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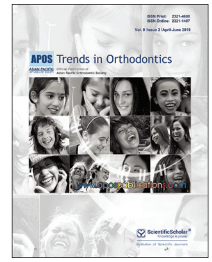

Experts Corner

Expansion in the absence of crossbite – rationale and protocol

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ABSTRACT

Transverse maxillomandibular discrepancies are a major component of several malocclusions. Clinically, posterior crossbite is a common and valid indicator of maxillary transverse problems and orthopedic and orthodontic forces are routinely used to correct maxillary transverse deficiency. However, crossbite and transverse discrepancies are not a homologous group but must be viewed as a continuum with varying degree of abnormality. The etiology, diagnostic protocol, rationale, and procedures employed for correcting maxillary transverse discrepancy in the absence of crossbite are discussed in the article.

Keywords: Maxillary constriction, Maxillary transverse deficiency, Expansion, Rapid palatal expansion, Microimplant-assisted rapid palatal expansion, Surgically assisted rapid palatal expansion

INTRODUCTION

In orthodontics, among the three planes of space sagittal, vertical, and transverse, the transverse is the least studied. Malocclusion in the transverse dimension needs early intervention since they can impact the occlusion not only in the transverse dimension but also in the sagittal and vertical as well.

Transverse dimension is the most important since it grows the least, stops growing the soonest, and most often it is finished by the time we see these patients. Clinically, posterior crossbite is a common and valid indicator of maxillary transverse problems, and palatal expansion is an often used and well-established procedure for correcting the posterior crossbite in children and adolescents. In adults, the palatal expansion has to be surgically aided. However, there are many patients with transverse problems that do not exhibit posterior crossbite. Hence, crossbite and transverse maxillary deficiency are not a homologous group but must be viewed as a continuum with varying degrees of abnormality.

Ghafari *et al.*[1] found no crossbite or skeletal tendency toward crossbite in their sample group with 1 SD from the mean. Further in individuals with the maxillary transverse discrepancy, the dental compensation may obscure the transverse discrepancy. Treatment planning for the transverse skeletal problem requires the determination of the severity of the discrepancy and differentiating the difference between the skeletal and dental component.

This article will elicit the etiology, diagnostic protocol, and rationale for expanding the maxilla in children and adults with maxillary transverse discrepancy in the absence of posterior crossbite.

TRANSVERSE GROWTH

The clinical need for the normative data on maxillary transverse growth is essential to improve the diagnosis of maxillary transverse deficiencies in children. Craniofacial growth is multidimensional and a dynamic continuum. In assessing the completion of craniofacial growth, it is important to note that growth in all three dimensions does not stop at the same time.[2] More congruence exists on the sequence of growth pattern than the age at which maximum growth is achieved. Growth follows the sequential completion of the cranium followed by the facial width (transverse), then facial depth or sagittal and finally the facial height or vertical. Transverse growth is found to achieve near completion by late adolescence.[3]

Snodell[4] based on the assessment of longitudinal records of 25 males and 25 females established that maxillary width increases from 2 years to 6 years and were larger in males when compared to females by 2 mm at 2 years and 6.2 mm at 18 years. Maxillary width at an average increased 10.1 mm in males and 7.4 mm in females. The total percentage completion of the growth of the maxilla shows accelerated growth from 8 to 12 years as a steady increase until further width is achieved at 15 years in males and 16 years in females respectively.

Interestingly maxillary constriction is not always obvious clinically. While a posterior crossbite is often diagnostic for a narrow maxilla, a narrow maxillary intermolar width without a crossbite can also occur.[5] The absence of a crossbite in a patient with narrow maxilla possibly results from the stability of intermolar width established early and continues to manifest during maxillary and mandibular growth throughout the adolescence.[6]

In patients with narrow maxilla but no posterior crossbite, it is common to find dental compensations such as excessive buccal flaring of the maxillary dentition and deep Curve of Wilson in the lower dentition that masks the maxillary transverse constriction.[7] Transverse dental compensations develop in the same way and for the same reasons that anteroposterior dental compensations develop. Teeth tend to erupt throughout life until sufficient occlusal or soft tissue load prevents further eruption. They erupt along their long axis, but the buccal-lingual direction is influenced by the soft tissue envelope. In the presence of a hypoplastic maxilla, the tongue will tend to tip the maxillary molars buccally and the cheek will tend to tip the mandibular molars lingually (transverse compensation).[8]

The transverse compensation in the absence of crossbite can be due to: [9]

a. Small maxillary skeletal width compared to a large mandibular skeletal width
b. Comparable maxillary and mandibular skeletal width
c. Large maxillary skeletal width compared to a smaller mandibular skeletal width.

MAXILLARY TRANSVERSE DIMENSION IN RELATION TO SAGITTAL AND VERTICAL DIMENSION

Maxillary constriction can occur either in isolation or in tandem with sagittal and vertical disproportions.

Lux *et al.*,[10] using conventional 2D P.A cephalogram and dental cast examined growth changes in the transverse skeletal and dental measurements in children with Class I occlusion, "good" Class I with mild crowding and Class II div 1 and Class II div 2 malocclusion. They found that Class II div 1 boys and girls aged 7–15 years had consistently less transverse maxillary growth compared to other three malocclusion groups. Not surprisingly boys and girls with Class II div 1 malocclusion had the smallest maxillary intermolar distance throughout growth. Equally important to note is the finding that boys and girls with a Class II div 2 malocclusion had the second smallest maxillary base width throughout growth.[11] Likewise, maxillary width among girls with Class III malocclusion demonstrated reduced intrajugular width and maxillary intermolar distance. Both the parameters were significantly smaller in Class III subjects at each time point every year between the ages of 10 and 14 years. In summary, both maxillary and/or transverse dimension in Class II and Class III subjects were consistently found to be smaller than in Class I subjects.[12]

The extent of transverse growth has been found to have a relation to the vertical morphogenetic facial pattern as well. Vertical growers with high mandibular plane angle have been hypothesized to have lesser transverse growth and thereby lesser gain in intermolar width. Wagner and Chung[13] studied their relationship in a sample of 81 patients extracted from Bolton Burlington studies which included individuals with low, average, and high mandibular planes. Intermolar width increased gradually from 6 to 14 years in high angle patients. Growth continued although at a slower rate in patients with low and average mandibular plane angles. This study confirms that high angle patients had constricted maxillary width. They also observed that there was a greater width increase in the mandible compared to the maxilla in low mandibular plane angle cases.

The orthodontist must keep in mind that when a posterior crossbite often indicates a narrow maxilla, patients with a Class II or Class III skeletal malocclusion and high MPA without a posterior crossbite also may have a transverse maxillary deficiency.[6]

ETIOLOGICAL FACTORS

Etiological factors that may lead to the development of maxillary transverse deficiency and can manifest with or without a posterior crossbite include

1. Ectopic tooth eruption.[14]
2. Soft tissue imbalance: Habits like prolonged digit sucking.[15]
3. Palatal dimensions and inheritance.[16]
4. Iatrogenic (Cleft repair).[17]
5. Obstructive sleep apnea (OSA).[18]
6. Deficient or excess anteroposterior growth of the maxilla or mandible.[19]
7. Change in the sagittal and vertical relationship of the maxillary and mandibular apical bases can affect the transverse occlusal relationship.[8]

Rationale for transverse correction

Inadequate transverse occlusion has been claimed to coexist with non-carious cervical wear, i.e., abfraction possibly due to increase in non-axial loading causing cuspal flexure and stress concentration in the cervical region.[20] Gingival recession has also been reported to be induced by transverse deficiency.[21] In terms of masticatory function Choi *et al*.[22] reported in their clinical study that subjects with non-sagittal transverse malocclusion such as buccal edge to edge bite exhibited remarkably low masticatory ability index and food intake ability.

In terms of occlusal manifestation, it is clear that transverse discrepancy in the posterior area indirectly affects the incisal relationship. For instance, excessive crowding in the maxillary arch without obvious anteroposterior jaw discrepancy may reflect narrow maxilla, which necessitates active transverse correction. Unless the transverse discrepancy is corrected, it would be difficult to correct the incisor relationship and detail the occlusion optimally.[23]

In terms of esthetics, the transverse dimension is the least studied. Patients with constricted and narrow maxillary arch will have large buccal corridors. Sarver *et al*.[24] studied the effect of buccal corridor size on smile esthetic and found that large buccal corridors to be unesthetic.

Diagnosis of transverse problem

It is vital to assess the craniofacial skeleton in the transverse dimension as early as possible and accurately diagnose the need for transverse maxillary expansion, to improve the efficiency and effectiveness of treatment. This has driven the continued evolution and development of diagnostic tools for evaluating the maxillary transverse dimension.

Diagnosis of maxillary transverse deficiency can be difficult and often includes the use of one or more of the following methods:

Clinical evaluation

Clinical evaluation includes assessment of the maxillary arch form and symmetry, width of the buccal corridors on smiling, occlusion, and predominant mode of breathing.[25] The clinical evaluation further evaluates the degree of crowding, arch width measurement at the mucogingival junction and dental crowns, perceived buccolingual inclination of posterior teeth, and the shape and height of the palatal vault.[26] One of the problems with the clinical assessment is that it is based on clinical crowns without consideration for the buccolingual inclination of the roots, which may camouflage the true skeletal transverse deficiencies.[27] There may be minimal soft tissue changes associated with maxillary transverse deficiency including paranasal hollowing, a narrow nasal base, deepened nasolabial folds and zygomatic hypoplasia, and wide buccal corridor. Therefore, anteroposterior and vertical maxillary hypoplasia are much easier to clinically diagnose due to observable soft tissue changes. Where anteroposterior and vertical maxillary dysplasias exist, they can clinically mask a transverse deficiency rendering clinical evaluation alone inadequate for diagnosis of transverse skeletal discrepancies.[28,29]

Dental cast assessment

Study models are useful in assessing the archform and inclination of the posterior segments. Several indices have been proposed by various authors to measure lateral discrepancies. Most commonly used indices are Pont, Linder-harth, and Korkhaus.[30] Although these indices offer a guide to assess the transverse discrepancy, they are population specific and not completely reliable. McNamara and Brudon[31] recommended measuring the transpalatal width from the gingival margin of the lingual groove of the first molar to the first molar of the other side. They establish a mean normal value from age of 7 to 15 years. The patients transpalatal width can be compared with the reported values to determine if the upper arch is normal. Caution should be exercised in employing this method since the norms are combined with both genders, and the dental compensations are not considered.

WALA ridge

Andrews[32] proposed using the WALA ridge to serve as a landmark for assessing mandibular arch form which in turn can provide a template for the maxillary arch form. Andrews[33] observed that when an optimal arch is viewed from the occlusal perspective, the distance of FA point of the first molars to WALA ridge should be 2 mm. In this position, the mandibular first molars are decompensated, and the arch width between the central fossa of the mandibular molars is the optimal mandibular arch width. Ideally, the distance between the mesiolingual cusp tips of the right and left maxillary first molars should be equal to the distance between the mandibular right and left central fossa. Since the diagnosis is made on a dental cast, the root position in the alveolar bone is not taken into consideration.[34]

Recently, an attempt has been made to relate the position of the root obtained from cone-beam computed tomography (CBCT) to WALA ridge evaluated from the dental cast. It was established that although teeth more closely related to WALA ridge are not centered in the alveolar bone or over basal bone, there seem to be a definitive relationship between center of resistance of the posterior teeth and to the WALA ridge, this finding implies that the WALA ridge may serve as a useful landmark for determining arch constriction and customizing archforms.[35]

Posteroanterior cephalometric analysis

In the 1990s, PA cephalogram was considered the most readily available and reliable radiograph for evaluating transverse skeletal dysplasia. Ricketts[36] developed Rocky Mountain analysis and had suggested norms and differentials that allow one to determine departure from the ideal and to establish the degree of treatment difficulty for a particular patient's problem. Betts *et al*.[21] developed a PA analysis method using the Rocky Mountain analysis norms and landmarks. The analysis involves calculating the maxillomandibular width differential. This differential indicates that a transverse discrepancy greater than Ricketts norm of 1.96 mm even in the absence of crossbite requires skeletal expansion and that a surgical approach may be essential in adults.[37]

However, the PA cephalogram is not routinely used by clinicians because of the limitations related to landmark identification errors, superimposition, magnification distortion, and head rotation affecting horizontal relationship resulting in inaccuracies in estimating the maxillomandibular width.[38]

CBCT

With the advent of CBCT, the transverse dimension of the dentofacial structures can be visualized and measured. As a result, the width of the maxillary and mandibular basal bones and their relationship, the buccolingual inclination of each whole tooth and their root positions in the alveolar bone can be visualized and analyzed, and a proper diagnosis can be made. When examining using a CBCT on the transverse dimensions, Chung[34] pointed out that normally there should be proper skeletal widths of the maxilla and mandible. The roots of the teeth should be positioned in the center of the alveolar bone, the maxillary molars should slightly incline buccally, and mandibular molars slightly incline lingually. For a narrow skeletal maxilla without dental crossbite, the maxillary posterior teeth tend to compensate and incline buccally and mandibular posterior teeth tend to compensate and incline lingually.

Miner *et al*.[9] developed a transverse analysis using CBCT and Dolphin software. They identified a noncrossbite group who had apparently normal skeletal and dental transverse relationships and another group of patients with an obvious skeletal discrepancy between the maxilla and mandible that had been masked by dental tipping either buccally or lingually (dental compensation). The non-crossbite group was divided into two groups, namely, the superior convergent group and the inferior convergent group. The superior convergent group had maxillary molars that were tipped more buccally or mandibular molars that were tipped more lingually than in the control group. The inferior convergent group had maxillary molars that were tipped more lingually and mandibular molars that were tipped more buccally than in the control group. They further observed that in normal occlusion, at the mid alveolar bone levels of the lingual surfaces of maxillary and mandibular first molars the maxillary width to be about 1.2 mm ± 2.9 mm less than mandibular width.

In a recent study Koo *et al*.[39] employed an estimated center of resistance which was used to represent the transverse position of the posterior segment from CT. Transverse widths either at the crowns or the estimated center of resistance were measured and compared between Class 1 subjects with normal occlusion and Class III surgical patients. The average difference between maxillary and mandibular transverse width (Yonsei transverse index) at the estimated centers of resistance was –0.39 mm ± 1.87 mm. One of the interesting findings was that the maxillomandibular transverse differences were found at the center of the resistance level and not at the crown level, indicating possible transverse dental compensation in Class III subjects. The results implicate that it is reasonable to assess the transverse at the center of resistance rather than at the crown even in the absence of distinct clinical phenotype such as buccal crossbite.[23]

Conventionally, the dental casts and PA cephalograms are used to diagnose transverse problems of maxilla and mandible. However, they have limitations. In contemporary orthodontics, CBCT is an excellent diagnostic tool, particularly for adults, to diagnose transverse problems. The maxillary and mandibular skeletal widths at different tooth level, buccolingual inclination of each tooth, and root positions in the alveolar bone can be determined and evaluated from the CBCT. With all these information, the clinicians can make a proper diagnosis and treatment planning for the patient.

MAXILLARY EXPANSION IN THE ABSENCE OF POSTERIOR CROSSBITE

The correction of posterior crossbite can be an important component of an orthodontic treatment plan. This is achieved by expanding the arch with rapid palatal expansion (RPE) device in children and surgically assisted rapid maxillary expansion (SARME) device in adults. However, even in the absence of crossbite, maxillary expansion can be attempted to correct the maxillary transverse discrepancy. Some of the indications for expanding the arch even in the absence of crossbite include;

To intercept maxillary crowding in the mixed dentition

Crowding of the permanent incisors with associated rotations and/or anterior crossbite is commonly observed during eruption of the permanent lateral incisors. The rationale of interceptive treatment in the early mixed dentition is to generate adequate space for the spontaneous alignment of the upper permanent lateral incisors. When crowding is limited to few millimeters, normal growth could provide adequate space, but when the palate is narrow, and the crowding exceeds this amount RPE could represent an effective procedure. Space would be gained not only at the alveolar bone but also in the basal bone when canines and premolars are crowded too.[40] While the benefit of this approach has been highlighted by some,[40] the rationale for using RPE in the absence of crossbite has been questioned by others.[41-43] Since there is a possibility of the maxillary molars tilting further buccally, it may result in further exaggeration of the curve of Wilson. Moreover, the amount of expansion needed to correct the incisor crowding may be insufficient.[42]

To counteract the development of a scissor bite following further buccal tipping of the first permanent molars, Schepp[44] proposed the use of transpalatal bar to create a posterior crossbite before RPE. Marshall[45] proposed the use of crisscross elastics. McNamara[46] suggested uprighting of lower molars with expansion plates to avoid the scissor bite and others[40] have recommended anchoring the palatal expander on the second deciduous molar and second deciduous canines. The benefits of this approach have been documented by Rosa,[47] da Silva Filho *et al.*,[48] Cozzani *et al.*,[49] Lima *et al.*,[50] and Cozzani *et al.*[51]

Correction of arch length tooth size discrepancy

Crowding and protrusion of teeth are two of the common manifestations of arch length tooth size discrepancy. Howe *et al.*[52] have shown that dental crowding appears to be related more to a deficiency in arch perimeter than to teeth that are too large. A primary factor in dental crowding often is a maxillary transverse discrepancy. If the position of the maxillary dentition reflects the skeletal discrepancy, it results in crossbite. On the other hand, if maxillary constriction is camouflaged by the dentition, and both dental arches are constricted, crowding in the absence of a crossbite is observed. RPE in the late mixed/early permanent dentition stage is helpful in obtaining meaningful increase in arch width and perimeter in cases where there is no crossbite.[53] [Figure 1] Yet another advantage of using the acrylic splint expander in the mixed dentition is that it can result in spontaneous widening of the lower dental arch thereby providing space for correcting crowding of the lower incisors.[53]

Correction of the Class II malocclusion

Class II malocclusion is commonly observed in orthodontic patients. Tollaro *et al.*[54] documented an underlying posterior interarch transverse discrepancy of 3–5 mm in subjects with Class II malocclusion in the early mixed dentition without posterior crossbite in the centric occlusion. When these Class II subjects posture their lower jaw forward to a Class I molar relationship, the maxillary transverse discrepancy becomes apparent. It has been postulated that in these subjects, the mandible assumes a distal position relative to centric relation because of the maxillary constriction. Several authors[55-58] have recommended widening the maxilla with rapid maxillary expansion (RME), which often leads to spontaneous forward posturing of the mandible during the retention period. It has been hypothesized that expanding

Figure 1: (a) A 8-year-old male in mixed dentition with maxillary arch constriction and crossbite of the right lateral incisor. (b) Before and after rapid palatal expansion. (c) On completion of Phase II treatment which was initiated after the eruption of all permanent teeth and completed in 16 months.

the maxilla disrupts the occlusion. The patient apparently becomes more inclined to position the jaw slightly forward[59] thus eliminating the tendency toward a buccal crossbite and at the same time improving the sagittal occlusal relationship. Presumably, subsequent growth and remodeling of the structures of the temporomandibular joint make this initial postural change permanent[53] [Figure 2].

RPE for altering airway dimension and breathing

Sleep-related breathing disorder (SRBD) encompasses multiple conditions associated with increased upper airway resistance during sleep. OSA is perhaps the most severe forms of SRBD. OSA affects 1%–5% of school-age children.[60] The peak onset of SRBD symptoms in pediatric population occurs between 2 and 8 years of age.[61] Children with mouth breathing and SRBD have alteration in dental and craniofacial morphology. These alterations could include extended head posture, lower hyoid bone position, anterior and inferior posture of the tongue, more retrognathic and posteriorly inclined mandible, large anterior and total facial height, large mandibular plane angles, narrow maxilla with or without a posterior crossbite, proclined maxillary incisors, and retroclined lower incisor.

Figure 2: (a) A 9-year-old female in late mixed dentition with convex profile, retrusive mandible, constricted maxillary arch, retroclined maxillary incisor. (b) Bonded rapid palatal expansion device, before and after expansion. (c) After completion of IInd phase of treatment resulting in improvement in facial profile in addition to eliminating arch length tooth size discrepancy.

In 2004, Pirelli *et al*.[62] performed RME on 31 children with a mean age of 8.7 years with normal BMI, constricted maxilla, absence of adenoid hypertrophy, and diagnosis of OSA based on PSG. The subjects had a mean baseline AHI of 12.2 events/h that dropped below one event per hour in all subjects at 4 months follow-up.

A more recent systematic review and meta-analysis by Camacho *et al*.[63] looked at sleep study outcome in children who had undergone RME as treatment for OSA. It has been hypothesized that, since the maxillary bones form half of the nasal cavity's structures, when the midpalatal suture is opened, the nasal cavity's lateral walls are also displaced apart, and its volume increases and upper airway resistance decreases over time.[64] Head posture had also been associated with respiratory function, and increased craniocervical angulation was observed as a functional response to facilitate oral breathing to compensate for nasal obstruction.[65] Once RME results in increased nasal airway patency and reduced nasal airway resistance (NAR), the airway flow increases, and the craniocervical angulation consequently is reduced. Another reported consequence after RME is higher tongue repositioning, which could increase airway volume.[66] [Figure 3] A recent systematic review,[67] on the impact of RME on airway volume and nasal resistance concluded that there is moderate level of evidence that RME therapy during the growth period causes increases in nasal cavity width and the posterior nasal airway, associated with reduced NAR and increased total nasal flow. The stability of the results can be expected for at least 11 months after the orthopedic therapy. All changes in airway dimensions and functions might improve the conditions for nasal breathing but cannot be indicated only for this purpose [Figure 3].

Expansion for altering the buccal corridor width

Recent years have seen an increasing emphasis given to face and smile esthetics by dental professionals and patients alike. Maxillary constriction is very common in orthodontic patients, which can affect occlusion, facial development, and smile esthetics. RME is a treatment often indicated for correction of transverse skeletal deficiency by means of maxillary expansion appliances.

de Carvalho[68] conducted a study to evaluate the effect of palatal expansion in individuals with maxillary transverse deficiency. The transverse dimension of the smile and the right buccal corridor showed statistically significant differences during the study period ($P < 0.05$). It was found that the transverse distance of the smile had a statistically significant increase from time T_1 to times T_2 and T_3 and

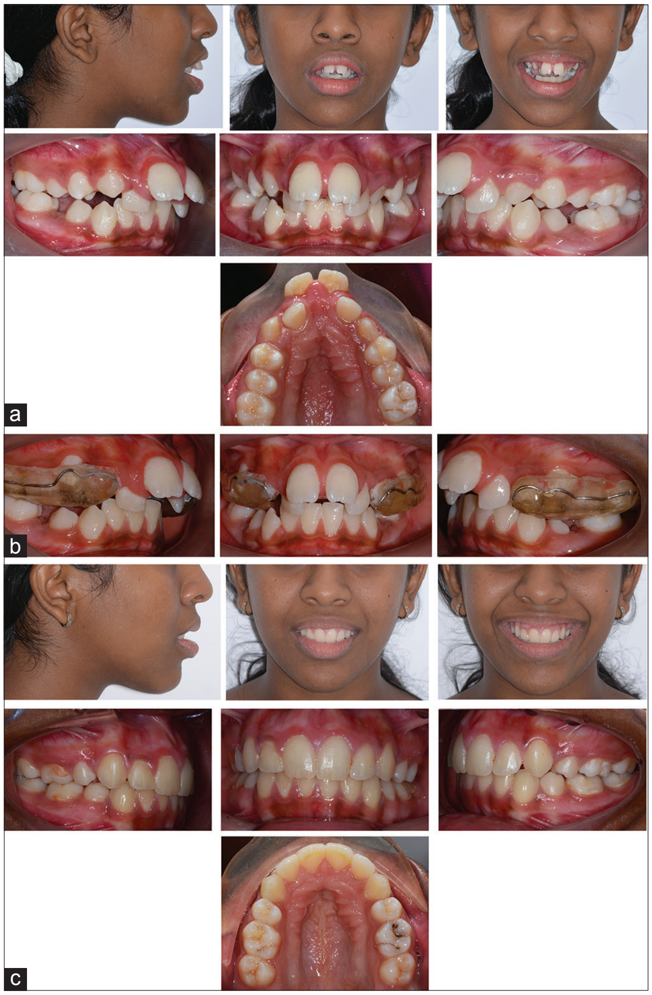

Figure 3: (a) A 8-year-old female patient with increased anterior facial height, convex profile, lip incompetence, and occlusal feature characteristic of altered breathing. (b) Maxillary expansion with bonded rapid palatal expansion. (c) At age 13, on completion of second phase of treatment with no further increase in facial height and improved maxillary arch form.

Figure 4: (a) Pretreatment appearance of a 13-year-old female with a narrow buccal corridor and blocked out maxillary left canine. (b) Treated non-extraction with a passive self-ligating system and wide arch form. (c) At the completion of treatment at age 15 with improved smile esthetics and reduced buccal corridor width.

the buccal corridor remained virtually unchanged even in the long term. Other methods of increasing the transverse dimension to reduce the buccal corridor width include the deployment of passive self-ligating appliance with wide arch forms[69] [Figure 4].

Bidental arch constriction

Bidental arch constriction has only recently been recognized as an orthodontic problem. Associated with the constriction of the width in both arches is the decrease in anterior arch perimeter and crowding. Handelman[70] has defined this malocclusion as bidental arch constriction syndrome, and it has the following characteristics:

a. Narrow maxillary and mandibular transverse widths
b. Absence of posterior crossbite
c. Lingual inclination of the posterior teeth, especially the premolars
d. Decreased arch perimeter
e. Crowding of the anterior teeth
f. Insufficient anterior arch contour
g. Dark buccal corridors

Correction of this malocclusion requires maxillary palatal expansion with concurrent mandibular expansion [Figure 5].

Gaining arch perimeter in adults

Maxillary arch constriction derived from an underlying transverse deficiency with or without a posterior crossbite is a common etiologic factor associated with dental crowding or protrusion. Therefore, improvement of the transverse arch dimension may play an important role in solving arch perimeter problems,[7] maxillary transverse deficiency has been successfully treated in young patients by intervention on the mid-palatal suture for separating the maxillary bones with the RPE technique.[71] However, in adults, as skeletal maturity advances there is progressive interdigitation of the sutures and increased stiffness of surrounding structures. In addition to the midpalatal suture, exerted forces must counteract the resistance provided by circummaxillary sutures and structures such as zygomatico maxillary buttress and sphenoidal structures.[72,73] Therefore, if conventional tooth-borne RPE devices are employed in adults it can result in alveolar bending and dental tipping rather than eliciting a skeletal response.[74] Consequently, root resorption, periodontal damages,[75-77] failure or limited expansion,[78] soft tissue swelling and ulcerations,[21] and questionable long-term stability[79] commonly results from conventional palatal expansion technique carried out in adult patients.

To overcome the dentoalveolar undesirable effects and maximize skeletal expansion potential, a non-surgical microimplant-assisted rapid palatal expansion technique was introduced.[80] A modification of the device to further enhance the skeletal component and minimize the dentoalveolar tipping was proposed by Moon *et al.*[81] The maxillary skeletal expander employs miniscrews that recruits the palatal and nasal cortices thereby augmenting the anchorage for facilitating opening of the midpalatal suture and overcoming the resistance from the circummaxillary sutures in adults.[82] The effectiveness of this technique has been recently documented[83] [Figure 6].

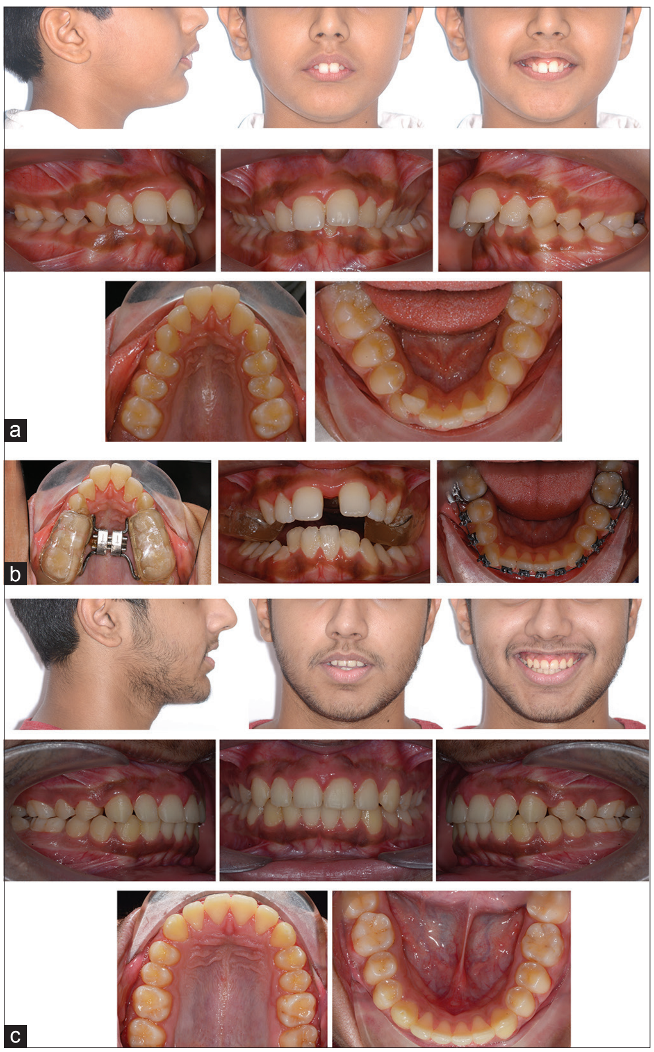

Figure 5: (a) A 12-year-old male patient with retrusive profile, incompetent lips, wide buccal corridor, and bidental arch constriction. (b) Maxillary arch expansion with bonded rapid palatal expansion followed by mandibular buccal segment uprighting with multi-banded appliance. (c) At 14 years on completion of treatment with improved facial profile, reduced buccal corridor width, and elimination of bidental arch constriction.

To facilitate sagittal correction in adults

Jacobs *et al.*[84] introduced the term "relative and absolute transverse discrepancy." A relative transverse discrepancy exists when the posterior teeth do not coordinate in centric relation but do coordinate when the canines are

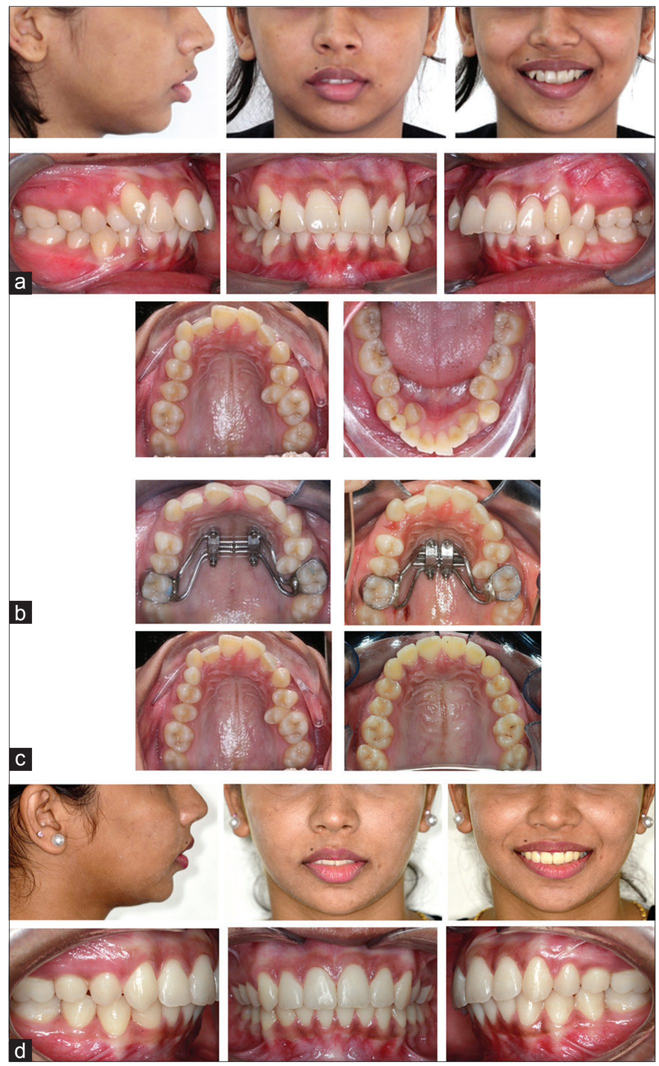

Figure 6: (a) 29-year-old female patient with convex profile, Class II molar relationship, constricted maxilla and arch length tooth size discrepancy. (b) Before and after expansion with miniscrew assisted rapid palatal expander (MSE) device. (c) Change in maxillary arch form, before and after completion of treatment. (d) On completion of second phase of treatment with improvement in occlusion and reduction in facial convexity.

approximated in Class I occlusion. In patients with skeletal Class II malocclusion due to retrognathic mandible it would be difficult to surgically advance, the mandible unless the maxillary arch is widened pre surgically. Arch expansion may be indicated in a number of joint orthodontic-orthognathic cases to maintain arch coordination following correction of the sagittal skeletal discrepancy, and a good post-surgical occlusion is important for enhancing post-treatment stability.[85] In skeletally mature patients surgically assisted rapid palatal expansion (SARPE) is indicated as a preliminary procedure even if future orthognathic surgery is planned.[86]

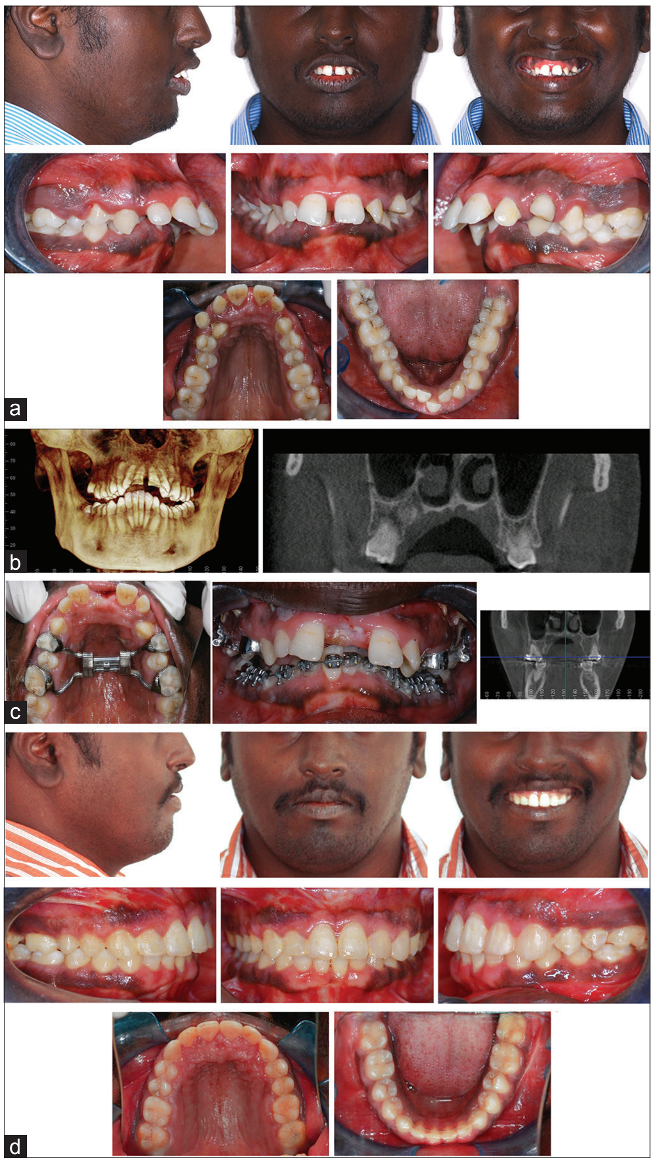

Figure 7: (a) 42-year-old male with retruded mandible, increased overjet and constricted maxilla and mandible. (b) Cone-beam computed tomography evaluation revealing constricted maxillary apical bone and compensated dentition. (c) Surgically assisted rapid maxillary expansion for widening the maxilla before mandibular advancement surgery. (d) Following mandibular advancement and post-surgical orthodontics.

SARPE procedures have traditionally been reported to have low morbidity, especially when compared with other orthognathic surgical procedures.[87] However, many complications have been reported, and the surgeon and the orthodontist must be aware of these before recommending SARPE to a patient.[86] The issue of long-term stability and relapse with SARPE has not been studied in detail in the literature. In general, most reports state that surgical expansion is more stable than orthopedic maxillary expansion.[87-90] Further SARME is preferred over multiple piece maxillary osteotomy when the expansion needed is >10 mm, when significant intercanine width widening is needed and when the palatal vault is low [Figure 7].

CONCLUDING REMARKS

Expansion of the transverse dimension in the absence of a posterior crossbite has many indications. As this article has described , orthopedic expansion with RPE is indicated in children and adolescents with constricted maxilla, orthopedic expansion is beneficial i n i ntercepting t he anterior crowding in mixed dentition and in eliminating arch length discrepancy in late mixed and early permanent dentition. When applied in the appropriate patient, it can result in enlarging of the nasal airway and may lead to spontaneous improvement in molar relationship in some Class II patients during the transition to permanent dentition. Other benefits of expanding a constricted maxilla include improvement in smile esthetics and eliminating bidental arch constriction.

In adults, a miniscrew aided palatal expansion can bring about orthopedic expansion for gaining arch length and reducing the width of the buccal corridor. Surgically assisted RME is beneficial i n c andidates w ho r equire o rthognathic surgery for mandibular advancement.

Conventionally, the dental cast and PA ceph are used to diagnose transverse problems. However, they have limitations. In contemporary orthodontics, CBCT is an excellent diagnostic tool, particularly for adults to diagnose transverse problems.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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There are no conflicts of interest.

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