

## Original Article

# Maxillary Arch Dimension Changes of 3-5 Years Old Filipino Children

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## Abstract

**Background:** The purpose of this study was to assess the dental arch dimensions in primary dentition of 3-5 years old Filipino children and determining the existence of sexual dimorphism.

**Materials and Methods:** In this descriptive study, 60 Filipino preschool children aged 3-5 years old were selected from Manila city. Study casts were used for measurements of 3 arch dimensions: bicanine width, bimolar width, and arch length. The analyses were performed to compare values within age-groups and within gender-groups, besides reporting mean and standard deviations. The data were subjected to One-way ANOVA and Student t-test.

**Results:** Significant differences were observed regarding dental arch dimensions among different ages and genders ( $p < 0.05$ ). Comparison between genders showed a statistically significant difference in bicanine width at the age of 4 ( $p = 0.04$ ), in bimolar width at age of 5 ( $p = 0.006$ ), and in arch length at age of 4 ( $p = 0.03$ ) and 5 ( $p = 0.02$ ). Differences within male group for different ages showed only arch length dimension was statistically significant ( $p = 0.021$ ). In females, however the comparison between age-groups also revealed a statistically significant difference in bicanine ( $p = 0.016$ ) and bimolar widths ( $p = 0.027$ ) dimensions.

**Conclusion:** The present study showed that dental arch dimensions, vary among different ages and genders of children. It also showed that a sexual dimorphism does exist between the gender groups.

**Keywords:** Primary Dentition, Maxillary Arch, Dental Arch Dimensions, Arch Length, Arch Width

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## Introduction

Dimensional increase of mandibular and maxillary dental arches is associated with the skeletal changes. Changes in arch width involve increase in the anterior and posterior dimension; a skeletal phenomenon<sup>1</sup>. There is a clinically significant difference between arch width changes in the maxilla and mandible. This is in correlation with the vertical growth of the alveolar process, of which direction is different in the upper and lower arches. Specifically, maxillary alveolar process diverges as the permanent

teeth erupt; whereas the growth direction of the mandibular alveolar process is parallel<sup>2</sup>. Generally, the maxillary arch width increases much greater than mandibular arch and can be more easily altered with treatment<sup>3</sup>.

The dental arch dimensions are determinant factors for: alignment of teeth, stability of the arch form, alleviation of arch crowding, attainment of a functional occlusion, balanced facial profile, and normal overjet and overbite<sup>4</sup>. Knowledge of arch dimension pattern is useful for: prevention of transient malocclusion, predicting future orthodontic problems,

normal occlusal changes in mixed dentition, and proper sequential exchange of permanent teeth<sup>4</sup>. Loss of arch space causes arch perimeter collapse and consequently may lead to: ectopic eruption, tooth impaction, and delayed eruption of permanent tooth<sup>4,5</sup>.

Scientific data pertinent to the above topic reveals a significant variation in arch dimensions among different ethnic groups<sup>3,5-10</sup>. Though such studies have been carried out in many different parts of the world, no such data is available regarding the Filipino children. The present study was carried out to evaluate the gender dimorphism and to compare the dental arch dimensions between children aged 3-5 years residing in Manila, Philippines.

## Methods

The present cross-sectional study included 60 children aged 3-5 years (30 males and 30 females) in Manila city. Samples of the study comprised of: twenty subjects of 3 years old (G1), 20 of 4 years old (G2), and 20 subjects of 5 years old (G3). Participants were selected randomly from different areas of Manila city.

The criteria for case selection included:

1. Children with complete primary dentition.
2. No interproximal loss of tooth structure as a result of caries, fracture, or excessive wear.
3. Flush terminal plane occlusion.
4. No interproximal restoration.
5. No erupted permanent teeth.
6. No congenital defects.
7. No tooth malformation.

Children descents' information was obtained back to 3 generations in order to assure the purity of the race in all participants. Due to irrelevancy, skeletal relationships of the children were not studied in the investigation. Following information was obtained and recorded from parents: child's name, age, birth date, address, phone number (for necessary contact). Kindergarten kids were randomly selected from the list of Kindergartens in Manila city.

At first, children's teeth and oral cavity were examined and the inclusion criteria were considered for the participants. Using dental explorer and plastic mirror, children's teeth were assessed for: absence of inter-dental caries, occlusion classification, tooth

malformations, tooth rotation, or impaction. Parents filled specific consent form for taking an impression. Following that, the upper jaw alginate impression was prepared for all eligible participants. Impressions were poured with stone immediately. The dental casts obtained were used for measuring various dental arch dimensions.

The measurements were made using a digital sliding caliper (MTC Tools; Model# 550-115, China) in 3 dimensions, with the precision of 0.01mm. Primary intercanine width was calculated between cusp tips of canines. The primary intermolar width was measured between the central fossa of occlusal surfaces right and left primary second molars. To calculate the arch length, the average value of the distance between two sheets tangential to the labial surface of the incisors and the distal surface of the deciduous second molars on the right and left side were recorded for analysis.

The mean and standard deviations of the measurements for all ages were recorded in the above dimensions for both genders, separately. The data were subjected to One-way ANOVA analysis and Student t-test for statistical evaluations.

## Results

The mean and standard deviation of maxillary dental arch dimensions of Filipino children are presented in the following four tables, regarding participants' age, gender, and the comparison within each age and gender group.

According to results of this study, the mean "bicanine width" for male children of 3, 4 and 5 years was 29.99±1.6 mm, 30.07±1.11 mm, and 30.74±0.8 mm, respectively. Concerning "bimolar width", the data for children of 3, 4, and 5 years, indicated 39.6±1.8 mm, 40.44±2.1 mm, and 41.5±1.3 mm distance, orderly. The measurement of "arch length" for these children was 28.29±1.3 mm, 28.63±0.1 mm and 29.68±0.9 mm, accordingly (Table 1).

For female children, the variable of "bicanine width" for 3, 4, and 5 of year's age was 29.69±1.4 mm, 31.15±1.1 mm, and 29.84±1.2 mm, accordingly. The "bimolar width" value for those children was 39.06±0.9 mm, 40.9±1.6 mm, and 39.47±1.6 mm, orderly. The "arch length" dimension for this group of children was also 29.45±1.5 mm, 29.97±1.5 mm, 28.25±1.5 mm, respectively (Table 2).

**Table 1:** The measurements of dental arch dimensions (bicanine width, bimolar width, and arch length) in age 3 (M3), age 4 (M4), and age 5 (M5) years of male children. There is a stable increase in all arch dimensions in older ages in this gender group.

Variables	M3	M4	M5
Bicanine	29.99±1.64	30.07±1.11	30.74±0.80
Bimolar	39.60±1.83	40.44±2.12	41.50±1.35
Arch Length	28.29±1.27	28.63±0.99	29.68±0.94

**Table 2:** The measurements of dental arch dimensions (bicanine width, bimolar width, and arch length) in age 3 (F3), age 4 (F4), and age 5 (F5) years of female children. The values in all arch dimensions advance from age 3 to 4 but decrease to age 5 in this gender group.

Variables	F3	F4	F5
Bicanine	29.69±1.39	31.15±1.09	29.84±1.23
Bimolar	39.05±0.89	49.90±1.58	39.47±1.57
Arch Length	29.45±1.52	29.97±1.55	28.25±1.53

**Table 3:** The statistical comparisons of dental arch variables within each age group for gender differences.

Variables	3 yrs	4 yrs	5 yrs
<b>Gender</b>	<b>Male vs Female</b>		
Bicanine	0.67 (NS)	0.04 (Sig)	0.07 (NS)
Bimolar	0.40 (NS)	0.59 (NS)	0.006 (Sig)
Arch Length	0.08 (NS)	0.03 (Sig)	0.02 (Sig)

**Table 4:** The statistical comparisons of variables for gender differences within each age group.

Variables	Male	Female
<b>Age</b>	<b>3 vs 4 vs 5</b>	
Bicanine	0.344 (NS)	0.016 (Sig)
Bimolar	0.078 (NS)	0.027 (Sig)
Arch Length	0.021 (Sig)	0.053 (NS)

The other statistical evaluation was regarding to different arch dimensions based upon gender differences (Table 3). Comparison of “bicanine width” between males and females showed that this dimension was not statistically significant at 3 ( $p=0.67$ ) and 5 ( $p=0.07$ ) years old. However, the difference of this dimension was statistically significant in 4 years old children between two genders ( $p=0.04$ ).

The “intermolar width” in 3 years old boys was higher than of girls, but insignificant ( $p=0.40$ ). In reverse, males showed slightly was less “intermolar width” than female children of 4 years old, although the difference was not statistically significant, but

this difference statistically was significant in 5 years children ( $p=0.006$ ).

The “arch length” dimension was higher in three years old girls than of boys. However, this difference was

was higher in four years old girls than boys and it was statistically significant ( $p=0.03$ ). For the age group of 5 years, evidence showed higher value for boys than girls. This additional value was also statistically significant ( $p=0.02$ ).

Finally, each dental arch dimension was evaluated based upon each gender within three age groups (Table 4). According to this statistical evaluation, there was a significant level of difference in “bicanine width” dimension within different age groups of female children ( $p=0.01$ ). Nevertheless, this dimension was not statistically significant within different age groups of male children ( $p=0.34$ ).

Concerning the “bimolar width” dimension of the maxillary dental arch of children in female group, there was a statistically significant difference within 3 age groups ( $p=0.02$ ). In contrast, in male groups this dimension was not statistically significant within its 3 age groups ( $p=0.07$ ).

Finally, the “arch length” value in male group was statistically significant within its age groups ( $p=0.02$ ). However, in female group there was no statistically significant difference value within different age group ( $p=0.05$ ).

## Discussion

The present study showed that all maxillary dental arch dimensions in males increases from 3 to 5 years old, steadily. Nevertheless, this increase was only significant in “arch length” dimension ( $p=0.02$ ). The changes in “bicanine width” ( $p=0.07$ ) and “bimolar width” ( $p=0.03$ ) were not statistically significant.

In addition, this study revealed a gradual increase in maxillary dental arch dimension in females from 3 years old to 4, while it was reversed slightly from 4 to 5 years old. This change was statistically significant in “bicanine width” ( $p=0.01$ ) and “bimolar width” dimensions ( $p=0.02$ ). This change was not significant in “arch length” dimension ( $p=0.05$ ).

Warren et al<sup>6</sup> also reported very similar rate of increase in the mean anterior dental arch width (between two canines) for the same age group of study

(3 to 5 years old). It should be noted that Warren and his colleagues based their measurements on the tips of mesial cusps while we used central fossa for this calculations. Nonetheless, this would not change the result of neither study, if the method of measurements were vice versa.

The other concern of this study was to compare dental arch dimensions based upon gender differences. The only significant difference between genders was observed in "bicanine width" dimension of the 4-years age group ( $p=0.04$ ). There was only a significant difference in the age group of 5 in the "bimolar width" dimension ( $p=0.006$ ). "Arch length" dimension was greater in females than males except between children of 5 years old. As the results, and the difference was statistically significant in 4 ( $p=0.03$ ) and 5 ( $p=0.02$ ) years old. In the present investigation, all variables indicated a statistically significant gender dimorphism. This is in contrast with the findings of Ferrario et al.<sup>7</sup> who suggested that changes of arch dimensions is not influenced by gender in their adolescent samples.

Dental arch width and its changes are correlated with the amount of spacing or crowding. Although not significant, generally, this study reported a higher intercanine width for males than females. This was similar to the findings of study conducted by Alhajja and colleague<sup>8</sup> on Jordanian preschool children. An investigation in 2001 showed that the deciduous dental arch width remains stable without any changes during primary dentition<sup>9</sup>.

Primate space physiologically develops during canine eruption in the maxillary and mandibular dental arches. According to Yuen et al.<sup>10</sup> results, in cases with a generalized spacing, the width of dental arch was more than dental arches without spacing. In this study, however, presence of the primate space was an inclusion criterion for sample selection.

Concerning the gender differences, the results of this study were similar to the findings of Sanin et al.<sup>11</sup> on Caucasian children of Oregon. In other studies conducted by Cohen<sup>12</sup> and Hopp<sup>13</sup> also concluded with similar results.

Knott<sup>14</sup> in his longitudinal study quantified changes in intercanine widths between the primary (mean age 5.4 years) and mixed dentition (mean age 9.4 years), in both male and female subjects. In the mandibular

arch, the mean change between the deciduous and the mixed was 2.9 mm and the corresponding mean change in the maxillary arch was 2.8 mm. He also observed individual variation in the total amount of intercanine width change between the deciduous and the permanent dentition (3.2 mm), but it ranged between 0 to 6.0 mm.

In addition, another longitudinal study was performed by Sillman<sup>15</sup> which consisted of a mixed sample of cases from birth to 25 years. He observed an increase of 5.0 mm in intercanine width dimension of maxilla and 3.5 mm in the mandible from birth to 2 years of age. Later, the intercanine width continued to increase until 13 years of age in the maxilla and until 12 years of age in the mandible. After which, the bicanine width remained stable. Moyers et al.<sup>16</sup> also found an increase in difference between the maxillary and mandibular intercanine widths from 4.0 mm in 4 to 7.5 mm in 17 years old.

Moorrees<sup>17</sup> stated that arch width does not change during the deciduous dentition (4-6 years) but increases markedly during the eruption of the maxillary and mandibular incisors by 3.0 mm and then stabilizes.

Although the dental arch widths undergo changes from birth to mid-adulthood, the magnitude as well as the direction of these changes does not provide a scientific basis for expanding the arches in the average patients beyond its established dimension at the time of complete eruption of the canines and molars. Both patients and clinicians should be aware of this limitations<sup>18</sup>.

## Conclusion

The present study provides an insight into the state of dental arch dimensions in the primary dentition of Filipino children. It showed that a sexual dimorphism does exist between the two gender groups. During primary dentition, dental arch dimensions of girls increase more than boys, considerably. Nonetheless, this difference may not be statistically significant in all dimensions.

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