on a case-by-case basis and includes consideration of the following factors: the presence or absence of a lateral mandibular shift, the degree of skeletal discrepancy, and the degree of posterior tooth compensations in each arch.

Depending on the underlying etiology of the crossbite, there are fundamentally two treatment options to correct posterior crossbites in the early mixed dentition. For skeletal crossbites, increasing the basilar maxillary width by lateral expansion of the midpalatal suture is the most common treatment approach. For dental crossbites, medial or lateral dental tipping and/or translation can reposition individual teeth into a more correct transverse occlusion. Generally, dental tipping or translation can be used to correct transverse discrepancies in the range of 4 to 5 mm, while skeletal correction is prudent for larger discrepancies.

A Hyrax jackscrew appliance is the most common technique employed for lateral expansion of the midpalatal suture. On activation, the initial force from the screw will tip and translate maxillary molars laterally until the speed of

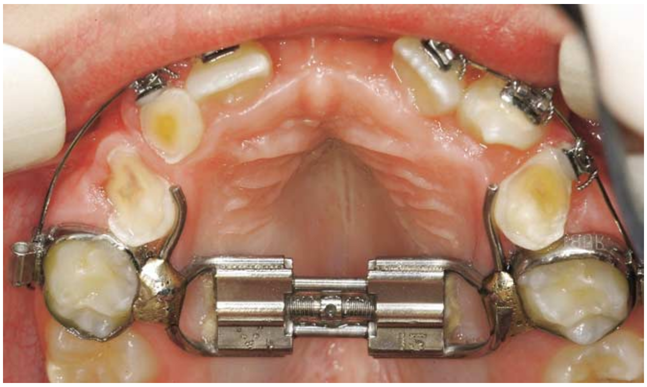

Figure 5 RME anchored using the primary second molars. (Color version of figure is available online.)

screw activation exceeds the speed of dental root movement. Beyond that point, the force generated by the Hyrax will increase dramatically until it is greater than the resistance offered by the maxillary skeletal articulations, the suture will separate, and skeletal expansion will begin. Separation of the two hemimaxillae may be symmetric or asymmetric, depending on rigidity of the bony architecture.

In general, younger patients require less force to separate the midpalatal suture, and the maxillary first permanent molars or the maxillary primary second molars provide adequate expansion anchorage (Fig 5). If the patient is young enough (maxillary skeletal resistance low enough), then a removable expansion plate may be attempted (Fig 6).[30] However, to guarantee true midpalatal sutural opening, a fixed appliance such as a Hyrax appliance, Porter W appliance,[31] a coffin loop, or a transpalatal arch will be required.[32] Nickel-titanium (NiTi) palatal expansion appliances produce a more continuous force than rapid maxillary expanders and have been shown to create midpalatal suture separation in 9-year-olds.[33,34] However, rapid maxillary expanders are found to separate the suture more reliably, and NiTi appliances result in greater buccal tipping of the maxillary molars.[33]

Which jaw should be treated to correct a skeletal transverse discrepancy? If a child presents with a constricted maxilla, then the obvious choice is to treat the maxilla. However, even if a transverse discrepancy results from an excessively broad mandibular arch, a reasonable choice may still be to leave the mandibular arch alone and to expand the maxilla. There is simply no way to constrict the mandibular basilar bone orthopedically.

For dental crossbites, posterior crossbites correctable by tooth movement alone, buccal or lingual tipping can be accomplished with many appliances. In the maxilla, a removable expansion plate, a transpalatal arch, or a 2 × 4 edgewise appliance using a round archwire expanded at the first molars can effectively tip teeth buccally. In the mandible, a lower lingual holding arch, a lip bumper,[35] or a 2 × 4 edgewise appliance using a round archwire constricted at the first molars can effectively tip teeth lingually.

Crossbite elastics can tip opposing teeth in opposite directions. By incorporating a cross-arch stabilizing appliance (eg, transpalatal arch or lingual holding arch), tipping with crossbite elastics can be restricted to one arch only.

To obtain pure lateral dental translation, root torque must be added to the lateral force applied to the molar crown to offset the couple generated by the lateral force. A removable 0.032 × 0.032-inch transpalatal or lingual arch fitted to 0.032-inch edgewise lingual molar band attachments is very effective in translating molar teeth laterally.

In terms of discrepancy magnitude, if 4 or fewer millimeters of expansion is needed, expansion plates, transpalatal appliances (transpalatal arches, quad-helicies, Porter W appliances), archwires, crossbite elastics, and rapid maxillary expanders are all equally effective.[36,37]

Correction of a dental crossbite may necessitate the patient wearing a biteplate to provide interarch space for banding or bonding and to permit opposing molar cusps to cross during correction. Depending on the degree of supraeruption of the molars in crossbite, occlusal adjustment may also be necessary if the bite is opened significantly during treatment.

How should true unilateral (maxillary lingual) crossbites be treated in children? *A rapid maxillary expander (RME) with reverse crossbite elastics on the noncrossbite side, in conjunction with a lower lingual holding arch, is recommended.*

Assuming that the child has a true unilateral lingual crossbite, and not simply a bilateral crossbite with a lateral functional shift, appliances and biomechanics must be selected that will exert primarily a unilateral effect. Expanded or constricted archwires, transpalatal arches, and lingual arches all exert bilateral effects.

If molars on the crossbite side are corrected with an RME, molars on the opposite side will begin to go into reverse crossbite due to the bilateral force exerted by the RME. To prevent this from happening, reverse crossbite elastics are applied. As an example, let us assume that in an 8-year-old child a true unilateral crossbite is found on the right side (Fig 7). To prevent teeth on the noncrossbite side from going into buccal crossbite during RME treatment, reverse crossbite elastics are worn from the buccal of the RME on the left side to lingual buttons on the permanent mandibular first molar and mandibular deciduous second molar on the left side. Additionally, to prevent the mandibular teeth from tipping buccally, a lower lingual holding arch is inserted.

A unilateral crossbite can sometimes be treated with uni-

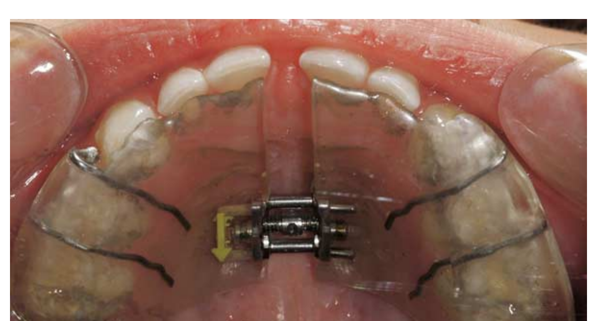

Figure 6 Maxillary removable expansion plate. (Color version of figure is available online.)

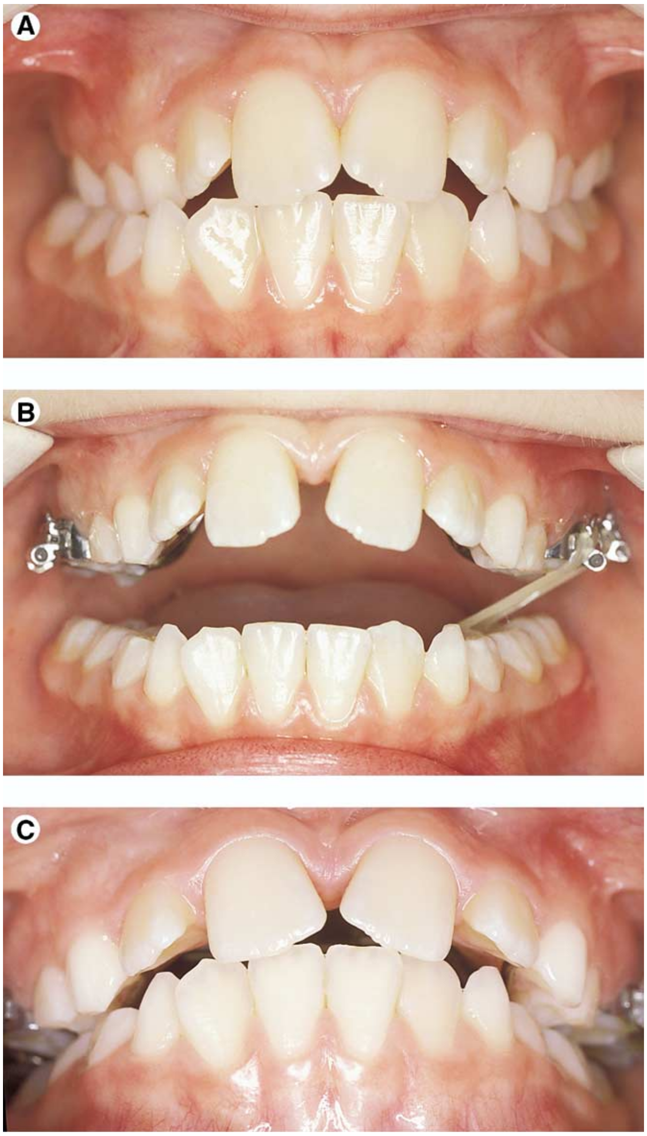

Figure 7 Unilateral right crossbite correction with RME and "reverse" crossbite elastics on the normal occlusion side. (A) Initial intraoral frontal view in centric occlusion. (B) RME exerting bilateral force and reverse crossbite elastics applied on normal left side. (C) Progress view illustrating even amount of transverse overjet created. (Color version of figure is available online.)

lateral crossbite elastics alone. If the crossbite involves permanent first molars and deciduous molars, then elastics should also include the deciduous teeth because failure to correct the deciduous tooth crossbite will result in a high probability of the permanent premolars erupting into crossbite.[5]

Removable expansion plates may be used for correction of true unilateral crossbites involving one or two teeth. However, because removable plates exert equal but opposite bilateral forces when activated, if more than two teeth are to be corrected, an increasingly bilateral effect will result.

A number of acrylic appliances, including the removable Nord appliance (Fig 8) and bonded RME (Fig 9), attempt to resist lateral movement on the normal side by incorporating an occlusal index into the acrylic (Fig 9). The objective is to have the mandibular dentition lock into the index and provide anchorage resistance to lateral maxillary movement. As illustrated in Fig 9B, the authors have been disappointed with these appliances as they have often noted that the noncrossbite side moves into reverse crossbite.

In the absence of a posterior crossbite, should rapid maxillary expansion be used to correct a Class II relationship? *Since functional appliances, which actively posture the mandible forward, do not enhance mandibular growth (long term), it is doubtful that rapid maxillary expansion enhances mandibular growth. Any Class II improvement with RME in adolescence is probably due to simple unlocking of the occlusion and the greater normal forward growth of the mandible compared with the maxilla.*

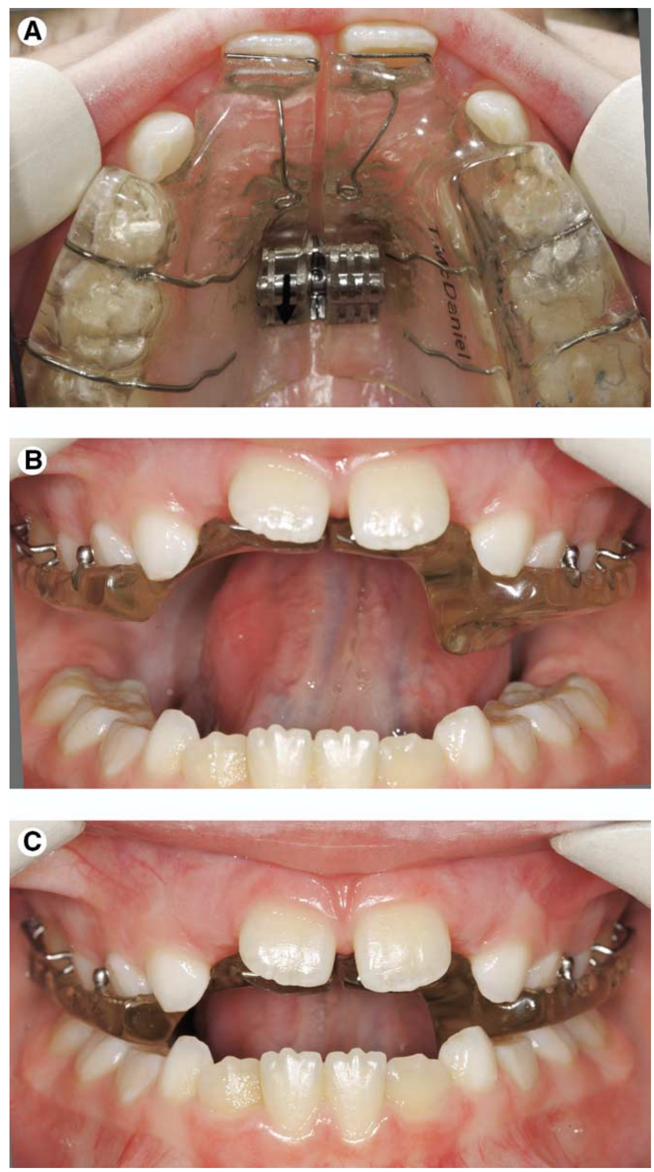

Figure 8 Nord removable expansion appliance (occlusal index on the normal occlusion side). (A) Intraoral occlusal view of appliance. (B) Frontal view illustrating occlusal index on left, normal, side. (C) Frontal view when patient bites together. (Color version of figure is available online.)

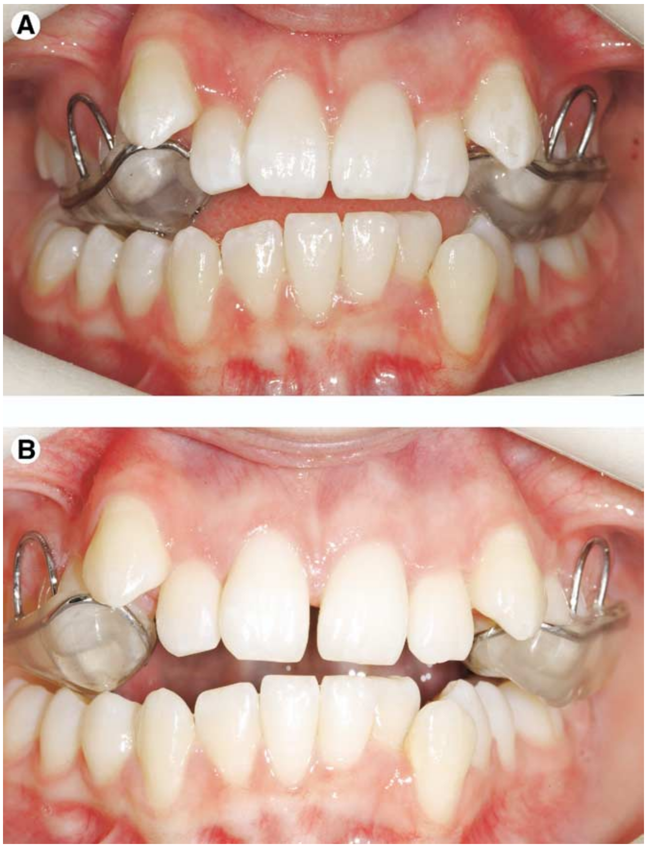

Figure 9 Unilateral right crossbite correction attempted with a bonded RME (occlusal index on the normal occlusion side). (A) Initial intraoral view with occlusal index on left.) (B) Progress view illustrating undesirable bilateral expansion effect. (Color version of figure is available online.

Close examination of the literature reveals that functional appliances, appliances that actively posture the mandible forward, do not enhance mandibular growth (long term) compared with controls. The latter conclusion needs further careful evaluation because it directly relates to the suggestion employing maxillary expansion to enhance mandibular growth.

Functional appliance studies have traditionally examined either short- or long-term effects on growth. Short-term effect studies by Stöckli and Willert,[38] McNamara,[39] and Woodside and coworkers[40] clearly demonstrate that, in a growing monkey, if an appliance postures the mandible forward, remodeling changes in the temporomandibular joint occur that tend to bring the mandible forward. In a recent magnetic resonance imaging study of children, Ruf and Pancherz demonstrated the same effect.[41] Thus in the short term, functional appliances have been shown to remodel the joint (accelerate growth).

However, what are the long-term mandibular growth effects of appliance treatment that posture the mandible forward? In other words, what happens years after the functional appliance is discontinued? One such study was conducted by DeVincenzo, who reported significant short-term increases in mandibular length when children wore the twin-block appliance.[42] However, compared with controls, this significant increase gradually diminished with time. By the fourth year after treatment with the twin-block appliance, DeVincenzo reported no significant difference in mandibular length compared with controls.

Wieslander, in a study of the headgear-Herbst treatment followed by activator appliance treatment, reported that the mandibular protrusive effect of these appliances decreased to insignificance years after treatment.[43] In fact, Wieslander found that the long-term skeletal effect did not come from enhanced mandibular growth but rather from maxillary restriction with the Herbst and the activator. Finally, Pancherz[44] reported that no long-term influence of Herbst treatment on mandibular growth was seen. In other words, in the short term, functional appliances enhance (accelerate) mandibular growth; but in the long term, controls catch up.

Therefore, in the long term, hyperpropulsive functional appliances do not enhance mandibular growth compared with controls, so how can one possibly anticipate improvement in Class II relationships through rapid maxillary expansion?

There may be a simple explanation. Research has shown that during adolescence the mandible usually grows forward more than the maxilla.[45-47] For this reason orthodontists should typically see a spontaneous improvement in Class II patients during growth without any treatment at all. However, in fact, we do not see it. Most orthodontists would agree that Class II malocclusions are not self-correcting, and studies have demonstrated that minimal change occurs in a Class II relationship in growing patients.[48,49] Reasons for this phenomenon need further evaluation.

Recently, You and coworkers compared mandibular growth in a sample of untreated Class II malocclusion children to a sample of norms.[50] Their findings confirmed earlier studies that forward growth of the mandible during adolescence exceeded that of the maxilla (by over 4 mm). However, they also reported that the effect of forward growth of the mandible, which could potentially bring the lower dentition forward, vanished because of intercuspal locking. In other words, without treatment, as the mandible outgrew the maxilla, intercuspal locking caused the mandibular teeth to drag the maxillary teeth mesially, the maxillary teeth to drag the mandibular teeth posteriorly, and the Class II relationship to be left intact.

Lager recommended elimination of intercuspal locking in a growing Class II patient with a biteplate to allow forward movement of the mandibular dentition, and improvement in the anteroposterior relationship, with mandibular growth.[51] In an interesting study of cervical pull headgear effects in Class II division 1 early mixed dentition patients, when the inner bow of a facebow was expanded (thus widening the maxillary arch) the mandible grew at a rate comparable to controls during the initial treatment period.[52] However, during the retention period, the mandible grew at a significantly accelerated rate compared with controls. The author concluded that, as the maxillary arch widened; the mandibular arch was unconsciously postured forward to maintain the accustomed sense of occlusion, as has been reported by Haas.[53] The occlusion itself would then act as a functional appliance and perhaps stimulate significant "catch-up" growth. McNamara suggested the same spontaneous correction of early mixed dentition Class II malocclusions following rapid maxillary expansion.[54] The concept of the mandible coming forward after maxillary expansion, "just as a foot in a narrow shoe will move forward after the shoe is widened," suggests that a constricted maxillary arch attenuates mandibular growth or denies a forward mandibular posture that accelerates (short term) mandibular growth.[55]

The authors of the present article are unaware of any data reported in a controlled study regarding the forward movement, by positioning or growth, of the mandible after rapid maxillary expansion. However, all of the above-mentioned studies describe one common variable—the elimination of intercuspal locking. The improved anteroposterior relationship in a Class II patient may simply be initiated by disruption of occlusal interlocking. Hypothetically, the mandibular teeth could be freed following disarticulation and 4 mm of differential mandibular growth (compared with maxillary growth) could result in Class II correction. However, at the present time controlled studies of such effects are lacking and the use of early rapid maxillary expansion, in the absence of posterior crossbite, to improve a Class II relationship remains equivocal.

Should dental arches be expanded in the absence of a crossbite to gain arch perimeter and avoid extractions? *Maxillary expansion increases arch perimeter. However, the mandibular arch limits the amount of maxillary expansion that can be achieved. Expansion of the arches beyond the point where the mandibular molar crowns are upright is inherently unstable and not recommended.*

As previously stated, Marshal et al recently reported that maxillary molars erupt with buccal crown torque and upright with age while mandibular molars erupt with lingual crown torque and upright with age.[20] Because this is an inherent part of normal human facial growth, uprighting lingually inclined mandibular molars to a more upright position is a reasonable orthodontic treatment. Any expansion resulting from mandibular molar uprighting will create additional arch perimeter. In other words, in those cases with lingually inclined mandibular molars, the molar roots are lateral to the crowns and moving the crowns to a position directly over the roots is appropriate. However, if the mandibular posterior teeth are already upright, then expansion that creates labial crown torque is not advisable.

The authors of this article stress that it is the upright position of the mandibular molars that ultimately determines the limit of potential maxillary expansion. Unless the mandible is widened (surgically) it should be considered the template beyond which the maxillary dentition should not be widened. As Little has noted, arch development (widening arches) in the mixed dentition without lifetime retention yields unstable results.[56]

What is an alternative to expansion to gain arch length? Gianelly noted that 68% of patients with crowding will have adequate space for alignment if a lower lingual holding arch is used to preserve leeway space, another 19% will have adequate space with only marginal arch length increase (up to 1 mm per side), and that any added benefit of rapid maxillary expansion treatment for these patients might be challenging to define.[57] Further, for mixed dentition cases with favorable leeway space, treatment results using a lower lingual holding arch appear stable.[56] Other than uprighting lingually inclined posterior teeth, transverse expansion of the mandibular arch to increase arch perimeter is not recommended.

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