Original Article

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

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Abstract

Objective: This study aimed to determine the palatal intercanine width from deciduous dentition to permanent dentition in 5–16-year-old children.

Materials and Methods: The study sample comprised 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 ($P < 0.034$). A statistically nonsignificant difference was found in UICW in mixed and permanent dentition. Data were analyzed using SPSS 22 (SPSS Inc., Chicago, IL, USA). One-way ANOVA followed by Tukey's *post hoc* test and *t*-test was applied to verify the existence of significant differences between the groups.

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

Key Words: *Arch, dimensions, intercanine width, maxillary*

Introduction

The human craniofacial complex and associated dental arches undergo visible alterations as they grow and adapt[1] 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 such as 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 patterns of inheritance or response to environmental influences than individual attributes.[2] These morphogenetic characteristics expressed differently in different ethnic people. The size and shape of dental arches present 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 pediatric 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, 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 5–16-year-old children of Shimla, a district in the northern hilly state of India.

Materials 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). The study has been approved by the institutional ethical committee. A total of 823 schoolgoing children between the age of 5 years and 16 years were examined and the dentition stage was clinically determined for each subject by a trained examiner. Informed consent was obtained 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 al*.[3] Stratified random sampling was done and students were selected from 10 kindergartens, 10 elementary, and 10 middle schools which were evenly distributed in the four regions of the district[4] and the patients attending the outpatient department of pediatric and preventive dentistry, as

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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 years in primary dentition, 9.64 years 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 treatment.[6] 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, and 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 the 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 min as all the surfaces of impression and tray were covered with the disinfectant solutions.[7] Then, these impressions were poured with dental stone on the same day, i.e. within 24 h 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
- Group III: Permanent dentition stage.

The measurements were done using Vernier digital caliper with an accuracy of 0.01 mm for the canine area. Intercanine 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 0.01 mm. A second measurement was performed randomly on 30% of the total sample casts 1 week after the first measurements. Intraobserver reliability was determined using intraclass correlation coefficient (ICC) test. Intraobserver reliability was considered excellent with ICC value of 0.998.

Table 1: Descriptive statics of age among primary, mixed, and permanent dentitions

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

SD: Standard deviation

Statistical analysis

Data were analyzed using SPSS 22 (SPSS Inc., Chicago, IL, USA). One-way ANOVA followed by Tukey's *post hoc* test and *t*-test was 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 5–16 years. 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 was calculated. Measurements of the arch dimension like intercanine width were measured on the cast using Vernier caliper.

Table 2 shows the mean (±standard deviation [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, and 35.07 ± 1.24, respectively. Group I have a statistically significant difference between males and females, i.e. $P = 0.034$. In Group II and Group III male and female, mean (±SD) do not differ significantly having $P = 0.088$ and $P = 0.189$, respectively. A statistically significant difference is found between Group I and Group II, Group I and Group III, and Group II and Group III which are $P < 0.001$, $P < 0.001$, and $P < 0.001$, respectively.

Discussion

India is a 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 dentoskeletal 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 5–16-year-old children of district Shimla, Himachal Pradesh. In the present study, an 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 a statistically significant difference between males and females in primary dentition. Ahn *et al*.[8] 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 a lesser increase in palatal intercanine width from primary to mixed dentition when compared to our study. A rapid increase in palatal intercanine width was reported by the studies done by Barrow and White[9] (increase of 4 mm), Moorrees *et al*.[10] (increase of 3 mm), and Sillman.[11] Very little increase in palatal intercanine width from primary to mixed dentition was found

Table 2: Comparison of palatal intercanine width among primary, mixed, and permanent dentition and between males and females

	Mean±SD			Male versus female (*P***)
	Male	Female	Total	
Group I	28.64±1.17	28.13±0.84	28.33±1.01	0.034 (S)
Group II	34.27±1.39	33.65±1.11	33.96±1.29	0.088 (NS)
Group III	35.29±1.27	34.82±1.17	35.07±1.24	0.189 (NS)
*P**	<0.001 (S)	<0.001 (S)	<0.001 (S)	
Total	33.09±3.08	31.87±3.18		
*P***	0.019 (S)			
Group I versus Group II (*P*)	<0.001 (S)	<0.001 (S)	<0.001 (S)	
Group I versus Group III (*P*)	<0.001 (S)	<0.001 (S)	<0.001 (S)	
Group II versus Group III (*P*)	0.016 (S)	0.001 (S)	0.001 (S)	

*ANOVA one-way test, **Independent sample *t*-test. *P* value: Tukey *post hoc* test for multiple comparisons. S: Statistically significant at 0.05 level, NS: Not significant, SD: Standard deviation

by Hassanali and Odhiambo[12] (an increase of 0.21 mm from 6 to 8–12 years of age for Kikuyu, Maasai, and Kalenjin sample), Ahn *et al*.[8] (1.08 mm from 6 years to 9 years), and Eslami Amirabadi *et al*.[4] (an increase of 0.47 mm from 5 years to 9 years of age). Knott[13] and Thilander[6] 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 Ross-Powell and Harris[14] and Harris and Smith[2] reported an increase in palatal intercanine width of 4.3 mm between ages of 5 and 10 years in which they 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 ([0.92 mm [Arslan *et al*.[15]], 2 mm [Sillman[11] and Knott[13]], Eslami Amirabadi *et al*.[4] [4.60 mm for Saudis], and Yang *et al*.[16] [0.95 mm from 10 years to 12 years]). These findings were in contrast with the finding of the studies done by Sinclair and Little[17] which showed a decrease of 0.31 mm, additionally Moorrees *et al*.[10] and Tsujino and Machida *et al*.[18] also showed a decrease from the mixed to the permanent stage. Bishara *et al*.[19] 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 Moyers[20] 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 Thilander[6] stated that with the eruption of permanent canines, a further minor increase was observed in the maxillary arch. Ahn *et al*.[8] stated that the permanent canines establish their final position and get stabilized by surrounding functional structures. Due to 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 studies.[8] Furthermore; Ciusa *et al*.[21] 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 an increase of 6.62 mm 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 dentition.[22]

Conclusion

Intercanine width varies among different populations. To summarize, the present study found that there is a significant increase in intercanine width in upper dental arch from primary dentition to permanent dentition. A statistically significant difference was found in UICW between males and females in primary dentition. A statistically nonsignificant difference was found in UICW in mixed and permanent dentition.

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Conflicts of interest

There are no conflicts of interest.

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