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Research Paper

Diagnosis of Transverse Problems-A Review

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ABSTRACT:
Among all the three planes transverse plane is the most difficult to diagnose. However, transverse facial growth and diagnosis is very important for treatment planning.
The purpose of this article is to study about various methods used to diagnose transverse maxillary and mandibular constriction. Different orthodontists use different set of criteria to diagnose a transverse problem. However, true skeletal problem cannot be diagnosed with a single criteria. Diagnosing a transverse problem plays a very important role in orthodontic management of malocclusion. This article sums up the traditional and advanced methods of diagnosing a transverse problem.

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I. INTRODUCTION:

Among sagittal, vertical, and transverse planes, the transverse is the least studied in orthodontics. In the orthodontic literature, there are plenty of articles related to sagittal and vertical dimensions of the face, but few related to the transverse dimension. Transverse facial growth and diagnosis and treatment planning deserve a lot more attention.

Many of the individual characteristics or symptoms of this condition have been well recognized in orthodontics, but rarely are they combined conceptually. However, it may be possible to produce a greater treatment effect on the skeletal structures of the maxillary complex than in the mandible, particularly with regard to the management of the transverse dimension.[1]

I CLINICAL SIGNS OF MAXILLARY DEFICIENCY:

Crowding and Protrusion

Crowding (Fig.1) and protrusion (Fig.2) of the teeth, result from discrepancies between the tooth size and the size of the alveolar base. Study done by Howe et al.[2] have shown that dental crowding is related more to a deficiency in arch perimeter than to increased tooth material. A primary factor in dental crowding often is maxillary transverse and/or sagittal deficiency. If the position of the maxillary dentition reflects the skeletal discrepancy, crossbite results; on the other hand, if maxillary constriction is camouflaged by the dentition, and both dental arches are constricted, crowding in the absence of crossbite is observed.[1]


Figure 1


Figure 2

1.Crowding is a common observation in mixed-dentition patients. This patient presented with crowded lower incisors and an unerupted upper-right lateral incisor. **2.**Protrusion of the maxillary dentition is evident in this patient

Reduced transpalatal width.

Transpalatal width measured between the closest points of the maxillary first molars (Fig.3). Typically, a maxillary arch with a transpalatal width of 35 to 39 mm is considered to be normal. However, maxillary arches less than 31 mm in transpalatal width may be crowded, it is considered to be constricted and requires expansion.[1]

Figure 3

Transpalatal width is measured from the closest points on the lingual surfaces on the maxillary first molars. Normal transpalatal width is 35 to 39 mm in the permanent dentition and 33 to 35 mm in the mixed dentition.

Crossbite.

Crossbite and dental crowding are two easily recognizable clinical signs that could be the result of maxillary deficiency. Posterior crossbite is a common and valid indicator of transverse problems. However, there are many patients with transverse problems that do not show a posterior crossbite. These patients have what appears to be a normal posterior occlusion, although on closer inspection the maxilla is narrow (e.g., intermolar width <31 mm), and the curve of Wilson is accentuated. The lingual cusps of the maxillary posterior teeth extend below the occlusal plane, often leading to balancing interferences during function. The dental compensation may obscure the skeletal and dental transverse problems.[1]

Negative space.

Another clinical manifestation of maxillary deficiency is dark spaces at the corner of the mouth (Fig.4). Vanarsdall[3] has used the term "negative space" to refer to the shadows that occur in the corners of the mouth during smiling in some patients having a narrow, tapered maxilla and a mesofacial or brachyfacial skeletal pattern.

Figure4:Maxillary constriction can be evidenced by black spaces appearing at the corners of the mouth during smiling.

II. MODEL ANALYSIS

Intercanine width (mm)

The ICW is measured from tips of the right and left canines.In case where the canines are out of arch, measurements were taken from the center of the alveolar arch in the canine region.

Interpalatal molar width (mm)

The interpalatal molar distance(IPMW) is measured from where the palatal groove ends on the palatal aspect of the first right and left molars.

Sum of incisors (mm)

The mesiodistal widths of all the four upper incisors (SI) were calculated and summed up.

Pont's analysis[4]

If the inter premolar width ≤SI × 100/80,it is a deficient arch
If molar width ≤SI × 100/64, it is a deficient arch.

Banker's hypothesis[4]

If ratio between IPMW:ICW = 1:1 ± 0.5, it is a normal arch.

McNamara's criteria[5]

Maxillary arches with IPMW≤31 mm = deficient arches
Maxillary arches with IPMW≥36 mm = normal arches.

Howe analysis[6]

Howe et al.proposed a simple rule of thumb for arch width prediction by determining an average maxillary intermolar width of 37.4 mm for males and 36.2 mm for females.[2]

Korkhaus palatal height depth and crossbite[7]

Palatal height according to Korkhaus,is defined as a vertical line perpendicular to the mid palatal raphe which runs from the surface of the palate to the level of occlusal plane. This is measured between the reference points of Ponts index for the posterior arch width. Korkhaus (1939) evaluates palatal shape according to the index.

$$\text{Palatal Height index} = \frac{\text{Palatal Height} \times 100}{\text{Posterior arch width}}$$

The average index value is 42%. Greater values indicate that palatal vault relative to the transverse arch development is high, and decreased value indicates that the palate is shallow. A high palate is a principle feature of constricted maxillary alveolar base.

Using the Korkhaus three dimensional orthodontic divider, the palatal height can be measured, as well as posterior arch width.

PALATAL HEIGHT IN CASE OF BILATERAL CROSS BITE:

Bilateral cross bite with a high palate (palatal height index=51.3%). The palatal configuration is characteristic of bilateral narrowing of maxillary arch. Treatment can include expansion of upper dental arch.

Bilateral cross bite with shallow palatal arch (index=36.6%). Extensive expansion of the upper dental arch would be contraindicated.[7]

Andrews's WALA ridge

Andrews[8] suggested that the primary landmark for assessing mandibular arch width and shape is the WALA Ridge while evaluating the dental casts. The WALA is an acronym for Will Andrews and Larry Andrews, who defined the ridge as the most prominent portion of a mandible's mucogingival junction. Andrews[9] suggested that when an optimal mandibular arch is viewed from the occlusal perspective, the distance of FA point (center of facial axis of the crown) of the first molar to WALA Ridge should be 2 mm. In this position, the mandibular first molars are decompensated, and the arch width between the central fossae of the mandibular first molars is the optimal mandibular arch width. For the maxilla, the occlusal plane on the maxillary first molars should be parallel to the transverse plane of the head from the frontal perspective. In this position, the maxillary first molars are decompensated and the distance between the mesio-lingual cusp tips of the right and left maxillary first molars should be equal to the distance between the mandibular right and left central fossa[8].

PROFFIT AND WHITE ANALYSIS[10]

According to Proffit and White[10] the most common crossbite is with maxillary teeth lingual rather than buccal to the mandibular teeth, which can be caused either either by too wide mandibular arch or constricted maxillary arch. They have given standard arch widths.

MAXILLA(mm)			MANDIBLE	
Tooth	Male	Female	Male	Female
Canines	32	31	25	23
1st PM	37	35	33	31
2nd PM	41	40	38	36
1st Molar	47	45	43	42
2nd Molar	52	49	49	47

PM=premolar

According to profit White and Sarver,[10] mandibular molars are normally positioned lingual to the underlying bone of the mandible,seen as undercut area below the molar teeth. If the undercuts are absent or diminished, it suggests narrow mandible. Whereas extreme undercuts suggest either wide mandible or more likely narrowing of the dentition.

In a crossbite caused by narrow maxillary arch , the vault is narrow and the maxillary alveolar process tips outward and it suggests that crossbite is skeletal in origin. If the palatal vault is wide and the maxillary alveolar processes tip inward, the crossbite is dental rather than skeletal.

III. PA CEPHALOGRAM ANALYSIS

In 1999, Vanarsdall proposed the use of a Maxillomandibular Transverse Differential as a diagnostic tool for diagnosing transverse skeletal problems.[11] The method was based on the Ricketts et al's[12] norms of maxillary and mandibular growth measured from PA cephalograms(Figure 5).The maxillary skeletal width (J-J) and mandibular skeletal width (Ag-Ag) of patient are measured on a PA cephalogram and compared with the norms of Ricketts'et al. The maxillomandibular width difference(Ag-Ag and J-J) of the patient and difference of Ricketts' norms of the same age (Ag-Ag and J-J)were calculated and compared. Normally the difference should be within 5mm. If it is more than 5mm, a transverse skeletal problem exists.[12]

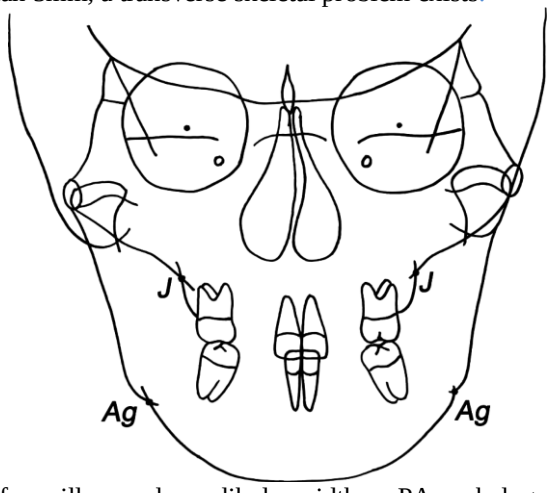

Figure 5: :Measurement of maxillary and mandibular width on PA cephalogram. J indicates jugale; Ag, antegonion.[12]

IV. CBCT EVALUATION

With the advent of cone beam computed tomography (CBCT),(Fig 6) the transverse dimension of Dentofacial structures can be visualized and measured. As a result, the widths of 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.

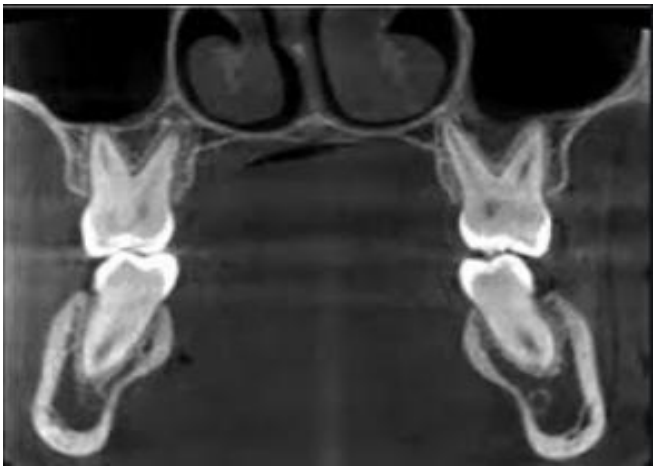

Figure 6

While examining CBCT on the transverse dimension, normally there should be proper skeletal widths of maxilla and mandible and a harmonious relationship. The roots of teeth are positioned in the center of alveolar bones, the maxillary molars slightly incline buccally and mandibular molars slightly incline lingually, Miner et al.[13] reported that in normal occlusion, at the mid-alveolar bone levels of lingual surfaces of the first maxillary and mandibular first molars, the maxillary width is about 1.2 ± 2.9mm less than mandibular width with a wide range. 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. The palatal width at the midroot level of maxilla is significantly less than that of mandible.

As a result a significant curve of Wilson takes place. The normal curve of Wilson allows for proper occlusal function however excessive curve of Wilson results in balancing interferences.[14]

For a wide maxilla without crossbite,the maxillary posterior teeth tend to compensate and incline lingually and mandibular posterior teeth tend to compensate and incline buccally. The palatal width at the mid-root level of maxilla is significantly wider than that of mandible. As a result reverse curve of Wilson appears.
The buccolingual inclination of posterior teeth and the root position in the alveolar bone can only be detected by 3D images.[15,16]

V. SUMMARY

The knowledge of transverse growth of maxilla and mandible is crucial in the diagnosis and treatment planning of transverse problems. It seems likely that clinical evaluation alone is inadequate for diagnosing transverse skeletal discrepancies. An objective assessment method would be more useful to clinicians. Arch width prediction indices and average measurements derived from dental casts are not clinically applicable to the general population, and do not take the skeletal component of transverse deficiencies into account. CBCT images appear to be more reliable than posteroanterior cephalograms (PACs), and offer an unobstructed view for the assessment of transversal intermaxillary discrepancies; though notably, further validation is required to confirm the diagnostic superiority of CBCT.[17]

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