Maxillary dental arch asymmetry in the mixed dentition

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Abstract

Many orthodontists evaluate dental asymmetry clinically by comparing landmarks on the occlusal surfaces of dental casts. The purpose of this study was to quantify and describe maxillary intra-arch asymmetry in 30 Iraqi children in the mixed dentition and to determine if a relationship exists between left and right side. The occlusal surfaces of casts were photographed and the measurements were carried out on photographs using a computer program. The median palatal plane (MPP) was used as a reference for transverse measurements and transverse palatal plane (TPP) was the reference for anteroposterior measurements. Asymmetry greater than 2.0 mm was present at any one landmark in 33.3 % of the sample. Transverse asymmetries exceeded anteroposterior asymmetries in magnitude and prevalence. Many children in the mixed dentition have intra-arch asymmetries that are more severe and prevalent in the transverse plane than in the anteroposterior plane. A high association (Pearson’s correlation) was present between the positions of anteroposterior and transverse maxillary intra-arch landmarks.

Key words: Asymmetry, Dental arch, Mixed dentition.

Introduction

Although each person shares with the rest of the population a great many characteristics there are enough differences to make each human being a unique individual. Variantious in the size, shape and relationship of the dental, skeletal and soft tissue facial structures are important in providing each individual with his or her own identity.(1)

Most studies of dentoalveolar asymmetry have used dental models and most often only the maxillary arch using the median raphe as an axis of symmetry, a number of studies reported some degree of dental arch symmetry even in persons with normal occlusion.(2,3)

Hechter (4)analyzed a symmetry of the dental arches in normal and malocclusion subjects and reported greater a symmetry in the mandibular arch for both groups. In addition he found an increase in symmetry in both arches when malocclusion was present. Adults with missing teeth tend to be more asymmetric than adults with intact dentitions (5) However, little is known about dental arch symmetries in children with mixed dentition. Early diagnosis and treatment of dental arch asymmetries could minimize the need for complex treatment mechanics or asymmetric extraction. Many factors, ( i.e ., congenital malformations , digital habits , interproximal caries , extractions ) can influence dental arch symmetry.(6,7)

Vig & Hewitt suggested that the dentoalvular region is more adaptive and shows a greater degree of symmetry than the remainder of the face probably because of the compensatory growth of the alveolus (8). Accordingly; the purpose of this study was to describe the degree and distribution of maxillary dental arch asymmetry in a sample of Iraqi children with relatively intact mixed dentition.

Material and methods

The sample consisted of 30 Iraqi children in the mixed dentition none of whom were seeking orthodontic care at the time records was taken. The Iraqi sample was chosen to minimize variability from racial differences. The sample included 18 females and 12 males with a mean age of 9 years 3 months (range, 7 years 2 months to 10 years 6 months).

Over a period of 2 months the parents of more than 60 children from primary school were contacted personally requesting the opportunity to examine their children and take dental records if the children met study
criteria. This sample represents the patients who met the inclusion criteria and for whom full records could be obtained.

The inclusion criteria required that subjects have all permanent first molars and central incisors and primary second molars erupted. The following exclusion criteria were chosen to minimize variables influencing asymmetry: history of orthodontic treatment or space maintenance, visually apparent interproximal caries, history of primary molar or canine extractions, history of dental trauma, restorations or fractures that included the incisal edges of the permanent central incisors, digit habits past the age of 3 years, ectopically erupting first molars, evidence of a syndrome or craniofacial malformation or obvious facial asymmetry.

Each child was seated on dental chair in upright position asked information about name, age, origin, history of previous orthodontic treatment, maxillofacial surgery, extensive restorative dental treatment. Then they were clinically examined to check their fulfillment of the required sample criteria and data recording case sheet was filled for every child. The upper impression was taken with a perforated metal orthodontic tray using alginate hydrocolloid impression material (Orthalgenat Duo, Dentaurum). Alginate impressions were poured in orthodontic stone with in 1 hour. Casts were trimmed with the back 90° to the median palatal raphe.

Mid incisal edges of the permanent central incisors and cusp tip of primary canines, primary second molars and permanent first molars were marked on the casts using a 0.5 mm lead pencil. (Table 1) defines the acronyms of each of the landmarks or reference planes from which measurements were taken in this study. These landmarks were chosen because they can be evaluated clinically for symmetry and identified easily on cast and they have been used in previous studies. Occlusal and buccal grooves were not used because of the presence of sealant in children of this age.

The occlusal surfaces of maxillary casts were photographed photography was standardized using a 35 mm telephoto lens set up at standard object film distance mounted on a Polaroid column and centering on casts placed on a flat elevated glass surface to diminish shadows. The distance between two reference dots placed on each cast was measured by using dental vernier and used to produce life size prints (1:1 photograph), the accuracy of the method has been previously confirmed by Begole.(9)

The median palatal plane (MPP) was drawn on photograph through two landmarks identified along the median palatal raphe, one landmarks was identified as the point on the median palatal raphe at the distal aspect of incisive papillae and the second at the posterior border of the raphe near the fovea centralis. A computer program(UNC) was used to construct maxillary transverse palatal plane (TPP) perpendicular to the median palatal plane. Eight maxillary transverse linear measurements were taken of lines constructed 90° from the MPP to the dental landmarks. Similarly, eight maxillary anteroposterior linear measurements were taken of lines constructed 90° from TPP to the dental landmarks.

The arithmetic mean for the sample was calculated by averaging the arithmetic differences (right measurement subtracted from left measurement) for all subjects. A negative arithmetic mean indicated the right side measurement was larger than the left, while a positive arithmetic mean indicated the left side measurement was larger than the right. The mean absolute difference for each landmark was calculated by averaging the absolute differences for all subjects. Absolute differences demonstrated the true magnitude of asymmetry where as arithmetic differences masked the magnitude of differences.

The frequency of differences that exceeded 2.0mm was calculated. The degree of asymmetry considered to be clinically important was arbitrarily set at 2.0mm. A one-tailed median sign test was used to determine whether the mean of the absolute differences was significantly different from the difference (2.0-mm) that was considered clinically important. Pearson’s correlation coefficient was calculated for each set of bilateral landmarks to determine if there was similar tendency for asymmetry between the left and right side of maxillary dental arch. Significance was accepted at P≤ 0.01.
Results

Small transverse and anteroposterior dental arch asymmetries were found in maxillary arch. Although the values were low, the left sides were larger for all transverse and anteroposterior measurement of maxillary arch (positive arithmetic mean) except the right sides were larger (negative arithmetic mean) for two measurement (U1-MPP, UC-TPP) (Table2 and Table3).

The mean absolute differences were slightly greater in the transverse dimension (1.35mm to 1.61mm) as compared with the anteroposterior dimension (0.7mm to 1.45mm). The only statistically significant difference (P < 0.01) occurred in the transverse dimension at the maxillary canine region. (Table 3). Transverse asymmetry greater than 2.0 mm was present at any one landmarks (Table2) in as many as 33.3 % (n=10) of subjects where as anteroposterior asymmetry was present in as many as 20 % (n=6) (Table3).

The prevalence of transverse and anteroposterior asymmetry increased in the posterior part of the maxillary arch. All bilateral maxillary intra-arch dental landmarks were significantly correlated (P ≤ 0.0001) in the transverse and anteroposterior dimensions (Table4). The strength of association between the position of the bilateral landmarks in the transverse and anteroposterior plane was higher in the posterior region region than the anterior.

Discussion

As many as 33.3% of the children in the mixed dentition had transverse maxillary asymmetries greater than 2.0 at any one landmark, although the mean differences were not large (Table 2). Fewer children (20%) had anteroposterior maxillary asymmetries greater than 2.0mm (Table3).

The small mean transverse and anteroposterior maxillary intra-arch asymmetries in Iraqi children in the mixed dentition (Table 2 and 3) corroborate previous investigations of subjects in the mixed dentition. (2,10,11,12,13) The significant transverse difference at the maxillary canines (Table 2) could be related to erupting incisors asymmetrically pushing primary canines buccally or to permanent canines erupting asymmetrically out of the line of the arch. The canine asymmetry could be a transitional problem that would be resolved as primary teeth exfoliate or long term problem of a buccally displaced permanent canine7

Similar to adults (3,5) the prevalence of anteroposterior asymmetry in the mixed dentition increases the more posterior the landmarks and this could contribute to asymmetric molar relationships. In this study the prevalence of transverse and anteroposterior asymmetry increases the more posterior the landmarks. The asymmetry in the anteroposterior dimension is not as severe or prevalent as in the transverse dimension in this population. This finding does not support the fining of the other studies (10,11) that report larger anteroposterior than transverse asymmetries. There may be age-related differences in dental arch asymmetry, because at least one longitudinal study of skeletal asymmetry found that mandible was longer on the left side at age 6 and on the right side at age 16.(14)

Sample differences also may account for some of these differences. Reports (3,8,15,16,17,18,19) of skeletal & dental arch asymmetry do not consistently favor the left versus the right side as larger. Although some landmarks in this study show one-sidness, the mean arithmetic differences are small and inconsistent and probably are not important clinically. The high degree of intra-arch association between the spatial positions of opposing dental landmarks in both the transverse and anteroposterior directions indicates that the dental arches had similar dimensions.

The lower transverse association between intra arch landmarks particularly in the anterior region may be related to the greater number of children with transverse asymmetry greater than 2.0mm or to skeletal relationships of the jaws. Many of these patients had class II molar relationships therefor guiding contacts in the anterior portion of the jaws would be minimal.(7) Vig &Hewilt suggested that dento alveolar structures compensate cephalometrically evident skeletal asymmetries in children showing no pronounced facial asymmetries, it is tempting to hypothesize that dento alveolar compensation is responsible for the
high degree of association between the distances of opposing landmarks to the reference planes in both the transverse and anteroposterior dimensions. (8)

Longitudinal studies are needed to determine the extent to which growth and development of the alveolus compensates for asymmetry of children’s dental arches. Many orthodontists evaluating dental arch asymmetry visually analyze the occlusal surfaces of dental casts. (11) Although there is some question as to whether the median palatal raphe is an ideal reference plane in all patients. 3 It’s the standard reference plane against which researchers make transverse comparisons of the position of bilateral landmarks. (2,3,10,12,19) The anteroposterior positions of bilateral dental landmarks are usually compared with a transverse palatal plane established 90° to the median palatal raphe. (12)

Researchers have measured casts either directly using a stereograph (2) or a ruled grid 12 or indirectly by digitizing life-size photographs of oriented casts. (10) There are problems with most of these methods particularly during the transfer of a median plane to the mandibular cast (ie ruled grid placed on the occlusal surfaces of aligned cast). Imprecise trimming of the backs of the casts so that they are not exactly 90° to the median palatal plane can contribute to error in bilateral anteroposterior measurements.

This study quantifies and describes maxillary dental arch asymmetry for Iraqi children in the mixed dentition who meet the inclusion criteria of this study and set the stage for future studies to determine the influence for various factors in dental arch asymmetry. Small amounts of transverse and anteroposterior maxillary asymmetries are common in Iraqi children in the mixed dentition. Statistically significant transverse asymmetry was present at the maxillary canine region. Asymmetries greater than 2.0 mm were more prevalent in the transverse plane than in the anteroposterior. The high degree of intra-arch association between the spatial positions of opposing dental landmarks in both the transverse and the anteroposterior direction indicates that the maxillary dental arches had similar dimension.

References
12. De Araujo TM, Wilhelm RS, Almeida MA. Skeletal and
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Fig (1) Maxillary intra-arch landmarks and reference planes.

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Table (1): Definitions of acronyms for maxillary cast landmarks or planes

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>UI(L/R)</td>
<td>Upper incisor mesioincisal line angle (left/right)</td>
</tr>
<tr>
<td>UC(L/R)</td>
<td>Upper canine cusp tip (left/right)</td>
</tr>
<tr>
<td>UEMB(L/R)</td>
<td>Upper second primary molar mesiobuccal cusp tip (left/right)</td>
</tr>
<tr>
<td>U6MB(L/R)</td>
<td>Upper first permanent molar mesiobuccal cusp tip (left/right)</td>
</tr>
<tr>
<td>MPP</td>
<td>Median palatal plane</td>
</tr>
<tr>
<td>TPP</td>
<td>Transpalatal plane</td>
</tr>
</tbody>
</table>

Table (2): Transverse maxillary-arch mean differences (mm) of children in the mixed dentition.

<table>
<thead>
<tr>
<th>Landmark measure</th>
<th>N</th>
<th>Arithmetic Mean±S.D.(mm)</th>
<th>Absolute Mean±S.D.(mm)</th>
<th>Asymmetry&gt;2mm percentage(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1-MPP</td>
<td>30</td>
<td>-0.65±1.46</td>
<td>1.42±0.73</td>
<td>23.3% 7</td>
</tr>
<tr>
<td>UC- MPP</td>
<td>30</td>
<td>0.84±1.73</td>
<td>1.35±0.63</td>
<td>20% 6</td>
</tr>
<tr>
<td>UEMB-MPP</td>
<td>30</td>
<td>1.15±0.98</td>
<td>1.4±20.94</td>
<td>26.6% 8</td>
</tr>
<tr>
<td>U6MB-MPP</td>
<td>30</td>
<td>1.24±1.92</td>
<td>1.61±0.88</td>
<td>33.3% 10</td>
</tr>
</tbody>
</table>

N =Sample number
Differences were calculated as right/ MPP from left/ MPP (P ≤ 0.01).
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Table (3): Anteroposterior maxillary arch mean differences (mm) of children in the mixed dentition.

<table>
<thead>
<tr>
<th>Landmark measure</th>
<th>N</th>
<th>Arithmetic Mean±S.D.(mm)</th>
<th>Absolute Mean±S.D.(mm)</th>
<th>Asymmetry&gt;2mm percentage(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1-TPP</td>
<td>30</td>
<td>0.09 ±63</td>
<td>0.7 ±56</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>UC- TPP</td>
<td>30</td>
<td>-0.32 ±1.10</td>
<td>1.15 ±65</td>
<td>6.6% (2)</td>
</tr>
<tr>
<td>UEMB-TPP</td>
<td>30</td>
<td>0.18 ±1.30</td>
<td>1.24 ±73</td>
<td>13.3% (4)</td>
</tr>
<tr>
<td>U6MB-TPP</td>
<td>30</td>
<td>0.21 ±79</td>
<td>1.45 ±92</td>
<td>20% (6)</td>
</tr>
</tbody>
</table>

N =Sample number
Differences were calculated as right/ TPP from left/TPP

Table (4): Correlation between maxillary dental landmarks of children in the mixed dentition.

<table>
<thead>
<tr>
<th>Landmarks</th>
<th>N</th>
<th>Anteroposterior</th>
<th>Transverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1-U1L</td>
<td>30</td>
<td>0.80*</td>
<td>0.66*</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0.86*</td>
<td>0.71*</td>
</tr>
<tr>
<td>UEMBR-UEMBL</td>
<td>30</td>
<td>0.88*</td>
<td>0.68*</td>
</tr>
<tr>
<td>U6MBR- U6MBL</td>
<td>30</td>
<td>0.91*</td>
<td>0.73*</td>
</tr>
</tbody>
</table>

N =Sample number
r =Pearson correlation coefficient P< 0.0001