

Maxillary Inter-canine Width at Three Stages of Dentition– A Cross-Sectional Study

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Abstract

Objective: To determine the palatal intercanine width from deciduous dentition to permanent dentition in 5 years to 16 years old children.

Materials and Methods: the study sample comprised of 168 children who fulfilled the inclusion and exclusion criteria were examined. Study models were constructed and maxillary intercanine width was measured using Vernier digital caliper.

Results: Statistically significant difference was found in upper intercanine width (UICW) between males and females in primary dentition ($p < 0.034$). Statistically non-significant difference was found in upper intercanine width (UICW) in mixed and permanent dentition. Data were analysed using SPSS 22 (SPSS Inc., Chicago, IL, USA). One-way ANOVA followed by Tukey's post hoc test and t- test were applied to verify the existence of significant differences between the groups.

Conclusion: The present study found that there is significant increase in intercanine width in upper dental arch from primary dentition to permanent dentition.

Keywords: Intercanine width, arch, maxillary, dimensions

Introduction

The human craniofacial complex and associated dental arches undergo visible alterations as they grow and adapt¹ from childhood to early permanent dentition. Morphological variations in the dental arch measurements in primary dentition, mixed dentition and permanent dentition are of great concern to a dentist as they encounter clinical problems associated with developing dentition like tooth anomalies, caries and malocclusion.

Individual occlusal variables are not functionally or anatomically independent. Their interdependence means that sets of occlusal features could have different pattern of inheritance or response to environmental influences than individual attributes². These morphogenetic characteristics expressed differently in different ethnic people. The size and shape of dental arches presents

with different variability within and among different population groups ranging from short and wide to long and narrow.

Thus; Understanding the peculiar features of the developing dentition and changes in dental arches that will take place from primary dentition to permanent dentition for a particular population is important for the Paediatric dentists who are involved in the guidance of eruption, preventive procedures and planning early orthodontic interventions before the peak of growth.

Although various studies have been done on the malocclusion status of the children of Himachal Pradesh, but there are no reported studies showing changes in upper intercanine width (UICW) from primary to permanent dentition. This investigation evaluated the changes in intercanine width cross-sectionally from primary dentition to permanent dentition in 5 years to 16

years old children of Shimla, a district in northern hilly state of India.

Material and Methods

This cross-sectional study was conducted in the Department of Pediatric and Preventive Dentistry, Himachal Pradesh Government Dental College and Hospital, Shimla (Himachal Pradesh) between 1st April 2019 to 30th June 2019. The study has been approved by the institutional ethical committee. A total of 823 school going children between the age of 5 years to 16 years were examined and the dentition stage was clinically determined for each subject by a trained examiner. Informed consent was taken from each subject and head of the corresponding school after explaining the purpose, methodology involved, the related risks and benefits. A sample of 150 (each dentition stage consisted 50 children) was estimated based on the study done by Younes et al³. Stratified random sampling was done and students were selected from 10 kindergarten, 10 elementary and 10 middle schools which were evenly distributed in the four regions of the district⁴ and the patients attending the outpatient department of Pediatric and Preventive Dentistry, as per the defined inclusion and exclusion criteria. Demographic information was taken regarding age and gender. Subjects with their parents and grandparents belonging to Shimla were selected to participate in the study, with an average age of 5.3 year in primary dentition, 9.64 year in mixed dentition and 14.28 years in permanent dentition (Table 1). They were diagnosed as having canines bilaterally in normal occlusion (Normal occlusion was considered as dental and skeletal class 1 occlusion with a satisfactory clinical occlusion^{5,6}) with no history of orthodontic treatment⁶. Individuals with teeth having proximal caries, proximal wear, proximal restoration or fracture as determined by clinical examination, facial asymmetry, oral habits, maxillofacial and dental fracture, palatal clefts, dental anomalies were excluded from the study. A perforated maxillary impression tray was tried for size and selected prior to every impression. A polysiloxane (condensation-type) putty impression was taken by using standard procedures for material mixing as recommended by

manufacturer. After taking the impression, it was rinsed in running water and was disinfected with 2% glutaraldehyde solution (by immersing it for 10 or 20 minutes as all the surfaces of impression and tray were covered with the disinfectant solutions⁷. Then these impressions were poured with dental stone on the same day i.e. within 24 hrs of impression making.

The casts were classified into three groups according to dentition stages as: Group I: Primary dentition stage, Group II: Mixed dentition stage and Group III: Permanent dentition stage.

The measurements were done using Vernier digital caliper with accuracy 0.01 mm for canine area. Inter canine width was measured as the distance between the crown tips of the canines (transverse width in between deciduous canines in primary and mixed dentition and transverse width in permanent canines in permanent dentition)⁶.

Measurement Reliability: Measurements were obtained for each parameter with a Vernier caliper accurate to 0.01mm. A second measurement were performed randomly on 30% of the total sample casts one week after the first measurements. Intra-observer reliability was determined using intra-class correlation coefficient test (ICC). Intra-observer reliability was considered excellent with ICC value of 0.998.

Statistical Analysis: Data were analysed using SPSS 22 (SPSS Inc., Chicago, IL, USA). One-way ANOVA followed by Tukey's post hoc test and t-test were applied to verify the existence of significant differences in "Primary Dentition (Group I), Mixed Dentition (Group II), and Permanent Dentition (Group III)," variables among dentition stages respectively. The level of significance was set at $p < 0.05$.

For the purpose of this study, it was concluded that this level of accuracy was appropriate.

Results

A total of 823 subjects were examined in different schools for the study in the age group of 5-16years.

Among these examined subjects, 168 impressions were poured. The casts which were fractured and had bubbles on the canine tips were excluded. Finally; the study included a total of 150 casts which were divided into three groups equally i.e. Group I, Group II and Group III. The mean age at different stages of dentition were calculated. Measurements of the arch dimension like inter-canine width, was measured on the cast using Vernier caliper.

Table 2 shows the mean (\pm SD) of Intercanine width using digital caliper in Group I, Group II and Group III which are 28.33 ± 1.01 , 33.96 ± 1.29 & 35.07 ± 1.24 respectively. The Group I have statistically significant difference between males and females i.e. $p=0.034$. In Group II and Group III male and female mean (\pm SD) do not differ significantly having $p=0.088$ and $p=0.189$ respectively. Statistically significant difference is found between Group I & Group II, Group I & Group III and Group II & Group III which are $p<0.001$, $p<0.001$ and $p<0.001$ respectively.

Table 1. Descriptive statics of age among Primary, Mixed and Permanent dentitions.

| | Male | Female | Total |
|-----------|------------------|------------------|------------------|
| | Mean \pm SD | Mean \pm SD | Mean \pm SD |
| Group I | 5.20 \pm 0.50 | 5.37 \pm 0.49 | 5.30 \pm 0.49 |
| Group II | 9.80 \pm 0.87 | 9.48 \pm 0.82 | 9.64 \pm 0.85 |
| Group III | 14.18 \pm 2.19 | 13.80 \pm 2.76 | 14.28 \pm 0.95 |

Table 2. Comparison of Palatal Intercanine width among Primary, Mixed and Permanent dentition; and between Males and Females.

| | Male | Female | Total | Male Vs Female |
|-------------------------------|------------------|------------------|------------------|----------------|
| | Mean \pm SD | Mean \pm SD | Mean \pm SD | P value** |
| Group I | 28.64 \pm 1.17 | 28.13 \pm 0.84 | 28.33 \pm 1.01 | 0.034 S |
| Group II | 34.27 \pm 1.39 | 33.65 \pm 1.11 | 33.96 \pm 1.29 | 0.088 NS |
| Group III | 35.29 \pm 1.27 | 34.82 \pm 1.17 | 35.07 \pm 1.24 | 0.189 NS |
| P value* | <0.001 S | <0.001 S | <0.001 S | |
| Total | 33.09 \pm 3.08 | 31.87 \pm 3.18 | | |
| P value** | 0.019 S | | | |
| Group I Vs Group II P value | <0.001 S | <0.001 S | <0.001 S | |
| Group I Vs Group III P value | <0.001 S | <0.001 S | <0.001 S | |
| Group II Vs Group III P value | 0.016 S | 0.001 S | 0.001 S | |

(P value**: Independent sample t test, P value*: ANOVA one way test, P value: Tukey Post Hoc test for multiple comparisons, S: Statistically significant at 0.05 level, NS: Not Significant).

Discussion

India is developing country and oral health, particularly the treatment of malocclusion is still not the priority of the people. Hence it is necessary to know about the normal dento-skeletal measurements for future diagnosis and treatment planning. Thus, the present study was conducted to evaluate the findings of palatal intercanine width from deciduous dentition to permanent dentition in 5 years to 16 years old children of district Shimla, Himachal Pradesh. In the present study, increase of 5.6 mm from age 5.2 to 9.8 years in overall palatal intercanine width from primary dentition to mixed dentition was found, which was statistically significant ($p < 0.0001$). There was significant difference between males and females in primary dentition. Ahn et al⁹ reported that the intercanine width increased from ages 6 to 8 years in maxilla, both in girls and boys.

Most of the studies in literature reported lesser increase in palatal intercanine width from primary to mixed dentition when compared to our study. Rapid increase in palatal intercanine width was reported by the studies done by Barrow & White¹¹ (increase of 4mm), Moorrees et al¹⁴ (increase of 3mm) and Sillman¹⁹. Very little increase in palatal intercanine width from primary to mixed dentition was found by Hasanali & Odhiambo¹³ (an increase of 0.21mm from 6-8 to 12 years of age for Kikuyu, Maasai and Kalenjin sample), Ahn et al⁹ (1.08mm from 6 years to 9 years), and Eslami Amirabadi⁴ et al (an increase of 0.47mm from 5 years to 9 years of age). Virgenia B Knott¹⁵ and Thialander B⁶ reported an increase in palatal intercanine width from primary dentition to mixed dentition due to eruption of permanent incisors in mixed dentition stage which leads to an increase of the anterior segment of maxilla. The studies done by Ruth Elaine Ross -Powell⁸ & Edward F Harris² reported an increase in palatal intercanine width of 4.3mm between ages of 5 and 10 years which he concluded that it could be due to the expansion at maxillary-premaxillary sutures. There was an increase of 1.02 mm in palatal intercanine width from mixed dentition to permanent dentition from the age of 10 years to 14 years in the present study, which was found

to be statistically significant ($p < 0.0001$). Similar results were reported in several studies [(0.92mm (Arslan et al¹⁸), 2mm (Sillman¹⁹ and Virgenia B Knott¹⁵), Eslami Amirabadi et al⁴ (4.60mm for Saudis) and Yang D et al¹⁰ (0.95mm from 10 years to 12 years)]. These findings were in contrast with the finding of the studies done by Sinclair & Little¹⁶ which showed decrease of 0.31mm, additionally Moorrees et al¹⁴ and Tsujino & Machida et al¹⁷ also showed a decrease from the mixed to the permanent stage. Samir E Bishara¹² stated that the arch width dimensions were established in the mixed dentition by 8 years of age with some, but minimal, increase until the early permanent dentition (13 years) and progressive but minimal decrease in early and mid-adulthood. Burdi and Moyers²⁰ pointed that the direction of the vertical alveolar growth differs significantly in the maxillary and mandibular arches. The maxillary alveolar processes diverge as the teeth erupt, whereas the growth of the mandibular alveolar process is more parallel. Such changes have significant clinical implications because they may allow for a greater differential increase in the maxillary arch width during treatment. The Study done by Thialander B⁶ stated that with the eruption of permanent canines, a further minor increase was observed in the maxillary arch. Ahn SJ⁹ stated that the permanent canines establish their final position and get stabilized by surrounding functional structures. Because of this stability, teeth are generally considered to move within bony confines and surrounding bone would change according to these functionally stabilized teeth which should be analyzed in future studies⁹. Furthermore; Ciusa V et al²¹ stated that “in children with a complete deciduous dentition, the lack of age-related modifications in maxillary intercanine width implies careful consideration of treatment timing of patients with crossbites and when a functional cause has been ruled out, the diagnosis of a crossbite at the deciduous canines should be a priority, because a relatively reduced maxillary intercanine distance will probably not correct spontaneously with growth”.

The present study indicated that there is increase of 6.62mm in intercanine width from primary to permanent

dentition. However, it is important to construct more precise findings for the width in anterior maxillary arch in canine region for children of Shimla origin of Himachal Pradesh. These progressive changes from deciduous to permanent dentition could not be indicated due to our cross-sectional research. Hence; further longitudinal studies are required to be done for the follow up of the dental arch development in children throughout the whole growth period to ascertain changes that may occur during the transitional periods from primary dentition to permanent dentition²².

Conclusion

Inter canine width varies among different populations. To summarize, the present study found that there is significant increase in inter canine width in upper dental arch from primary dentition to permanent dentition. Statistically significant difference was found in upper inter canine width (UICW) between males and females in primary dentition. Statistically non-significant difference was found in upper inter canine width (UICW) in mixed and permanent dentition.

Conflicts of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper and the study has not been funded by any source.

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