Original article

Analysis of mandibular bone symmetry by tracing angular lines in children with unilateral crossbite

Published in Spanish Científica Dental Vol. 11. Nº 1. 2014.

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Indexed in:
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Received: 9 October 2013.
Accepted (or accepted for publication): 23 January 2014.

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Ilustre Colegio Oficial de Odontólogos y Estomatólogos de la Iª Región

ABSTRACT

Introduction: Patients with crossbite can develop skeletal asymmetry in the long term. Considering this premise, we wonder whether crossbite may lead to quantifiable bone changes in children. The main objective of this study is to determine whether the unilateral crossbite can produce quantifiable early bone alterations in the mandibular angle.

Methods: The panoramic radiographs of 217 children aged 6 to 9 years old, with unilateral crossbite and whose dentition stage was mixed first phase were used in the study. The gonial angles of the side of the crossbite and of the side with no crossbite were traced, measured and compared, using the tpsDig2 computer program and subsequently, a descriptive and comparative statistical analysis was performed.

Result: Patients with right unilateral crossbite presented a statistically significant larger mandibular angle on the left side. Patients with left unilateral crossbite also presented a greater left mandibular angle, although not reaching statistical significance.

Conclusions: There was no relation between the side of the crossbite and the mandibular bone size in the mandibular angle in children with mixed first phase dentition.

KEYWORDS

Asymmetry; Children; Orthopantomography; Posterior crossbite.

INTRODUCTION

The bone growth of the mandible is not only strongly influenced by genetic factors, but it can also be significantly affected by environmental factors such as: nutrition, masticatory function and systemic or localised disease, among others. For some authors, the neuronal excitation occurs during mastication and the developmental response takes place during rest periods[1].

Patients with crossbite present postural and functional alterations: decrease in biting strength, asymmetric muscular activity, articular problems, mandibular deviation towards the side of the crossbite during closing. In addition, if the malocclusion is present throughout the patient's growth, it facilitates the development of skeletal asymmetry[2]. The posterior unilateral crossbite is the most common type[3]; according to some authors it appears for the first time between 19 months and 5 years of age, with a prevalence in the general population between 5.9% and 9.4%[4]. Other authors report a prevalence between 8-22% in deciduous and mixed dentitions[5-7].

There are different opinions on how malocclusion affects mandibular growth and a possible skeletal asymmetry development[8-10]. For this reason and in the need of an early diagnosis and treatment1 we consider whether mandibular bone asymmetries can be observed in orthopantomographies of young children, given that previously published studies were performed in adults.

MATERIAL AND METHOD

Sample

The sample universe included 645 children attended in a radiological diagnostic centre located in Madrid. Previously, a questionnaire about general medical information was given and they all signed a document authorising the use of their records for research purposes, according to the Law of Data Protection.

Inclusion criteria were: patients with unilateral crossbite, in first phase of mixed dentition, without a history of corrective treatments of malocclusion and with photographic and radiographic records of enough quality. Exclusion criteria were: presence of orofacial pathology, dysmorphology as well as syndromes that could cause alterations in the development and/or growth, dental/periodontal alterations and wearers of fixed devices. After applying both criteria, the sample was reduced to 217 children, with a mean age of 7.5 years old (Table 1).

A radiological diagnostic protocol was established for the purpose of visualising the anatomic structures of interest and the mandibular angles were traced corresponding to the variables A1 and A2, which are always pairs, right and left (Figure 1).

- **A1** (R Tangents): angle that is formed by tracing a tangent that passes through the most prominent points of the right mandibular body and another tangent that passes through the most prominent points of the right mandibular branch.

Table 1. Distribution of the sample by age and gender

Age range	Boys	Girls	TOTALS
6-7	27	34	61
7-8	28	37	65
8-9	25	26	51
9-10	17	23	40
6-10	***97***	***120***	***217***

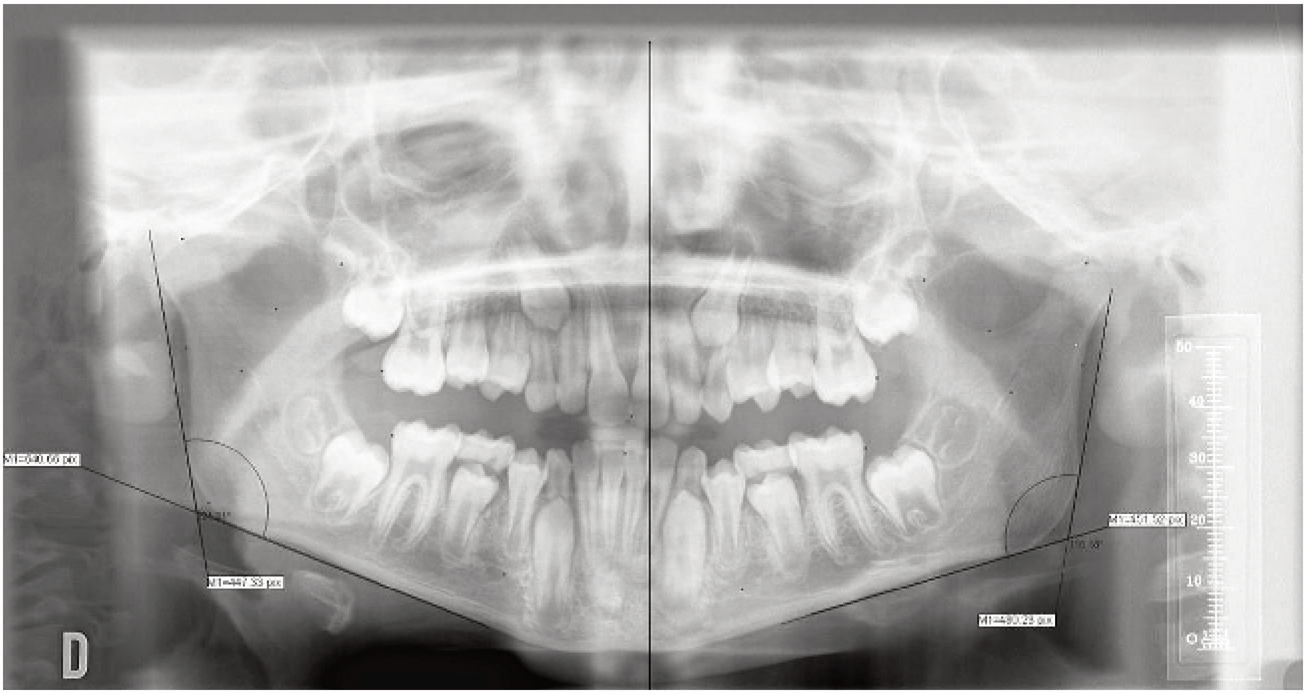

Figure 2. Mild occupancy in right sinus due to an apical process in 17 due to defective root canal treatment.

- **A2** (L Tangents): angle that is formed by tracing a tangent that passes through the most prominent points of the left mandibular body and another tangent that passes through the most prominent points of the left mandibular branch.

A 30" monitor and the tpsDig version-2 computer program were used. The principal researcher evaluated 20 radiographs per session and the measurements were made in degrees.

The program used for the statistical analysis was SPSS 17.0 for Windows. The mean and the standard deviation were calculated for each of the measurements and the Student t test was applied at 95% confidence ($p<0.05$). Twenty days after the last measuremet was taken, the principal researcher randomly selected a 20% of the total images in order to repeat the measurements. A paired t test was performed aiming to detect systematic errors.

RESULTS

In the sample with right crossbite, a greater angulation of the A2 variable corresponding to the left side was found, with respect to the variable A1 of the right side. The results showed that the difference between the right and left angular variables (A1 and A2) was statistically significant, with a p value of 0.000. Analyzing the variables in the entire sample and with the left crossbite, a higher magnitude of the A2 variable corresponding to the left side was found, with respect to A1 of the right side. In this case, the difference between the variables A1-A2 was not statistically significant, with a p value of 0.051 (Table 2).

By studying the angulations in patients with right unilateral crossbite and with an age range of 6-7 years, A2 on the left side was significantly higher than A1; the p value was 0.019. In the sample with left crossbite, A2 was also greater. In this case, the difference was not statistically significant, with a p value of .171 (Table 3).

Table 2. Descriptive and comparative analysis of the asymmetry of the angular measurements in the total sample with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

SAMPLE TOTAL

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	137	130.057 ± 6.5898	128.7220 ± 6.67894	-3.795	0.000
Unilateral Left Crossbite (ULC)	80	128.0325 ± 5.61362	128.842 ± 5.6491	-1.982	0.051

Table 3. Descriptive and comparative analysis of the asymmetry of the angular measurements in the age range of 6-7 years with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

AGE RANGE OF 6-7 YEARS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	39	132.611 ± 5.6981	131.0726 ± 5.25605	-2.441	0.019
Unilateral Left Crossbite (ULC)	22	127.3405 ± 5.56121	128.529 ± 5.3596	-1.417	0.171

By studying the angulations in patients aged 7-8 years with right crossbite, A2 was greater compared to A1. This difference was significant with a p value of 0.034. In the sample with left unilateral crossbite A2 was also greater, but not significantly, p equaling 0.295 (Table 4).

By studying the angulations in patients aged 8-9 years with right crossbite as well as in the sample with left unilateral crossbite, A2 was again greater than A1. In both cases the difference was not statistically significant, with p values of 0.661 and 0,536 respectively (Table 5).

By studying the angulations in patients aged 9-10 years with right crossbite, A2 was greater than A1. The difference between the angular variables was statistically significant, presenting a p value of 0.019 In the sample with left crossbite A2 was also greater but not significantly, p equaling 0.0502 (Table 6).

Regarding gender, when analyzing the angulations boys with right crossbite, again a greater A2 was found with respect to A1. This difference between the right and left angulation was statistically significant, with a p value of 0.07. When the crossbite was on the left, a greater A2 angulation also found, a dif-

Table 4. Descriptive and comparative analysis of the asymmetry of the angular measurements in the age range of 7-8 years with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

AGE RANGE OF 7-8 YEARS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	46	128.480 ± 6.8057	127.0061 ± 6.78056	-2.189	0.034
Unilateral Left Crossbite (ULC)	19	127.6100 ± 4.98086	128.633 ± 5.4337	-1.078	0.295

Table 5. Comparative analysis of the asymmetry of the angular measurements in the age 8-9 years with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

AGE RANGE OF 8-9 YEARS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	32	130.274 ± 5.6152	129.9863 ± 5.93163	-0.443	0.661
Unilateral Left Crossbite (ULC)	19	127.9075 ± 6.39546	129.933 ± 5.3267	-0.631	0.536

Table 6. Descriptive and comparative analysis of the asymmetry of the angular measurements in the age range of 9-10 years with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees.

AGE RANGE OF 9-10 YEARS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	20	128.355 ± 7.8875	126.0625 ± 8.31541	-2.569	0.019
Unilateral Left Crossbite (ULC)	20	127.9075 ± 6.39546	128.348 ± 6.6695	-0.684	0.0502

ference not statistically significant, since the p value was 0.891 (Table 7).

In the sample of girls with right crossbite as well as with unilateral left crossbite, a greater A2 angulation was found with respect A1. In both cases the difference was statistically significant, with p values of 0.012 and 0.014 respectively (Table 8).

DISCUSSION

There is scarce literature about the degree of asymmetry and quantifiable skeletal changes in the mandibular angle from orthopantomographs. Most of the studies analyze an adult population sample that does not always present a unilateral crossbite.

The first studies investigated the reproducibility of nine mandibular measurements, corresponding to linear dimensions and mandibular angles, as in our research. Radiographs were made on 60 mandibles of adult skulls and an acceptable reproduction of the vertical and angular variables were observed[11].

In 1987, Habets et al., using a model of an adult human mandible and by means of panoramic radiographs of nine different positions of the model, determined that the use of orthopantomography at the

Table 7. Descriptive and comparative analysis of the asymmetry of the angular measurements in the sample of boys with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

SAMPLE OF BOYS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	65	131.484 ± 6.7718	130.0892 ± 6.76752	-2.777	0.007
Unilateral Left Crossbite (ULC)	32	129.4063 ± 5.61334	129.500 ± 6.2043	-0.138	0.891

Table 8. Descriptive and comparative analysis of the asymmetry of the angular measurements in the sample of girls with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees.

SAMPLE OF GIRLS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	72	128.768 ± 6.1885	127.4878 ± 6.39585	-2.585	0.012
Unilateral Left Crossbite (ULC)	48	127.1167 ± 5.48121	128.403 ± 5.2687	-2.551	0.014

level of the branch and mandibular condyle, as they did in their method, can be useful for the diagnosis of condylar asymmetry. These same authors in subsequent studies observed that the group of patients that presented a higher degree of asymmetry were women with craniomandibular disorders[12,13].

The majority of studies try to show the reliability of the panoramic radiographs for the analysis of bone symmetry[11,12, 14-19].

In 2002, Tsai et al. studied the contours of mandibular branches, condyles, coronoid process and the mandibular body on panoramic radiographs of children without pathology in deciduous dentition, in the first phase of mixed dentition and in permanent dentition. They observed that angular measurements decreased with age20. In our study the angular measurements corresponding to the 6-7 age range are greater than those of the 9-10 age range, regardless of the side of the crossbite.

In the year 2005 Liukkonen et al. tried to evaluate the mandibular asymmetry by analysing panoramic radiographs of 182 healthy patients aged 7-16 years. In this study, unlike ours, they found statistically significant differences between the right and left side in relation to the height of the condyle and at the age of 7 years, and in the height of the branch at the age of 16 years. The healthy young patients generally had a mandibular asymmetry, which rarely was clinically singificant[21].

Afterwards, other published studies analyzed young patient samples with different types of crossbites and malocclusions, which also studied condylar and branch asymmetry, with the diagnosis of mandibular asymmetry at young ages being controversial with respect to the results[22-24].

Based on the scarcity of studies on the symmetry of the angle, it is difficult for us to be able to compare our results with those of other similar studies. In the total of the sample from our study and regardless of the side of the crossbite and of the age range, the mandibular angle was in all cases greater on the left side. When the sample was stratified according to gender and regardless of the side of the crossbite, the mandibular angle was also greater on the left side.

CONCLUSIONS

- In this sample, the increase of the angular variables, although not significant, was greater on the left side, regardless of the side of the crossbite.
- Gender does not seem to affect the asymmetry of the mandibular angle.

Also, age does not affect this result and the increase is significant in all age ranges except for children aged 8 years.

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