

A Review Article on Diagnosis and Treatment Planning of Transverse Malocclusion

¹Dhanya M, Post Graduate, Department of Orthodontics and Dentofacial Orthopaedics, St Gregorios Dental College, Kothamangalam, 686681, India

²Binnoy Kurian, Professor and Head of Department, Department of Orthodontics and Dentofacial Orthopaedics, St Gregorios Dental College, Kothamangalam, 686681, India

³Shikha B, Post Graduate, Department of Orthodontics and Dentofacial Orthopaedics, St Gregorios Dental College, Kothamangalam, 686681, India

³Sunil Skariya, Post Graduate, Department of Orthodontics and Dentofacial Orthopaedics, St Gregorios Dental College, Kothamangalam, 686681, India

Corresponding Author: Dhanya M, Post Graduate, Department of Orthodontics and Dentofacial Orthopaedics, St Gregorios Dental College, Kothamangalam, 686681, India

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Abstract

One of the most frequently reported malocclusion in transverse dimension is crossbite. Analysis of transverse dimension may provide some insight into solving this problem. The crossbite may be due to a functional shift from centric relation, or actual skeletal asymmetry. If the crossbite and functional shift are treated in a timely manner the asymmetry can be largely eliminated. This article reviews an out various diagnostic methods like posteroanterior cephalogram, CBCT analysis, various model analysis, occlusograms and usage of ABO measuring gauge in identification and absolute and relative transverse malocclusion and how the treatment planning should be done to correct these transverse malocclusion.

Keywords: Centric relation, centric occlusion, transverse maxillary deficiency, absolute crossbite, relative crossbite.

Introduction

Transverse maxillary deficiency is often characterized by unilateral or bilateral crossbite as well as anterior crowding. Deficiency in the maxillary arch width leads to constriction of maxilla, and it is considered to be one of the most pervasive skeletal problems in the craniofacial region. Depending upon structures involved, these problems may be primarily, dental, skeletal, functional in origin or may even have combination of these factors present. It is not self correcting, therefore correction during the mixed dentition stage is recommended. One likely cause of the relatively high

percentage of unilateral cross-bite in the early dentition is the influence of finger- and dummy-sucking. The prevalence of posterior cross-bite in the mixed and permanent dentition has been found to be of the same magnitude as in the deciduous dentition, the great majority of cases being unilateral and very often associated with forced guidance.

Terminologies¹

Cross-bite - It is defined by Graber as a condition where one or more teeth may be malposed buccally or lingually with reference to opposing tooth or teeth.

Scissor Bite -Scissor bites can develop from either a maxillary buccal or mandibular lingual crossbite.

Brodie Bite- Complete Maxillary Buccal Cross-bite. A situation in which the maxillary dental arch is wide and it lies entirely buccal to (contain) the mandibular dental arch, also called Telescopic Bite

Reverse telescoping bite- The opposite (i.e., a complete maxillary palatal or a complete mandibular buccal cross-bite) is called a reverse telescoping bite.

Etiology²

Etiology of Transverse maxillary deficiency

- Habits–thumb sucking
- Obstructive sleep apnea
- Iatrogenic (cleft repair)
- Palatal dimensions and inheritance
- Muscular
- Syndromes
- Klippel-Feil syndrome
- Cleft lip and palate
- Congenital nasal pyriform aperture stenosis
- Marfan syndrome
- Craniosynostosis (Apert's, Crouzon's disease, Carpenter's)
- Osteopatiastriata

- Treacher Collins
- Duchenne muscular dystrophy

Timing of Maturation of Mid Palatal Suture³

Skeletal maturation stages of the MPS proposed by Angelieri et al.2013

STAGE A -Represents the earliest maturation stage of the suture, and in this stage the suture was identified as a relatively straight high-density line at the midline

STAGE B -The suture presents an irregular shape and was identified as a scalloped high-density line at the midline

STAGE C - The suture is seen as two parallel, scalloped, high-density lines close to each other and separated in some areas by small low-density space

STAGE D - The complete fusion of the suture has occurred in the palatine bone and the radiographic image of the suture was identified as two scalloped, high-density lines at the midline on the maxillary portion of the palate that were not visible in the palatine bone

STAGE E-Fusion of the suture has occurred in the maxilla. It is not possible to identify the MPS. As to bone density, it is the same as in other parts of the palate

Diagnosis⁴

Clinical Evaluation-

Case history and extraoral examination-

Ask for family history, history of trauma and facial midline examination, examination of buccal corridors on smiling, paranasal hollowing, check for TMJ dysfunction and path of closure, narrow nasal base, deep nasolabial fold.

Intra Oral Examination

Check for crowding, examination of arch width, shape and height of palatal vault, form and symmetry of the maxillary arch, can't of occlusal plane and most importantly posterior crossbite. Crossbite can be skeletal or dental.

Mandibular shift upon closure (functional crossbite)⁵

Lateral chin deviation may be noted in a frontal facial examination, and if so, its root cause needs to be identified. This could be due to a functional shift from centric relation, or actual skeletal asymmetry.

Temporary disarticulation of the occlusion for one to two weeks, followed by a re-examination will confirm this. A bite plate can be used to disarticulate the occlusion. In the absence of a lateral shift, findings of chin asymmetry and unilateral crossbite establish the presence of a true unilateral skeletal asymmetry. Unilateral crossbite found in the absence of skeletal asymmetry and lateral shift is most commonly the result of aberration of transverse tooth positions.

Radiographic Examination

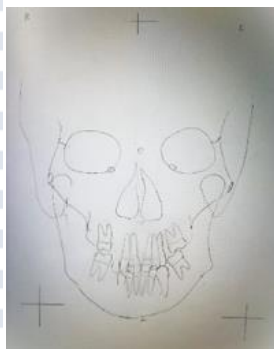
Occlusal radiograph⁴

Occlusal palatal radiograph now days are not used regularly because the superposition on to the midpalatal suture or other bony structures and an inability to effectively visualize the posterior inter maxillary suture make this an unreliable method.

PA Cephalometric view

Table 1 Maxillary width (J-J') in males

Age (y)	Width (mm)
3	55
4	56
5	57
6	58
7	59
8	60
9	61
10	62
11	63
12	64
13	65
14	66
15	67
16	68
17	69
18	70
19	71
20	72
21	73



Maxillary and mandibular width⁶

Maxillary width is the width between the points jugale left (JL) and jugale right (JR) Patient age and the maxillary width of the patient should be compared with

the normal value chart to assess the transverse deficiency if any.

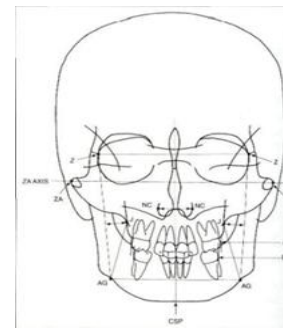
Maxillomandibular transverse differential⁶

The method is also based on the Ricketts norms. The measurement of the maxillae at the J points are compared to the Ag points on the mandible.

Table 3 Maxillomandibular differential and index values in males

Age (y)	Maxillary (mm)	Mandibular (mm)	M-M differential (mm)	Ratio (%)
3	55	68.0	13.0	80.0
8	60	74.5	14.5	80.5
13	65	82.0	17.0	79.27
18	70	87.5	19.5	80.0
Adult	72	92.5	20.5	78.0

If the proportion is calculated at different ages, regularity is observed. The value or ratio of maxilla to mandible is about 80%. There is a 20-mm width difference between the J points and the Ag points in adults.



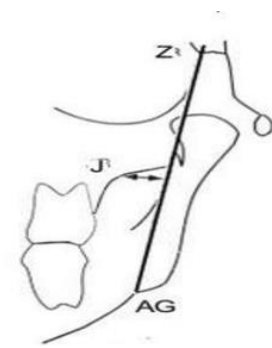
Proportional maxillary width⁶

Measured from the jugal process to the frontal facial plane (constructed from the medial margins of the zygomatic of rental sutures to the AG point).

Used to measure skeletal cross-bite.

Table 5 Proportional maxillary width (J to Z-Ag) in males

Age (y)	Width (mm)
3	9.0
4	9.2
5	9.4
6	9.6
7	9.8
8	10.0
9	10.2
10	10.4
11	10.6
12	10.8
13	11.0
14	11.2
15	11.4
16	11.6
17	11.8
18	12.0
19	12.2
20	12.4



This is an independent measurement made on each side and compared to the normal value of 10 +/- 1.5 mm in adults. A value greater than this indicates the existence of a transverse discrepancy between the mandible and the maxilla.

This is a useful method for illustrating the total discrepancy and identifying which side contributes a greater deficiency but it does not effectively determine in which jaw the discrepancy is present

CBCT⁷

The maxillary and mandibular transverse relationship was measured through 3 CBCT-based diagnostic methods:

University of Yonsei transverse analysis (Yonsei's analysis)

University of Pennsylvania CBCT analysis (Penn's analysis)

Boston University Goldman School of Dental Medicine's analysis (BU's analysis)

For Yonsei's analysis, the centers of the root furcation of the first molars were chosen as the jaw width measurement points. They were located and calibrated in 3 dimensions, followed by the automated distance calculation between selected points. The difference between maxillary width and mandibular width was calculated.

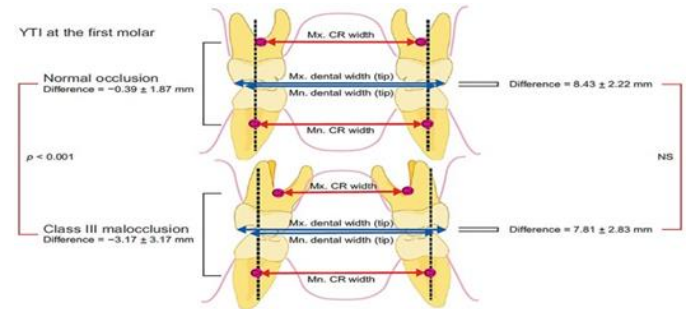
The average difference between the maxillary and mandibular transverse widths at the estimated center of resistance was -0.39 ± 1.87 mm

If the difference was less than -2.26 mm, the patients were considered MTD.

As with Penn's analysis, the maxilla-mandible width difference of less than 5 mm was judged to have MTD.

Finally, for BU's analysis, maxilla-mandible width difference of less than 4.13 mm was judged to have MTD

The transverse deficiencies diagnosed by these 3 methods were compared and Yonsei's analysis had the highest correlation coefficient, followed by BU's analysis and Penn's analysis.



Study model Analysis

Palatal height index

$$\text{Palatal height Index} = \text{Palatal height} \times 100$$

Posterior arch width

The average value is 42%

Ashley Howe's Index

$$\text{P.M.B.A.W\%} = \frac{\text{P.M.B.A.W}}{\text{T.T.M}} \times 100$$

If P.M.B.A.W is more than P.M.D then it is an indication that arch expansion is possible.

Pont's Index

The arch width of premolar region is measured by the formula

$$\frac{\text{MD width of the upper incisors} \times 100}{80}$$

The arch width in the molar region is also measured using the formula

$$\frac{\text{MD width of the upper incisors} \times 100}{64}$$

If the calculated value is greater than measured value then the arch is narrow and needs expansion

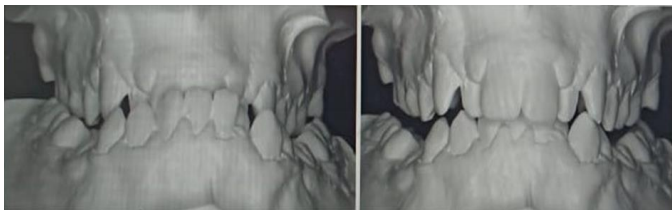
Absolute Transverse Maxillary Deficiency Implies A True Horizontal (Width) Insufficiency⁸

Such cases may present clinically with palatal cross-bite or with no cross-bite present.

When study models are positioned into a class I canine relationship, a unilateral or bilateral palatal cross-bite is evident or the existing transverse deficiency is worsened. Absolute deficiencies of this nature are frequently associated with skeletal class II malocclusions or open-bite deformities. The long, tapering maxillary arches exhibited clinically in these persons frequently are not associated with existing palatal cross-bite. However, when the patient postures the mandible into a simulated class I relationship, palatal constriction may become evident. Even in cases with normal-appearing transverse relationship in class II malocclusion when simulated correction of class II malocclusion to class I canine relationship may exhibit bilateral palatal cross-bite as a result of absolute bilateral transverse maxillary deficiency.

Posterior cross bite due to relative transverse maxillary deficiency

In such cases there is a functional shift from centric relation to centric occlusion with a midline shift due to interfering cusps. This may be registered with an accurate centric relation wax bite.



Above is a clinically exhibited bilateral palatal cross-bite in Class III malocclusion. Simulated correction of anteroposterior (sagittal) discrepancy, with no palatal cross-bite now apparent. This case exemplifies relative bilateral transverse maxillary deficiency

ABO measuring gauge⁴

While studying posterior cross bite in these cases posterior dental compensations in the cast should be investigated first. American Board of Orthodontics (ABO) measuring gauge is used for this.

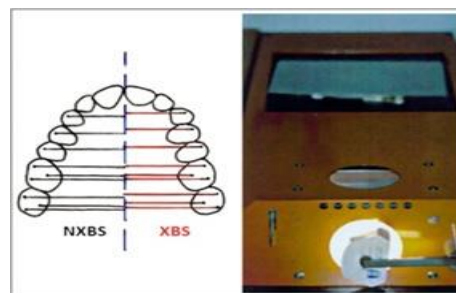
Placing an ABO gauge across left and right first molars defines a transverse occlusal plane.

When positioned in this manner, the straight edge should contact the buccal cusps of contra lateral mandibular molars. The lingual cusps should be within 1 mm of the surface of the straight edge. In the maxillary arch, the straight edge should contact the lingual cusps of the maxillary molars. The buccal cusps should be within 1 mm of the surface of the straight edge.

A 1 mm displacement from the transverse occlusal plane from normal value is approximately 10° of buccolingual inclination. If the mandibular lingual cusps or maxillary buccal cusps are more than 1 mm, but less than 2 mm from the straight edge surface 1 point shall be scored for that tooth.

Occlusogram⁹

Occlusograms were obtained with the Kinast polygraph in which occlusal dental surfaces appeared on the diaphanoscope with a 1:1 enlargement. The dental variables identified on the occlusograms were the tips of the canine cusps, the premolar buccal cusps (or deciduous molar buccal cusps), and the mesiobuccal, mesiolingual, and distobuccal cusps of the first and second molars. These points were measured in relation to the palatal midline.



Each dental hemi-distance was measured at both the crossbite side and the non crossbite side. The average of all dental distances of the crossbite side was compared with that of the non crossbite side. The value of the dental transverse difference, with reference to the

crossbite side, could be negative (crossbite less than non crossbite), positive (crossbite greater than non crossbite), or neutral (crossbite and non crossbite the same).

Negative dental transverse difference values indicated that the average dental transverse distance at the crossbite side was closer to the midline rather than at the non crossbite side. The associated clinical observations indicated a maxillary morphology contracted at the crossbite side.

Average transversal distance was increased at the crossbite side compared with that of the counter side (positive dental transverse difference values), the morphology of the crossbite side appeared expanded.

For equal dental distances of the crossbite and non crossbite sides from the midline, a neutral dental transverse difference was registered to indicate a symmetric maxillary arch.

Treatment Planning

Differentiate between a dental and skeletal cross bite¹⁰

By visualizing what happens in the transverse dimension when we upright the molars (eliminate transverse compensations) it can be differentiated. Since maxillary and mandibular skeletal bases relate well in a dental cross bite, uprighting molars will improve (eliminate) a dental cross bite. On the other hand, since maxillary and mandibular skeletal bases do not relate well in a skeletal cross bite, then uprighting molars will worsen a skeletal cross bite.

When to treat crossbite¹⁰

Functional shifts in the primary dentition can be corrected by selective enameloplasty of 1 or 2 deciduous teeth but it is recommended to postponed until the early mixed dentition due to reported high failure rates (30-50%).

Other treatment and appliances cannot be employed due to lack of cooperation so it is recommended to postpone crossbite correction until the permanent first molars erupt where transverse relationships can be assessed more thoroughly. There is still adequate time for growth modification in the mixed dentition.

Differentiation between posterior skeletal and dental cross bite¹⁰

We cannot conclude that when only 1-2 posterior teeth are in cross bite it is a dental cross bite and when more teeth are in cross bite that it is a skeletal cross bite because there is a large variation in transverse skeletal dimensions even in the absence of cross bites.

Treatment of crossbite¹⁰

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. 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.

Identifying which jaw to be treated with crossbite¹⁰

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 because there is no way to constrict the mandibular basilar bone orthopedically.

Treatment Approaches for cross bite

Dental cross bite: Upright the involved teeth, thus improving/correcting the cross bite.

Skeletal cross bite:-Orthopedics (maxillary skeletal expansion)

Masking (camouflage, increasing transverse compensations)

Orthognathic surgery (SARPE, Segmental maxillary osteotomy)

Expansion for dental problems

Broadly classified into:

According to the rate of expansion

- Slow expansion-W-arch, Quad Helix, Coffin spring
- Rapid expansion - Hyrax, Isaacson

According to appliance attachment:

- Removable- active plate and functional appliances
- Fixed:

Tissue borne: Haas type expansion, Derichsweiler type

Tooth borne: Banded - Hyrax or Biedermann type.

Bonded maxillary expansion. Minne Expander or Isaacson type

Conclusion

Transverse discrepancies warrant special consideration in the orthodontic diagnosis and treatment planning. Patients with these problems pose special diagnostic and biomechanical challenges to the clinician. Determination of the underlying cause of the asymmetric or symmetric transverse problem must be an important ingredient in the process of formulation of an appropriate treatment plan. Depending upon the structure involved, these problems may be primarily dental, skeletal or functional in origin or may even have a combination of these.

As the transverse growth of the jaw cease first, expansion achieved in the earlier ages is more

advantageous and stable. Apart from achieving arch expansion it also has its effect on oral, nasal and pharyngeal tissues so as to benefit respiration. Thorough knowledge, keen observation, proper diagnosis and decision can enormously benefit the outcome of treatment.

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