The Interrelationships Among Height, Weight And Chronological, Dental And Skeletal Ages*

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INTRODUCTION

Orthodontics includes the study of the growth and development of the dentofacial complex particularly, and the growth and development of the body generally[16]. Over-all growth and development should be recognized as one of the most important factors in orthodontics.

The early prevention and interception of dentofacial deformities is dependent upon an accurate interpretation of the inherent facioskeletal pattern and the over-all growth and development.

Hereditary, functional, environmental, sexual, nutritional, and metabolic factors influence normal growth and development greatly. The proportional effects of each of the factors are not easily determined, but nevertheless, orthodontists should attempt to evaluate each patient in relation to these influences.

Physical growth and developmental manifestations provide useful criteria for orthodontic diagnostic evaluations. Orthodontists frequently utilize such physical characteristics as weight, height, skeletal maturation and dental development which are subjected to biometric tests and compared with standards based upon large groups of healthy subjects in order to evaluate the growth and maturational status of patients.

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In this study, the nature of the interrelationships among height, weight, and chronological age, dental and skeletal development was investigated. The purpose of this investigation was to point out the value of various physical indices of the over-all developmental status and the nature of the relationships among these indices.

The appearance and union of the different skeletal centers of ossification follow a fairly definite pattern and time schedule from birth to maturity. A roentgenographic study of these skeletal maturational processes provides a valuable criterion of the child's level of osseous maturation[13,23]. The skeletal maturity of the individual is known as bone age or skeletal age. The carpal area provides a useful index of skeletal maturation and is frequently utilized because it is easily accessible and radiographs can be taken at a minimum of expense and time[12].

Suitable standards, such as those of Todd,[22] Flory,[4] Greulich and Pyle[8,9] are used to determine skeletal age when the x-rays are evaluated.

The development and eruption of teeth are a part of the child's total development. Dental developmental schedules are used as indices of growth and maturation during childhood since teeth develop and erupt in characteristic sequences and within predictable age ranges.[11,13,17,23]

Serial radiographic studies of the dentition provide very critical and useful methods for appraising the intra-alveolar dental development throughout the various developmental stages of the

teeth.[14] The radiographic evaluation of intra-alveolar growth and calcification of the dentition provides a valuable indicator of dental age and serves as an index of the over-all maturation of a child.

By comparing the physical measurements of a child with the measurements of healthy children over a period of time, it is possible to determine whether he is progressing toward maturity at an average rate.

Height and weight are the physical manifestations of growth and development which are probably utilized most in diagnostic procedures, and in the assessment of growth and development. Body weight is probably the best index of nutrition and growth because it sums up all increments in size.[1,20,23]

Although there are individual patterns in physical manifestations, certain trends in the rate of growth are common to all children. The different stages of the life cycle exhibit different rates and trends of growth. When evaluating growth and development by means of physical measurements, many factors which introduce variability into growth trends and rates should be considered. Tables are available which provide mean height and weight measurements for sex age groups. These tables provide a guide for evaluating individuals in reference to the pattern of growth of a group similar to the child being evaluated, since a child normally maintains his relative pattern of growth as compared to his age group.[1,23]

Many investigators [3,5,6,10,18,21] have studied the relationship between the dentition and various aspects of growth and development. The findings of these investigators, in general, support the theoretical contention that positive relationships exist in varying degrees between the maturation of various tissue systems, whereas other investigators[2],[19] found low correlations between dental development and body growth. In this study an attempt was made to determine the nature of the correlations among dental, skeletal, height, weight, and chronological ages.

Materials and Methods

A total of fifty-six Caucasian males, between the ages of eight and twelve years, were selected from patients in the pedodontic and orthodontic departments, School of Dentistry, University of Pittsburgh. The following data were obtained from each subject: chronological age, a carpal radiograph of the left hand and wrist, a lateral head radiograph, height and weight.

The carpal radiographs were analyzed by comparing each radiograph with the standards of Greulich and Pyle.[9] For evaluation of the dental development, the norms of Nolla[14] were utilized. The height and weight data were evaluated by means of norms provided by Olson and Hughes.[15] These various physical indices of growth and development were evaluated and assigned age values. These age values were obtained by comparing the raw data and materials to normative age values and standards which are based on age and the stage of maturity. This method permits the expressions of growth and development to be based on the same qualities. Statistical analyses were applied to these physical index values to determine the nature of the correlations among them.

Findings

The dental ages ranged from 93 months to 158 months with a mean of 109.55 months; the skeletal ages varied from 70 months to 149 months with a mean of 129.46 months; the weight ages were from 83 months to 191 months with a mean of 133.66; the chronological ages ranged from 95 months to 144 months with a mean of

Table I

Correlation Coefficients

(Between all Age Variables)

Ages	Dental	Skeletal	Weight	Height
Skeletal	0.4616			
Weight	0.4810	0.7570		
Height	0.5630	0.7859	0.8145	
Chronological	0.6774	0.6882	0.5534	0.6657

119.26 months; and the height ages were from 88 months to 164 months with a mean of 129.46 months. The ranges for all age variables were greater than the chronological age range.

The correlation coefficients for these age variables (Table I) showed that each of these variables was positively correlated with all the other variables. In Table I, dental age showed the highest degree of correlation with chronological age (0.6774) and the lowest correlation with skeletal age (0.4616). Skeletal age revealed the highest correlation with height age (0.7859) and the lowest correlation with dental age (0.4616). Height age had the highest correlation with weight age (0.8145) and the lowest correlation with dental age (0.5630). Weight age revealed the highest correlation with height age (0.8145) and the lowest correlation with dental age (0.4810). Chronological age had its highest correlation with skeletal age (0.6882) and the lowest correlation with height age (0.5534).

Discussion

The correlation coefficients for the age variables studied showed positive correlation (ranging from 0.4616 to 0.8145) between each other.

The findings of this study support those of Hotz, Boulanger and Weisshaupt[11] in that the degree of association was closer between dental age and chronological age than between dental age and skeletal age.

A review of the correlation coefficients in this study indicated that chronological age was more highly correlated to dental age (0.6774) than were the other age variables. This observation indicates that in this study, chronological age is the best single predictor of dental maturity. Approximately one half of the variability in dental age may be accounted for by chronological age variability.

There was a high correlation between height age and weight age (0.8145). About two-thirds of the differences in the weights of these subjects can be accounted for on the basis of the differences in their heights.

The correlations did not fall into any obvious pattern. There appears to be a slight indication of a factor composed of skeletal age, height and weight. This factor might be termed the skeletal factor. We might hypothesize that the factors which control skeletal growth and development are also quite important in determining height and weight.

The growth of individuals is often irregular and this should be realized in applying norms of development based on central tendencies and variabilities of healthy children. Some aspects of growth and development for healthy

children may show a shifting pattern of growth, that is, a shift from high to average, to low and back to average again when comparing a child with his maturing age group. Therefore, correlation of these aspects of growth and development often will not show the degree of correlation which theoretically exists between these different areas of growth and development.

It should also be pointed out that only sample evaluations in various areas of growth and development were obtained in this study. A more complete appraisal of the entire skeleton rather than the carpal bones alone, and the evaluation of the entire dentition, rather than just the mandibular posterior teeth, might improve the degree of correlation between these variables.

It is felt that this study served to point out the need for more extensive investigation, the need for more current tables and norms representing more geographical areas, the need for a larger and more representative sample of subjects from both sexes and the need for more precise methods of appraising growth and development.

Conclusions

The purposes of this study were to review the various indices of over-all growth and development used in orthodontic diagnosis and to determine statistically the nature of the interrelationships among these various indices. The indices chosen for investigation were dental development, skeletal development, height, weight and chronological age.

The correlation coefficients between dental, skeletal and chronological ages (with r values ranging from 0.4616 to 0.6882) showed a moderately high association, but not as high as reported by Demisch and Wartmann[3] (0.83 to 0.89 for males) in their study of the calcification of the mandibular third molar as related to skeletal and chronological ages.

The findings of this study support those of Hotz, Boulanger and Weisshaupt[10] in that the degree of association was closer between dental age and chronological age than between dental and skeletal age.

Chronological age was more highly correlated with dental age than any of the other variables studied. Skeletal age, height and weight showed a slight tendency to form a factor which is possibly controlled to some degree by the same forces of growth and development.

Further investigation of growth and developmental relationship was indicated for a larger number of subjects of both sexes, and in wider age ranges, particularly in the higher age ranges of males. This study also indicated the need for more recent and adequate standards and norms and for more precise methods of evaluation of these expressions of growth and development.

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