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Abstract

Dental arch dimensions undergo visible alterations as they grow, adapt, and age. Relatively rapid changes occur during the transitional dentition. Once a functional permanent dentition is established, smaller changes continue to be observed. The concept of maintainting of intercanine dimensions as an indicator for posttreatment stability has been supported by studies in the literature. An understanding of the development and changes in intercanine widths helps in distinguishing changes occurred from natural growth or appliance therapy, planning orthodontic treatment, and assessing stability and smile esthetics following orthodontic treatment. This article attempts to review the literature and summarizes the natural development and changes in intercanine widths of untreated dentitions; it will also establish a comparative standard for evaluating treatment changes to intercanine widths and their postretention stability produced by orthodontic treatment.

Keywords

intercanine width

Review Article

Natural Development and Changes in Intercanine Widths of Untreated Dentitions

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Dental arch dimensions undergo visible alterations as they grow, adapt, and age. Relatively rapid changes occur during the transitional dentition. Once a functional permanent dentition is established, smaller changes continue to be observed. The concept of maintainting of intercanine dimensions as an indicator for posttreatment stability has been supported by studies in the literature. An understanding of the development and changes in intercanine widths helps in distinguishing changes occurred from natural growth or appliance therapy, planning orthodontic treatment, and assessing stability and smile esthetics following orthodontic treatment. This article attempts to review the literature and summarizes the natural development and changes in intercanine widths of untreated dentitions; it will also establish a comparative standard for evaluating treatment changes to intercanine widths and their postretention stability produced by orthodontic treatment. ***(J. Taiwan Assoc. Orthod. 23(4): 4-12, 2011)***

Key words: intercanine width

INTRODUCTION

The development of the human dentition is a continuous process.[1] Dental arch dimensions change dramatically during the period of intensive growth and development but less so in adulthood. Many studies report a moderate increase in dental arch width before the eruption of the permanent canines and little change thereafter during the first two decades of life.[1-14] Steady and small, clinically significant changes beyond the age of even 20 years have been reported.[11,15-20]

The natural development and changes in untreated dentitions are often used as the comparative gold standards for evaluating dental arch changes produced by orthodontic treatment. An understanding of the mechanisms underlying these changes has to be considered in orthodontic treatment planning as well as in the assessment of stability following orthodontic treatment.

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Mandibular intercanine width is suggested an uncompromising dimension and should maintain its pretreatment width after treatment because this width represents a position of muscular balance for the individual.[21-23] Thus, dimensional changes in intercanine width may influence posttreatment stability, which have been demonstrated by numerous studies; dental arch widths increase during orthodontic treatment and tend to return toward pretreatment values after retention, regardless of patient diagnostic and treatment modalities.[24-60]

Arch width, at least in the canine region, is thought to be a determinant of smile esthetics. Buccal corridor and its ratios are the main focal points in smile esthetics, since these measurements are directly linked to the changes in arch form and width.[61-65] Several studies have evaluated the relationship between arch-width changes and smile esthetics in patients treated with extraction and nonextraction. These results reveals two things. First, the intercanine widths were the same after extraction and nonextraction treatment[49-51,53,54,67-70]. Second, posttreatment arch widths, regardless of whether premolars were extracted or not, did not significantly impact buccal-corridor ratios and smile esthetics.[61,63,66,68]

Because the changes in dental arch dimensions can occur with maturation or from treatment, it is necessary to realize and distinguish the changes in intercanine widths that induced by orthodontic treatment from those that occur during natural growth and development.

DEVELOPMENT AND CHANGES BETWEEN CHILDHOOD AND EARLY ADULTHOOD

Barrow and White[2] investigated the changes occurring in development of the arch during 3 to 15 years of age and showed that little change in the intercanine arch width occurred from 3 to 5 years of age; a very rapid increase in intercanine width occurred from 5 to 8 or 9 years of age; and, in most cases, the maxillary and mandibular intercanine arch widths steadily decreased between 0.5 mm and 1.5 mm after 14 years of age. In longitudinal studies of dental arch development between the ages of 3 and 18, according to Moorrees et al.[3,4], the arch width did not change materially during the deciduous dentition from 4 to 6 years of age, but increased markedly (3.0 mm) during the emergence of the maxillary and mandibular incisors. A second increase (1.5 mm) in the intercanine width of the maxilla occurred after eruption of the permanent canines, but this increase was not apparent in the mandible; intercanine width changed little in both male and female subjects. A similar growth pattern for the intercanine width was observed in black American children, although all the absolute dimensions exceeded the comparable values for white American children.[5]

Sillman[6] evaluated a mixed longitudinal sample from birth to 25 years of age and observed the intercanine width increased by 5.0 mm in the maxilla and 3.5 mm in the mandible from birth to 2 years. After 2 years of age, the intercanine width continued to increase in the maxilla until 13 years of age and in the mandible, until 12 years of age; after this time, the canine width remained stable. Male subjects, in general, had larger arch widths than the female subjects. In a longitudinal study, Knott[7] quantified the changes in intercanine widths between deciduous (average age = 5.4 years), mixed (average age = 9.4 years), early permanent (average age = 13.6 years), and early adulthood (average age = 25.9 years), in both male and female subjects. In the mandibular arch, the mean changes between the four stages were 2.9, 0.3, and – 0.1 mm. The corresponding mean changes in the maxillary arch were 2.8, 2.0, and 0 mm. In 97% of the subjects, intercanine width in both arches remained unchanged, increased, or decreased by 1.0 mm from the mixed to the permanent dentitions. Sinclair and Little[8] conducted a similar study on the maturation of untreated normal occlusions in mixed dentition (9 to 10 years), early permanent dentition (12 to 13 years), and early adulthood (19 to 20 years). Their results indicated a small decrease of 0.75 mm in the mandibular intercanine width from the mixed dentition stage into early adulthood, with the most significant change occurring in female subjects from ages 13 to 20 years. The changes found in a sample

of untreated normal individuals were similar in nature but lesser in extent than the postretention changes found in a sample of treated cases. Arslan et al.[9] also confirmed a decrease in mandibular intercanine width between the mixed and early permanent dentitions.

When evaluating changes in the maxillary and the mandibular arch widths, Moyers et al.[10] found that the difference between the intercanines widths in both arches increased from 4.0 mm at age 4 years to 7.5 mm at age 17 years. They also observed greater sexual dimorphism in the maxillary intercanine width than in the mandibular intercanine width in the permanent dentition.

Longitudinal changes in arch widths from 6 weeks to 45 years of age were studied by Bishara et al.[11] The study showed that between 6 weeks and 2 years of age, i.e., before the complete eruption of the deciduous dentition, the maxillary and mandibular intercanine widths significantly increased in both sexes and ranged between 2.2 and 4.2 mm. They also found that the intercanine widths between 3 and 13 years of age significantly increased by an average of 6 and 3.7 mm in the maxillary and mandibular arches, respectively. After the complete eruption of the permanent dentition, the intercanine width decreased slightly in both sexes, and this decrease was greater in the intercanine widths than the intermolar widths between 13 to 26 years and 26 to 45 years. In addition, the study showed that mandibular intercanine width, on an average, was established by the age of 8 years, i.e., after eruption of the four incisors. After eruption of the permanent dentition, either no changes or a slight decrease in arch width should be expected. Their findings were consistent with those of Slaj et al.[12] that most arch width dimensions are established in the early mixed dentition. The period between the emergence of the early and late mixed dentition is sufficient for environmental factors to disrupt the ideal symmetrical developmental pattern because more growth and developmental changes occur after a relatively stable period of deciduous dentition.

Thilander[13] analyzed the dental arch dimensions in 436 subjects with an untreated ideal occlusion, followed chronologically from 5 to 31 years of age. The results verified that continuous changes of the dental arches occur from the primary to the early adult period. In terms of changes in intercanine widths, a different developmental pattern was observed between the maxilla and mandible. In the maxilla, an increase was recorded up to 16 years of age (4 mm) particularly between the age of 5 and 10 years. In the mandible, an increase of the same degree was recorded to the age of 10 years, followed by a continuous decrease, particularly in male subjects between 16 and 31 years of age. Henrikson et al.[14] showed similar results, with a significant reduction in the upper as well as lower intercanine widths between 13 and 31 years of age.

CHANGES DURING ADULTHOOD

Although several decades of adult life are considered an interval of non-growth, arch dimension changes are still slower but continuous during this period, and the direction of growth (or "aging") may be different from that occurring in children and adolescents. However, changes are readily discernible, particularly over a long term. Bondevik[15] and Tibana et al.[16] evaluated longitudinal occlusal changes in young adults between 21 and 34 years of age and showed that the mandibular intercanine width decreased significantly (ranging from -0.14 to -0.42 mm), whereas the maxillary intercanine width remained unchanged, and no sexual dimorphism was observed. These findings suggested occlusal dimensions continue but little change during young adult life.

Bishara et al.[11,17,18] and Carter and McNamara[19] evaluated the longitudinal dental arch changes in untreated subjects from young adulthood (during the second and third decades of life) to mid-adulthood (during the fifth and sixth decades of life) and found that the maxillary and mandibular intercanine widths decreased significantly in both sexes (ranging from -0.4 to -0.92mm), with a greater decrease in the mandibular than in the maxillary intercanine width (ranging from -0.07 to -0.2mm). Males had significantly wider intercanine widths than females, except for mandibular intercanine width, which was not significantly different. However, the results of Harris[20] showed that arch widths increased over time, with little

change across the canines but appreciably more in the more distal regions of each arch. These data implied that intercanine widths continue to change subtly during adulthood, and these changes occur most rapidly during the second and third decades of life, but continue to occur to a lesser extent thereafter.

The average changes in the intercanine width of untreated samples are summarized in Table 1.

Table 1. *Mean changes (mms) in intercanine widths of the maxilla and mandible in untreated subjects*

Author	Sample	Time (years)	Maxilla C-C, 3-3 (mm)	Mandible C-C, 3-3 (mm)
Barrow et al. 1952	51	3-15	+3	+2
Sillman 1964	65	0-25	+5	+3.5
Moorrees et al. 1965,1969	84 Males 100 Females	3-18	+4.5	+3
Knott 1972	21 Males 44 Females	5.4;9.4;13.6;25.9	+2.8;+2.0; 0	+2.9;+0.3; -0.1
Moyers et al. 1976	Males: 10U,16L Females: 9U,14L Males: 10U,11L Females: 6U,5L	7-12 12-18	Male: +3.84 Female: +3.53 Male: -0.17 Female: -0.34	Male: +1.78 Female: +1.84 Male: -0.33 Female: -1.73
Sinclair and Little 1983	33 Males 32 Females	9-13; 13-20	None	Male: -0.52 Female: -0.08 Male: -0.16 Female: -0.73
Bishara et al. 1994,1996	15 Males 15 Females	25-46	Male: -0.3 Female: -0.4	Male: -0.4 Female: -0.6
Bishara et al. 1997	28 Male infants 33 Female infants 15 Males 15 Females	6wk-2yrs 3-45yrs	Male: +4.2 Female: +4.0 Male: +4.9 Female: +4.5	Male: +2.3 Female: +2.2 Male: +2.7 Female: +2.3
Harris 1997	43 Males 17 Females	20-55	Male: +0.7 Female: +0.1	Male: +0.1 Female: +0.3
Carter and McNamara 1998	27 Males 26 Females	17-48	Male: -0.76 Female: -0.65	Male: -0.92 Female: -0.58
Bondevik 1998	80 Males 64 Females	23-34	Male: -0.02 Female: -0.05	Male: -0.18 Female: -0.14
Ross-Powell and Harris 2000	25 Males 27 Females	3-18	Male: +6.3 Female: +6.3 (3-11 yrs) Male: +1.1 Female: +0.6 (11-18 yrs)	Male: +3.9 Female: +4.9 (3-11 yrs) Male: -0.9 Female: +0.8 (11-18 yrs)
Henrikson et al. 2001	11 Males 19 Females	13-31	Male: -0.3 Female: -0.5	Male: -0.6 Female: -0.8
Slaj et al 2003	17 Males 13 Females	9.69-11.72 9.73-11.72	+0.86	-0.62
Tibana et al. 2004	13 Males 14 Females	21-28	Male: -0.14 Female: -0.27	Male: -0.42 Female: -0.37
Arslan et al. 2007	29 Males 36 Females	9.44-14.44 9.64-14.64	Male: +1.59 Female: +0.39	Male: -0.59 Female: -0.11
Thilander 2009	189 Males 247 Females	5-31	Male: +4.0 Female: +3.9 (5-16 yrs) Male: -0.1 Female: +0 (16-31 yrs)	Male: +4.1 Female: +3.7 (5-10 yrs) Male: -1.2 Female: -0.3 (10-31 yrs)

U: Upper arch. L: Lower arch.

CONCLUSIONS

1. Generally, the development and changes in the dental arches precede the eruption of groups of teeth. In the curves of intercanine width dimensions, a noticeable similarity exists between the maxillary and mandibular arches, and greater changes occur in the maxilla than in the mandible.
2. The intercanine widths of male arches grow wider than those of female arches.
3. Before the complete eruption of the deciduous dentition around 6 weeks to 2 years of age, the intercanine widths increased significantly.
4. A rapid and notable increase of intercanine width development and change occur during the eruption of the permanent incisors and canines. In the mandible, the increase occurs between 6 and 9 years for boys and between 6 and 8 years for girls. In the maxilla, the intercanine width continues to increase for longer, up to 16 years in boys and 12 years in girls. This increase is approximately 2~3 mm in the mandible and 3~5 mm in the maxilla. After 11 to 13 years of age, at about the time of complete eruption of the permanent dentition, little intercanine width change is expected.
5. Age-related changes in the intercanine widths do not cease to occur with the onset of adulthood, but continue, although at a significantly slower rate, throughout adult life.
6. The natural development and changes in intercanine widths should be regarded as a dynamic rather than a stable inter-relationship between facial structures. They could be interpreted as a biological migration of the dentition.

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無治療齒列犬齒間寬度的自然發育與變化

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當個體成長、適應與老化時，牙弓寬度會受到明顯可見的變化。這個寬度在齒列轉換時期變化得相對較快，一旦功能性永久齒列建立後，小量的寬度變化仍持續可見。維持犬齒間寬度以作為矯正治療後穩定度評估的指標已有許多的研究支持。了解犬齒間寬度的發育與變化對於區分由自然生長或矯正治療產生之變化，訂定矯正治療計畫，以及評估矯正治療後的穩定度與微笑美觀有相當的幫助。本文針對無治療齒列犬齒間寬度的自然發育與變化作文獻的回顧與整理探討，並可建立為評估犬齒間寬度於矯正治療後變化與維持後穩定度的比較標準。***(J. Taiwan Assoc. Orthod. 23(4): 4-12, 2011)***

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