Early Orthodontic Diagnosis and Correction of Transverse Skeletal Problems

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Abstract

Rapid maxillary expansion (RME) is an orthodontic treatment commonly used in children to correct skeletal transverse problems of the maxilla. This clinical report introduces an effective way to diagnose and treat skeletal transverse problems achieving an orthopedic response, thereby reducing dental tipping and the need to overcorrect. Two clinical cases are used to illustrate an accurate skeletal diagnosis of the transverse dimension, orthopedic treatment using RME and a rationale for early orthodontic intervention.

ORTHODONTIC DIAGNOSIS and treatment of transverse discrepancies continue to be sources of controversy among orthodontists and other practicing dentists.[1] A major part of the confusion about the transverse dimension stems from the fact that most practitioners diagnose transverse problems based on the clinical appearance of teeth, without properly assessing the skeletal width of the maxilla and mandible.

Compensatory buccal or lingual inclination of maxillary and/or mandibular teeth can easily mask an underlying transverse skeletal discrepancy. Therefore, the presence or absence of maxillary crowding, posterior crossbite or constricted arches does not necessarily indicate a transverse skeletal problem or the severity of the discrepancy and should not be used to diagnose the skeletal width discrepancy between the upper and lower jaws.

Established skeletal landmarks must be used to properly diagnose the skeletal width of the maxilla and mandible. Broadbent introduced lateral and posteroanterior (PA) cephalograms in the 1930s, which soon became the gold standard for orthodontic skeletal diagnosis in the sagittal and vertical dimensions. However, PA cephalograms were not considered an important part of routine orthodontic record and were mainly used to assess facial asymmetry. Consequently, skeletal diagnosis of the transverse dimension was greatly overlooked.

More recently, Vanarsdall[2] emphasized the use of PA cephalograms to diagnose the skeletal width of the maxilla and mandible based on skeletal landmarks (Figure 1) and norms (Table I) developed by Ricketts.[3] It is important to emphasize that the skeletal diagnosis using a PA cephalogram will not only show the existence of a discrepancy in the width between the maxilla and mandible, it will also show the severity of such discrepancy. The severity of the transverse skeletal discrepancy and the age of the patients are the most important factors in determining the appropriate treatment (orthodontics, orthopedics or surgery) and the prognosis.

Clinical Management of Rapid Maxillary Expansion

Orthopedic expansion of the maxilla is based on application of forces of up to 120 Newton to open the palatal suture and achieve optimal skeletal correction.[4] We recommend appliances such as Haas RME (Case One; Figures 2a to 2h) and "bonded" RME (Case Two; Figures 3a to 3h) that utilize the palatal contour for anchorage and produce orthopedic response, minimizing adverse dental tipping.

The appliances should be cemented with glass ionomer cement because of its caries-protective effect through fluoride release. The activation is semi-rapid, requiring two turns of the screw daily (.5 mm. opening) for approximately two weeks. It is important to notice that the skeletal response to expansion can be different from one patient to another, depending on factors such age. The younger the patient is, the closer the relationship to 1:1 between expansion at the screw level and skeletal level will be. On the other hand, as the patient matures, the skeletal expansion obtained can be only one-third of the expansion produced at the screw level. Then, post-expansion PA cephalogram is useful to evaluate the amount of skeletal correction achieved.

The appliance is left in place for about five months to provide stability and to

allow the opened suture to heal through bone apposition. This approach differs from slow maxillary expansion, which does not favor orthopedic correction but, rather, produces buccal tooth movement, which is unstable, and may cause future relapse and potential periodontal problems.

Case One

J.A. (7 years 10 months), a Caucasian male, was referred by his pediatric dentist for an orthodontic evaluation because of a posterior crossbite. His medical history was normal; and he had normal growth and dental development. Clinical examination revealed a unilateral posterior crossbite with a functional shift of the mandible to the patient's right.

As part of the routine orthodontic records, a PA cephalogram was taken to evaluate the skeletal width of the maxilla and mandible. PA cephalogram analysis showed a narrow maxilla (Mx-Mx) 56/61 mm. (patient/norm for his age) and a wide mandible (Ag-Ag) 78/73 mm. The recommended treatment was orthopedic expansion of the maxilla to normalize the skeletal transverse discrepancy.

A Haas RME was fabricated and cemented with glass ionomer *(Multi-Cure Glass Ionomer Band Cement from Unitek, 3M)* to the first permanent molar and the first primary molar. The RME screw was turned twice a day for 14 days. Post-expansion PA cephalogram analysis showed a 5 mm. increase of the skeletal width of the maxilla, from 56 mm. to 61 mm.; and the expander was left in place for five months.

Post-treatment intraoral photographs show the correction of the unilateral posterior crossbite and the functional shift of the mandible. In addition, maxillary and mandibular midline alignment was also corrected. No further retention was needed after the RME was removed (Figures 2a to 2h).

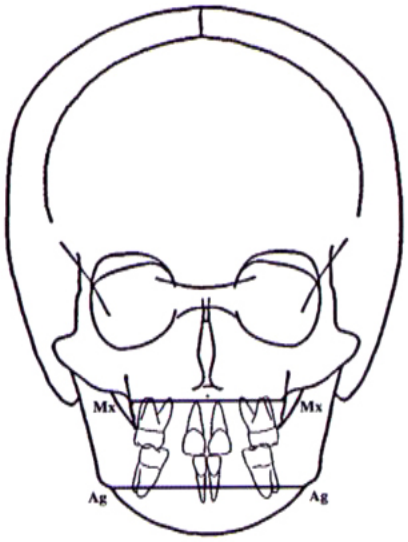

Figure 1. Posteroanterior cephalogram showing skeletal landmarks used to evaluate width of maxilla and mandible. Maxillare (Mx), or J point, located at depth of concavity of lateral maxillae contours, where maxilla intersects zygomatic buttress. Mx-Mx: distance between left and right Mx (mm) that represents skeletal width of maxilla. Antegonion (Ag), or antegonial notch of mandible; defined as innermost height of contour along curved outline of inferior mandibular border, low and medial to gonial angle. Ag-Ag: distance between left and right Ag (mm); represents skeletal width of mandible.

Case Two

L.B. (7 years 3 months), an African-American female, was referred by her pediatric dentist for an orthodontic evaluation because of an anterior crossbite. Medical history was within normal range. Intraoral examination showed a pseudo Class III relationship with an anterior crossbite. Upon closing, the upper and lower incisors

TABLE I.
Rocky Mountain Norms of Maxillary and Mandibular Widths by Age

Age (year)	Maxillary Width (mm)	Mandibular Width (mm)	Difference (mm)	Ratio
9	62	76	14	81.60%
10	62.6	77.4	14.8	80.90%
11	63.2	78.8	15.6	80.20%
12	63.8	80.2	16.4	79.50%
13	64.4	81.6	17.2	78.90%
14	65	83	18	78.30%
15	65.6	84.4	18.8	77.70%
16	66.2	85.8	19.6	77.40%

Rocky Mountain Skeletal Transverse Norms. Widths of maxilla and mandible, as well as difference between them, are expressed in mm. and by patient age.

Figure 2a. Pre-treatment intraoral frontal photograph exhibiting right unilateral posterior crossbite and mandibular functional shift to patient's right.

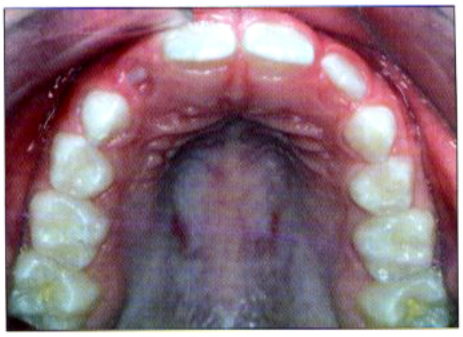

Figure 2b. Pre-treatment intraoral maxillary occlusal photograph.

Figure 2c. Intraoral frontal photograph after active orthopedic expansion was concluded. Posterior unilateral crossbite has been corrected and mandible is now centered on facial midline.

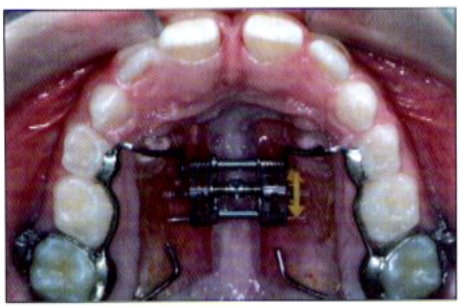

Figure 2d. Intraoral maxillary occlusal photograph after active expansion was concluded. Observe opening of Haas RME and diastema between central incisors.

Figure 2e. Post-treatment intraoral frontal photograph showing corrected buccolingual relationships, diastema between central incisors closed and midlines coincident.

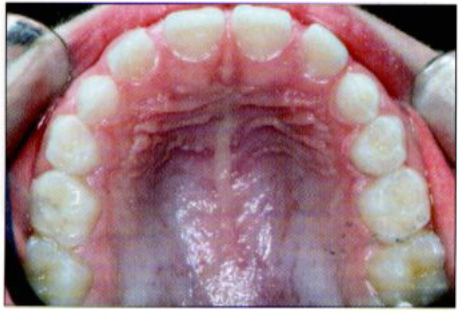

Figure 2f. Post-expansion intraoral maxillary occlusal photograph one week after removing RME.

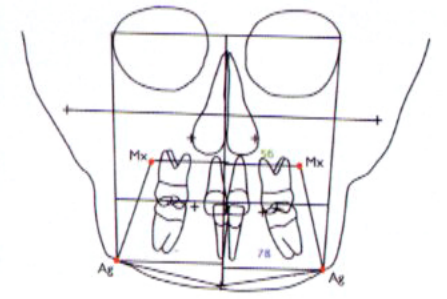

Figure 2g. Pre-expansion PA cephalogram. Maxillary width (Mx-Mx) of 56 mm. (61 mm. norm) and mandibular width (Ag-Ag) of 78 mm. (73 mm. norm).

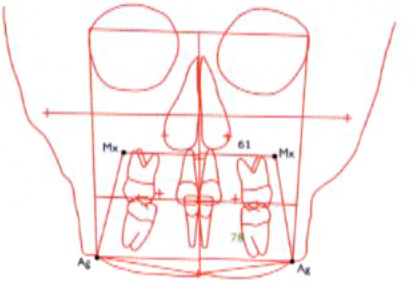

Figure 2h. Post-expansion PA cephalogram showing increase in maxillary width of 5 mm., from 56 mm. to 61 mm.

made contact at the incisal edge, resulting in a forward movement of the mandible into an anterior crossbite relationship.

As part of the routine orthodontic records, a PA cephalogram was taken to evaluate the skeletal width of the maxilla and mandible. PA cephalogram analysis showed a wide maxilla (Mx-Mx) 64/61 mm. (1SD wider than norm) and a wide mandible (Ag-Ag) 80/73 mm. (3SD wider than norm). Though the maxilla was skeletally wider than the norm for the patient's age, it was not wide enough to harmonize with the mandible.

The normal difference between the skeletal width of the upper and lower jaw at this age is 12 mm.; the patient's was 16 mm. Therefore, to normalize the transverse skeletal relationship, orthopedic expansion of the maxilla was performed using "bonded" RME. This appliance allows opening of the bite to facilitate labial movement of the upper incisors. The expander was cemented using a fluoride-releasing bonding material *(Excel Regular Set Kit from Reliance Orthodontic Products)*. The RME screw was turned twice daily for 12 days.

A post-expansion PA cephalogram showed a 5 mm. skeletal expansion of the maxilla, from 64 mm. to 69 mm. With the "bonded" RME, the bite was open, thus eliminating anterior interferences, along with the forward functional shift of the mandible. The anterior crossbite was corrected. The RME was kept in place for five months (Figures 3a to 3h).

Discussion

Early orthopedic correction of the transverse dimension of the maxilla is valuable because

Figure 3a. Pre-treatment intraoral frontal photograph showing anterior crossbite.

Figure 3b. Pre-treatment intraoral maxillary occlusal photograph. Notice palatal inclination of central incisors resulting from traumatic occlusal interference with lower incisors.

Figure 3c. Intraoral frontal photograph after active expansion was concluded. Bite is open due to "bonded" RME acrylic's occlusal thickness. Opening bite allows for labial movement of maxillary incisors, which facilitates correction of anterior crossbite.

Figure 3d. Intraoral maxillary occlusal photograph immediately after active expansion was concluded. Notice opening of "bonded" RME. This RME design covers palatal contours with acrylic, both soft tissue palate and occlusal and buccal surfaces of teeth.

Figure 3e. Post-treatment intraoral frontal photograph showing good buccolingual relationships and correction of anterior crossbite.

Figure 3f. Post-treatment intraoral maxillary occlusal photograph immediately after removal of RME. Redness of gingiva around teeth on palate is expected and returns to normal in less than week.

of three factors: growth; function; and periodontal health. The transverse growth of the maxilla is completed earlier than in most of the other maxillofacial structures.[5]

The greatest growth of the maxilla occurs from 7 to 11 years in males and from 6 to 11 in females, with greater than 95% of total growth attained by 12 years of age.[6] It has been reported that children with a functional unilateral posterior crossbite (FUPXB) could develop asymmetric muscle function and growth of the mandible because of the functional shift of the mandible.[7] This growth pattern can be intercepted early by orthopedic expansion of the maxilla, allowing the mandible to grow normally.[7]

Using PA cephalograms and clinical examination, Herberger[8] evaluated 55 patients 7 to 10 years post-treatment. These patients had orthopedic expansion between ages 8 and 13. He found significant skeletal expansion of the maxilla when compared to controls. However, when compared with patients who had the expansion done early (before age 10), the older patients (treatment at age 11 to 13) revealed considerable gingival recession in the premolar and molar areas. This occurrence can be explained by the fact that as the palatal suture begins to fuse, there is less skeletal expansion and more dental movement. As teeth move in a buccal direction through the alveolar bone, cortical bone thins out and produces dehiscences with subsequent gingival recession. Therefore, we encourage early correction of transverse problems based on a skeletal diagnosis obtained through PA cephalograms. The future is promising in this regard since new technologies such as the CBCT will allow us to better diagnose and evaluate treatment through high-resolution 3D images.

Conclusion

A proper skeletal diagnosis of the transverse dimension using specific landmarks on a PA cephalogram is useful to determine the severity of the dysplasia and select the proper treatment. Because of the transverse growth of the maxilla, the potential to correct a transverse skeletal dysplasia is much greater for a 7-year-old patient than for a 12-year-old. Early correction of skeletal transverse discrepancies has been shown to help reduce susceptibility to functional and periodontal problems; therefore, early orthodontic diagnosis and correction of transverse skeletal problems should be considered. ■

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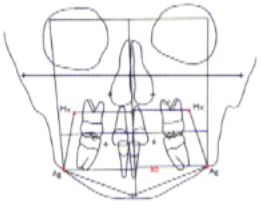

Figure 3g. Pre-expansion PA cephalogram. Maxillary width (Mx-Mx) of 64 mm. (61 mm. norm) and mandibular width (Ag-Ag) of 80 mm. (73 mm. norm). Skeletal width of maxilla is 1SD wider than norm. However, skeletal width of mandible is 3SD wider than norm.

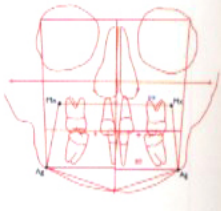

Figure 3h. Post-expansion PA cephalogram exhibiting increase in maxillary width of 5 mm., from 64 mm. to 69 mm.

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