A Study of Dental Arch and Body Growth

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The study of dental arch growth is not only of academic interest, but also of practical necessity for orthodontic treatment since disproportionate imbalance between arch and tooth size is responsible for many malocclusions. Although dental arch growth has been subject to much investigation, the majority of studies relate to the changes in dental arch dimensions alone without regard to the body as a whole.[5,8,11,12]

Dental arch growth is subject to considerable variation, both intrinsic, i.e., genetic[10,13] and extrinsic, i.e., environmental.[18] In addition, such factors as the timing of tooth eruption,[6] tooth migration,[3] and size of adjacent teeth[16] affect dental arch form as does jaw growth.[17] Also, in adults the size of the dental arch is closely related to that of the skull[9] with the latter being associated with that of the body,[20] although Thompson and Popovich[24] have reported a diminishing correlation between stature and mandibular size between four and eighteen years of age. This study was therefore undertaken to ascertain the relationship between stature and dental arch size during the early growth period.

Materials and Methods

Subjects

This was a longitudinal study based upon 50 boys examined annually between 4 and 10 years of age. These boys were initially selected from patients attending for routine dental treatment. The criteria for patient selection were: an intact dental arch with a normal anteroposterior maxillary and mandibular molar relationship; all were derived from the same socioeconomic group; and ethnic (British Caucasoid) stock; no one patient was related to another. In addition, all patients received routine dental treatment during the period of study but no orthodontic therapy.

Measurements

In addition to stature and body weight, maxillary and mandibular dental arch widths between the canines were measured annually. These latter dimensions were measured from alginate-base hydrocolloid casts by vernier callipers held vertical to the occlusal plane. The bicanine arch width was computed as the sum of dental arch widths determined from the most buccal canine convexities and most lingual canine convexities divided by two. The dimension of bicanine arch width was selected since arch lengths are affected by the eruption of permanent teeth whereas during the period 4-10 years of age most growth in dental arch width occurs in the bicanine region.[20]

As a test of technique, these dimensions were determined by two independent observers for 50 dental arches selected at random. Analysis of variance showed that any errors arising from inconsistencies of the measurement technique were insignificant ($P < 0.02$). compared with the variation between different individuals.

Results

Not only were there increases in bicanine arch width, stature and body weight during the period 4-10 years, but also their respective standard deviations increased during this period. This latter indicated that there was a greater degree of variability between individuals as age increased. Nevertheless, within each age group, dental arch widths were positively correlated with stature and body weight (Table I) and the bicanine widths of the maxillary and

TABLE I

CORRELATION OF BICANINE ARCH WIDTH WITH STATURE AND BODY WEIGHT

Age	Maxillary			Mandibular		
	Stature v Weight	Arch width v Stature	Arch width v Weight	Arch width v Stature	Arch width v Weight	Maxillary v Mandibular arch width
4	0.71	0.57	0.41	0.53	0.44	0.79
5	0.65	0.48	0.45	0.50	0.42	0.67
6	0.73	0.45	0.44	0.47	0.45	0.71
7	0.72	0.42	0.41	0.49	0.46	0.68
8	0.71	0.44	0.38	0.52	0.49	0.67
9	0.67	0.49	0.36	0.44	0.42	0.70
10	0.68	0.45	0.37	0.46	0.43	0.74

mandibular arches were highly correlated with each other. Furthermore, whereas stature, body weight, and arch width were correlated one with another, the degree of correlation was greater between stature and body weight compared with stature and arch width or body weight and arch width. In addition, arch width showed a slightly greater degree of correlation with stature than body weight. The closer relationship between arch width and stature than body weight was confirmed when one of the latter was held constant (Table II). There were significant correlations between the annual increments of stature and body weight ($r = 0.51$), maxillary ($r = 0.49$) and mandibular ($r = 0.30$) arch width, and stature. By contrast, the correlation between the annual increments of maxillary ($r = 0.21$) and mandibular ($r = 0.13$) arch width and body weight were not statistically significant. The annual increments in arch width between the maxillary and mandibular arches were highly correlated one with another ($r = 0.62$).

Discussion

In the analysis of facial growth much attention has been focused upon whether this structure follows the general body growth curve. For instance, Nanda[15] measured seven facial dimensions of ten males and five females aged 4-20 years and noted that the facial growth curves were typical of skeletal curves, although completion of facial growth was achieved after adult stature had been attained. Other studies have confirmed the close association between facial and arch dimensions with general skeletal growth.[7,21] By contrast,

TABLE II

PARTIAL CORRELATIONS OF BICANINE ARCH WIDTH WITH STATURE AND BODY WEIGHT

Age	Maxillary		Mandibular	
	Arch width v Stature (Weight constant)	Arch width v Weight (Stature constant)	Arch width v Stature (Weight constant)	Arch width v Weight (Stature constant)
4	0.22	0.23	0.27	0.19
5	0.27	0.14	0.23	0.22
6	0.31	0.19	0.25	0.16
7	0.28	0.20	0.28	0.15
8	0.29	0.20	0.27	0.19
9	0.30	0.14	0.31	0.14
10	0.20	0.17	0.29	0.19

Bambha[2] noted that the facial growth spurt occurred after that of the body in a semilongitudinal study spanning one month to thirty years of age.

The present study not only showed a close correlation between maxillary and mandibular arch width, but also that these dimensions were more closely associated with stature than body weight. Bicanine arch growth during the period 4-10 years of age, in common with jaw growth,[24] stature and body weight, appears to be an orderly process, although variation occurs between individuals in timing and rate. Cognizance must be taken of the fact that the dental arch comprises just part of the craniofacial complex,[14] so that the relationships between the maxillary and mandibular arches may be affected by growth changes in other regions of the skull.

Even with such a dimension as bicanine arch width, care must be taken in using the data of different workers for the prediction of future changes. This mainly arises from the conflicting estimates of bicanine arch width. Willet[25] measured from the most medial points on the erupted lingual surfaces of the canines whereas Burson[4] measured from the tips of the canines. Sillman[19] measured intercanine arch width from the interdental gum nests or contact regions separating the canine and deciduous first molars whereas Allen[1] determined the distance from the most lateral points on the erupted portions of the canines. Then contrasting estimates of dental arch width may have differing relationships between stature and body weight.

The present study was based upon estimates of dental arch and body growth obtained at yearly intervals, so that no information could be obtained relating to minor fluctuations in growth rate of seasonal variation.[23] Nevertheless, in view of the findings that dental arch and general body are correlated one with another during the period 4-10 years of age, further research is required to ascertain whether this relationship is shown by the craniofacial complex as a whole.

Summary

From a longitudinal examination of 50 boys, aged 4-10 years, bicanine arch width was found to be more highly correlated with stature than body weight.

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