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Relationship between Intermolar Width and Tooth-Bone Discrepancy in Children: A Cross-Sectional Study

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ABSTRACT

Introduction: The tooth-bone discrepancy or dental crowding occurs in the early, mixed and permanent stage of the dentition and is considered a frequent characteristic in malocclusion. This condition generates other structural and functional alterations in the stomatognathic system that directly influence the shape and size of the dental arch.

Objective: This research aimed to determine the relationship between the intermolar width and the tooth-bone discrepancy of the upper arch in children.

Material and Methods: A convenience sample was constituted, made up of 57 plaster study models of children aged 6 to 10 years, who attended the orthodontic clinic of the Catholic University of Cuenca, from Cuenca, during the period from March to August 2018. The type of study was analytical, correlational, cross-sectional and retrospective, the collected data were analyzed by correlation coefficient and Pearson's R2.

Results: The correlation coefficient of the variables was -0.046128083 and $R^2 = 0.0021$, showing that there was a null correlation between the intermolar width and the tooth-bone discrepancy of the upper arch. However, Pearson's R2 value expressed a maximum linear precision of 3% between the study variables.

Conclusion: It is concluded that there is a null statistical relationship between the intermolar width and the bone-tooth discrepancy of the upper arch of the studied sample. A certain degree of continuity of the intermolar width was evidenced in values of 39-40 millimetres.

Keywords: Dental arch, Dentition mixed, Intermolar width, Malocclusion, Stomatognathic System, Tooth crowding

INTRODUCTION

The growth and development processes are part of the formation of each individual. Their rhythm varies and occurs in a particular way because the functions of the organism are conditioned by the degree of maturation according to the determined period of life.[1] In fetal life, the shape of the dental arches is defined. These over the years change their transversal, sagittal and vertical sizes.[2]Once the formation of the face is determined, the oral cavity is formed, made up of rigid (bones, teeth) and soft (muscles, tendons, ligaments and cartilage) structures.[3] Dental eruption is a physiological process that allows the balance of the teeth within their alveolar cortex with their antagonists and the surrounding muscles with a correct maxillary mandibular relationship.[4]

Inadequate dental positioning, known as malocclusion, is a tooth-bone discrepancy in the maxilla and mandible. Due to the irregularity of contact between the teeth of the maxilla and mandible, there are alterations in all planes of space such as open bites, crossbites, vertical overbites and horizontal underbites, among others, that generates inequality between the tooth and the dimension of the maxilla, resulting in a possible dental crowding of mild or minimum, medium or moderate, and maximum or severe type.[2]

Malocclusions are the third most prevalent oral health problem. In Latin America the trend is similar, showing high percentages exceeding the prevalence of 85% of the population.[2,5,6] The causes of malocclusion vary between genetic factors and harmful oral habits in children during their growth, such as finger sucking or thumb sucking, atypical

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swallowing and bottle feeding beyond the three years of age, among others; also due to inadequate eating habits during the eruption transitions of the teeth in the conformation of the dental arches.[7]

Primary crowding is considered as the discrepancy between the dimension of the maxilla, mandible and teeth, being influenced by genetic factors.[8-9] Secondary crowding is caused by environmental factors, such as the premature absence of deciduous teeth that cause migration of the adjacent teeth, causing a decrease in the space of the permanent teeth.[8-9] Tertiary crowding is characterized by occurring in the adolescent and post-adolescent stages, while maxillary and mandibular growth continues; as a consequence of the manifestations of dentoalveolar compensation and the modifications of the facial development that takes place between 15 and 20 years old.

The result of the negative discrepancy or lack of space in the dental arch is considered as dental crowding, therefore it is essential to analyze and relate the space required for a correct alignment of the teeth, and the space available in the maxilla for an accurate bone-dental analysis.[10] It is important to analyze the discrepancy between the dimension of the teeth and the length of the arch, since in mixed dentition dental crowding may occur because the permanent incisors are larger than the temporary ones, likewise for the canines and premolars.[11]

There are several analysis methods to determine the degree of dental crowding, in mixed dentition, based on measurements of the permanent teeth, among them the Tanaka - Johnston analysis in which a setback equation is evaluated, and the Moyers analysis.[12,13] The intermolar width is the dimension obtained from the mesiobuccal cusp of the first molar, covering both sides; if this dimension is outside the ranges established as normal, crowding can occur; and additionally, it could be worsened by skeletal and/or neuromuscular imbalances.[14]

The scientific literature reports studies on both the intermolar width and the dental arch width in children and adolescents. Louly et al.[15] found an increase in the intermolar width of the maxillary and mandibular first and second molars in children, although without statistically significant differences. Ross-Powell et al.[16] reported that the dimensions of the lower teeth were similar in African American boys and girls 3 to 10 years of age, but at the beginning of puberty, the difference in arch size was significantly higher in the male sex. An investigation in children aged 3 to 5 years in two regions of India found an average intermolar width for the maxilla and mandible of 40.0 ± 2.2 and 34.7 ± 1.7 respectively.[17] A study in Egyptian children reported that almost the entire width of the maxillary and mandibular arch of children in their sample was protruding.[18]

A definition of "standard measurement" for dental arches is difficult because, in addition to environmental factors, there is an ethnic diversity that can influence them; persisting the need for further research to establish associations between intermolar width, tooth-bone discrepancy, and tooth width, with arch perimeter in children, particularly for Latin American populations that may present different characteristics from those reported in patients from North America, Europe, Asia and Africa. Hence, it is novel to carry out this study since Ecuador is a multiethnic and multicultural country and data can be provided to establish a baseline that contributes to the formation of its profile that can be used in the diagnosis and treatment planning of Ecuadorian children.

MATERIALS AND METHODS

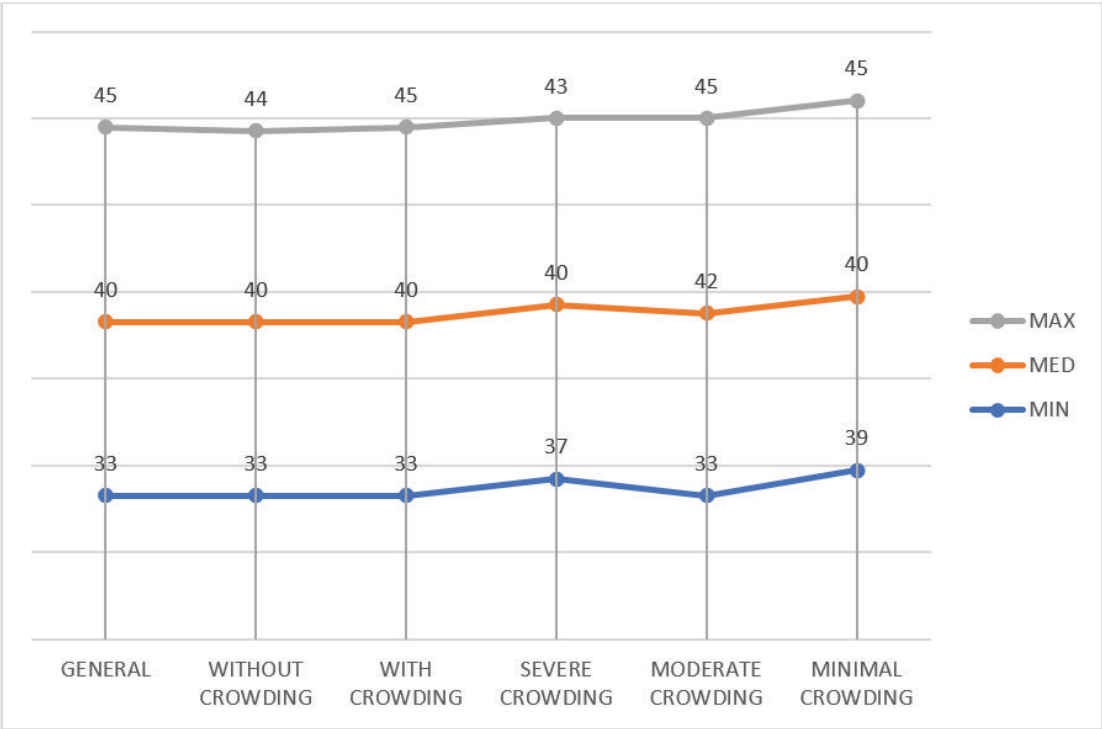
A quantitative, analytical, correlational, cross-sectional and retrospective research was carried out. A convenience sample was constituted, made up of 57 study models taken from children aged 6 to 10 years, who attended the Orthodontic Clinic of the Catholic University of Cuenca, during the period from March to August 2018

The examiners were trained in the analysis method of Tanaka and Johnst on and in the measurement of the intermolar width of the upper arch; subsequently, the analysis was applied to each study model and the measurement of the permanent superior intermolar width was taken with a vernier calliper.[12] The data were tabulated in Excel®. Pearson's correlation coefficient was applied to establish the relationship between the intermolar width and the tooth-bone discrepancy of the upper arch; in addition to performing the R2 test to identify the values of linear precision.

RESULTS

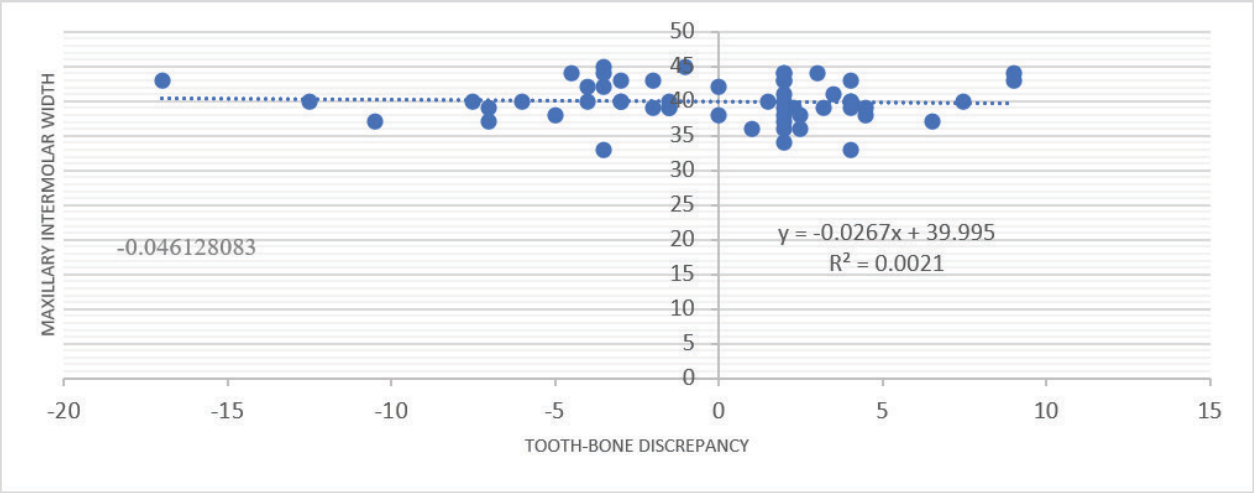
Dental crowding was found in 42% of the models; of these, 38% were minimal, 33% were moderate, and 29% were severe. The mean intermolar width was 40 mm with a maximum of 44 mm and a minimum of 33 mm; no significant difference was found in the variation of the maxillary intermolar width with the different types of crowds. SD (±) 2 (Fig. 1).

When evaluating the relationship between intermolar width and the maxillary tooth-bone discrepancy, a value of -0.046128083 and R^2 = 0.0021 was obtained, with no correlation between maxillary intermolar width and tooth-bone discrepancy (Fig. 2).In the group of the study models that reported a tooth-bone positive discrepancy, a value of 0.186326963 and R^2 = 0.0347 was found; showing a weak correlation between the intermolar width and the maxillary tooth-bone positive discrepancy (Fig. 3). In the group with tooth-bone negative discrepancy or crowding a value of 0.08854424 and R^2 = 0.0078 was obtained; showing the null correlation between intermolar width and maxillary tooth-bone negative discrepancy (Fig. 4).



Mean maxillary intermolar width according to the degree of crowding

Figure 1: Maxillary intermolar width in children treated at the Orthodontic Clinic, period March/August 2018 Catholic University of Cuenca, Cuenca.



Correlation between maxillary intermolar width and tooth-bone discrepancy

Figure 2: Correlation of intermolar width and tooth-maxillary bone discrepancy in study models of children treated at the Orthodontic Clinic.

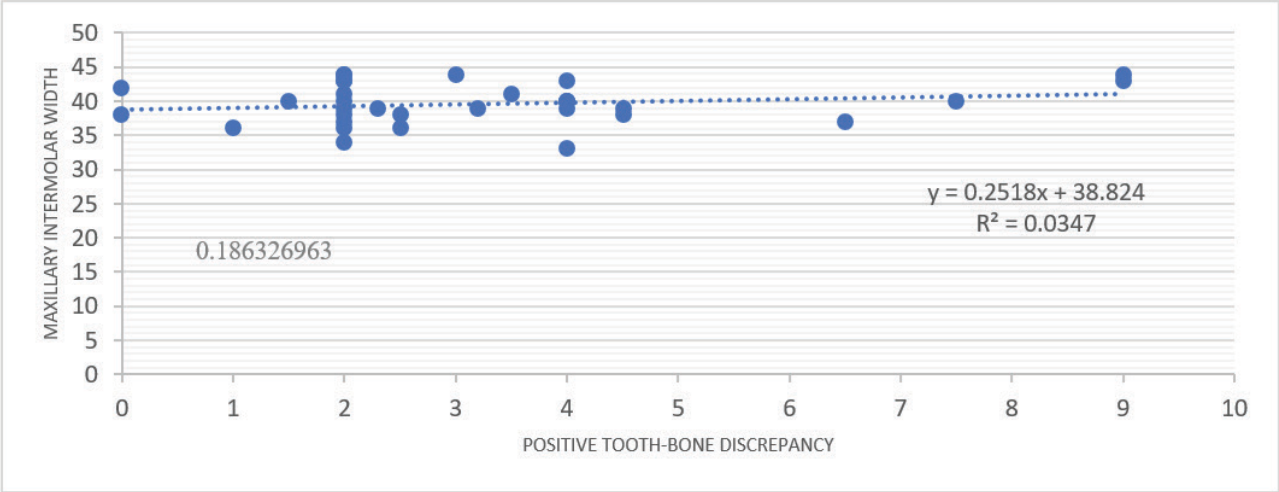


Figure 3: Correlation between intermolar width and maxillary tooth-bone positive discrepancy in study models of children treated at the Orthodontic Clinic.

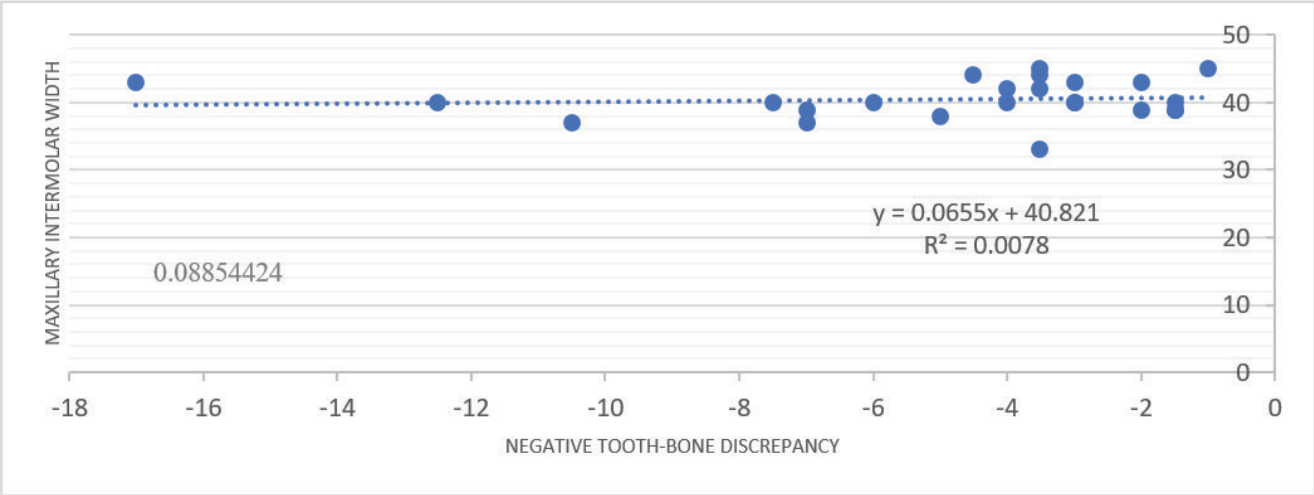
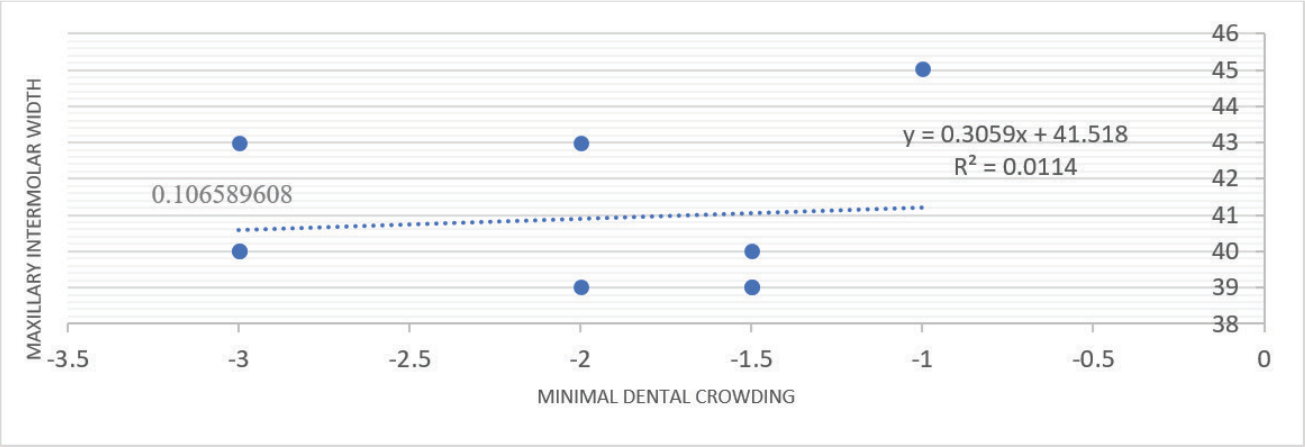


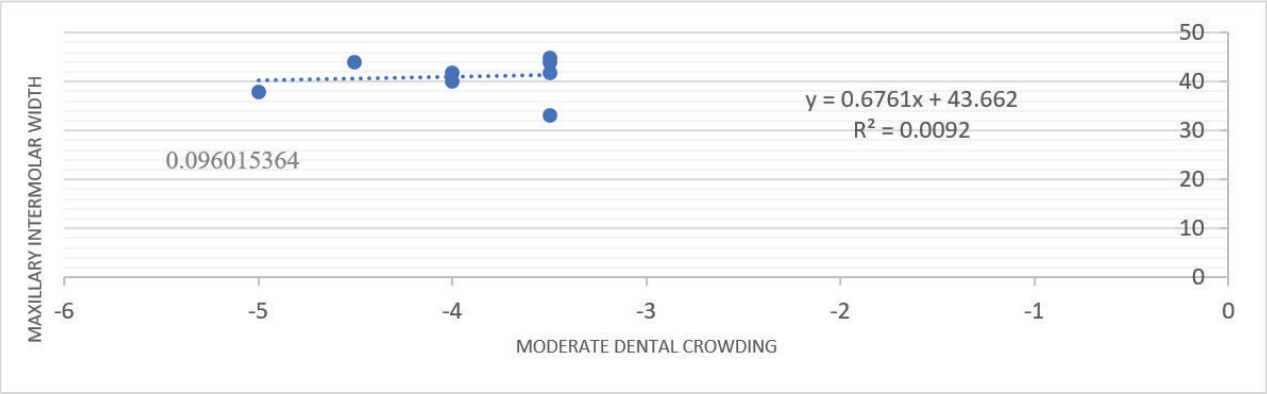
Figure 4: Correlation between intermolar width and maxillary tooth-bone negative discrepancy in study models of children treated at the Orthodontic Clinic.

The minimal dental crowding showed a value of 0.106589608 and $R^2 = 0.3707$; showing weak correlation between intermolar width and the minimal maxillary tooth-bone negative discrepancy. (Fig. 5). The moderate maxillary tooth-bone negative discrepancy presented a value of 0.096015364 and $R^2 = 0.0092$; showing no correlation between maxillary intermolar width and moderate dental crowding (Fig. 6). In the maxillary tooth-bone negative discrepancy, a value of -0.608880139 and $R^2 = 0.3707$ was obtained; showing a negative correlation between maxillary intermolar width and severe dental crowding (Fig. 7), and showing a moderate negative correlation between maxillary intermolar width and severe dental crowding. (Fig. 8)



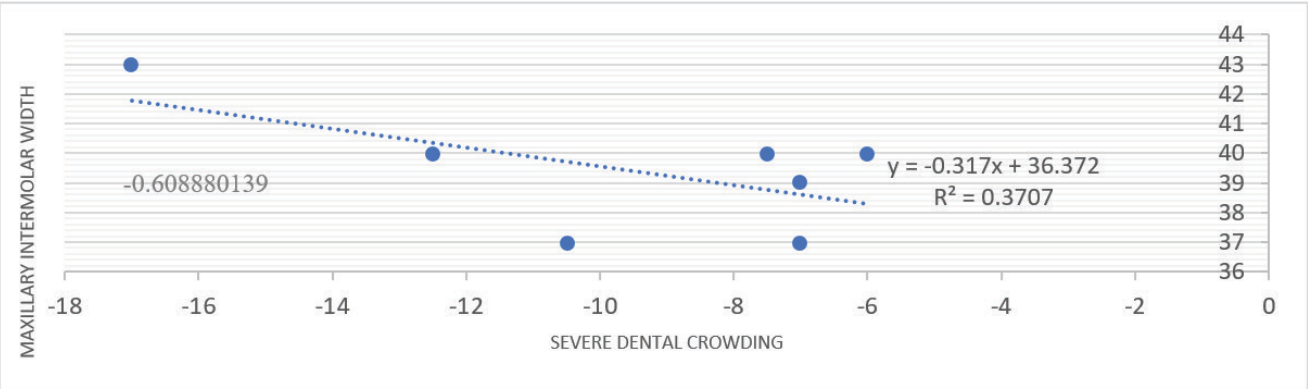
Correlation between maxillary intermolar width and minimal dental crowding.

Figure 5: Correlation between maxillary intermolar width and minimal dental crowding in study models of children treated at the Orthodontic Clinic.



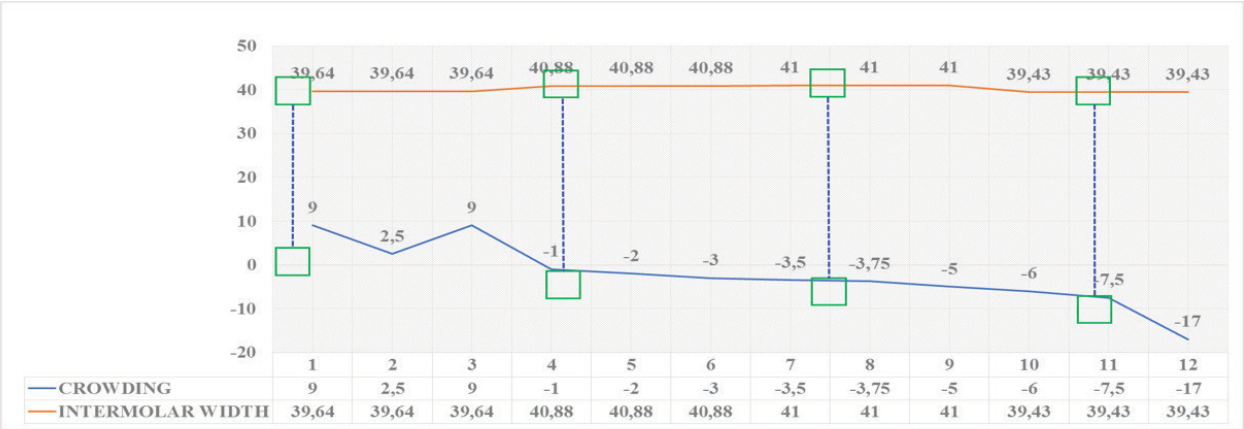
Correlation between maxillary intermolar width and minimal dental crowding.

Figure 6: Correlation between maxillary intermolar width and moderate dental crowding in study models of children treated at the Orthodontic Clinic.



Correlation between maxillary intermolar width and severe dental crowding.

Figure 7: Correlation between maxillary intermolar width and severe dental crowding in study models of children treated at the Orthodontic Clinic.



Descriptive data between maxillary intermolar width and dental crowding

Figure 8: Descriptive data between maxillary intermolar width and dental crowding in study models of children treated at the Orthodontic Clinic.

DISCUSSION

Negative tooth-bone discrepancy or dental crowding was found in 42% of the child population in the sample; of this percentage, 38% had a minimum crowding, 33% had a moderate crowding and 29% had a severe crowding. These results differ from the Burgos study[5] carried out in Chilean children and adolescents, in which 96.2% of the sample had some type of malocclusion, with a negative dentomaxillary discrepancy being observed more frequently in 67.4% of the cases.

The mean maxillary intermolar width in this study was 40 mm with a maximum of 44 mm and a minimum of 33 mm; in turn, it was observed that there was no significant difference in the variation of maxillary intermolar widths with the different types of crowding, maintaining a standard deviation of (±) 2 mm. These findings coincide with Renteria who found an average maxillary intermolar width of 39.20 mm and 38.60 mm.[19]

The analysis of the relationship of the variables: intermolar width and maxillary tooth-bone discrepancy reported a correlation of -0.046128083 and $R^2 = 0.0021$, showing a null correlation between these variables, these results concur with Vidal, who, studying a similar sample, reported that the measurements of the transversal dimensions of their study had no significant relationship with the tooth-bone discrepancy.[20]

The descriptive measurements of the two variables, when organizing and confronting them, showed that the maxillary intermolar width was little or not at all modifiable even when there is sufficient space in the maxillary dental arch or if space is lacking, as was the case of one of the study models that presented a lack of 17 mm for the correct alignment of the permanent teeth in the dental arch (Fig. 8). The minimal, moderate and severe crowding presented a minimal, null or very weak correlation concerning the maxillary intermolar width, which is why a concordance with the general data of the maxillary intermolar width and the tooth-bone discrepancy was achieved. No studies were found about these relationships with whom to contrast.

CONCLUSION

The present study showed that there is no statistically significant relationship between maxillary intermolar width and tooth-bone discrepancy or maxillary dental crowding, even if it were minimal, moderate or severe. In addition, the intermolar width, which is one of the key pieces for orofacial development during childhood and adolescence, maintained a certain degree of transverse continuity of approximately 39 to 40 mm. It is suggested to continue researching with longitudinal designs that allow knowing the evolution, sequence, stability, frequency and chronology of the intermolar width and the bone-tooth discrepancies of the maxilla in larger samples.

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Conflict of Interest: There is no conflict of interest among the authors.

Authors Contribution:

Ronald Ramos-Montiel: Conception and design of the study, data collection, data analysis, discussion of the results, writing the manuscript, approval of the final version of the manuscript.

Lorenzo Puebla-Ramos: Conception and design of the study, data analysis, discussion of the results and approval of the final version of the manuscript.

Ribadeneira-Morales Leslee: Discussion of the results, writing the manuscript and approval of the final version of the manuscript.

Guerra-MendozaYolanda: del Carmen: Discussion of the results and approval of the final version of the manuscript.

Sáenz-LópezNicol:Data acquisition.

Ethics Committee Approval: The study was carried out after the approval of institutional ethics committee.

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