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Original Research

Skeletal age assessment with hand-wrist and cervical vertebrae radiography

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ABSTRACT:
Background: Adolescence is a period during which the rate of growth accelerates, reaches a peak velocity and then decelerates until adulthood is achieved. The present study assessed skeletal age with hand-wrist and cervical vertebrae radiography. **Materials & Methods:** 120 subjects of both genders were subjected to lateral cephalograms and hand wrist radiographs were taken. Lateral cephalograms was taken with the head stabilized by ear rods and nasal support The Frankforthorizontal plane was set parallel to the floor, and theteeth were in centric occlusion. Skeletal age was determined on the hand-wrist radiographs according to the method of Greulich and Pyle. Morphometric changes of the vertebral bodies C2 through C4 were measured (concavity, anterior height, and angle). **Results:** Out of 90, males were 50 and females were 40.Excellent correlations for concavity of C2,C3, and C4 as well as for anterior height of C3 andC4 was observed. Angle C3 had only a low correlation coefficientand angle C4 had no correlation.There was agreement of calculated skeletal age (CSA) of the Greulich and Pyle hand-wrist assessment. There was an agreement of chronologic age with the Greulich and Pyle hand-wrist assessment. **Conclusion:** Morphometric assessment of age-dependent changes in chronologic age had advantage over cervical spine.
Key words: Cervical spine, hand wrist radiographs, Lateral cephalograph

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INTRODUCTION

Adolescence is a period during which the rate of growth accelerates, reaches a peak velocity and then decelerates until adulthood is achieved. This pattern can be found in all individuals, but there may be a marked individual variation in the initiation, duration rates and amounts of growth during this period of life.[1] In certain individuals, physiologic development proceeds rapidly and the entire pubertal growth period is short, in other words it is sluggish and takes much longer time.[2] Knowledge of maturation status of a child plays an important role in the diagnosis, treatment planning and eventual outcome of the treatment.[3] The developmental status of a child may be best assessed not by chronologic age but by physiologic parameters such as peak growth velocity in standing height, voice change in boys, menarche in girls, dental development and skeletal ossification.[4]

The developmental status of a child is usually assessed in relation to events that take place during the progress of growth. Thus, chronological age, dental development, height and weight measurements, sexual maturation characteristics and skeletal age are some biological indicators that have been used to identify stages of growth.[5]Many researchers have agreed that skeletal maturity is also closely related to the craniofacial growth, and bones of hand wrist and cervical vertebrae are very reliable parameters in assessing it.[6] The complete hand wrist radiograph involves 30 bones and assessment of these stages is one elaborate task which needs time and experience and also involves increased radiation exposure, therefore putting a question mark on ALARA principle.[7,8]The present study was conducted to assess skeletal age assessment based on hand-wrist and cervical vertebrae radiography.

MATERIALS & METHODS

The present study consisted of 90 subjects of both genders. The written consent was obtained from all subjects.

Data such as name, age, gender etc. was recorded. All were subjected tolateral cephalograms and hand wrist radiographs. All radiographs were taken using Kodak Machine operating at 120 kVp and 10 mAs. Skeletal age was assessed on the hand-wrist radiographs according to the method of Greulich and Pyle. Morphometric changes of the vertebral bodies C2 through C4 were measured (concavity, anterior height, and angle). Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I: Distribution of subjects

Total- 90		
Gender	**Males**	**Females**
Number	50	40

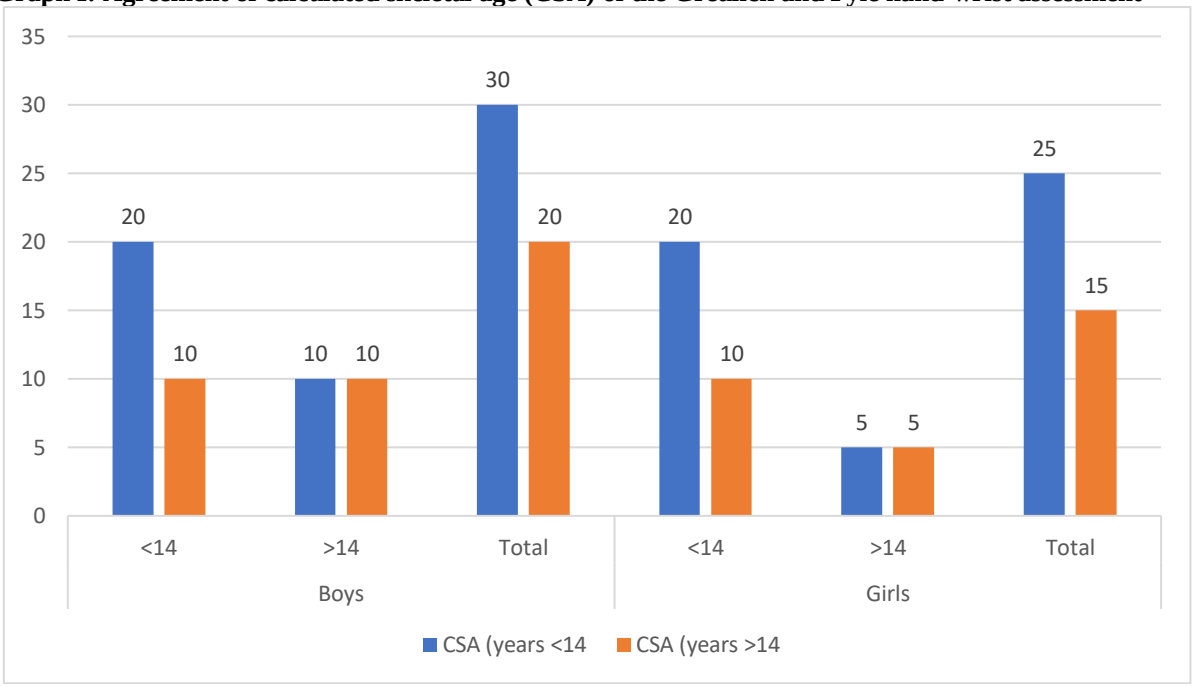
Table I shows that out of 90, males were 50 and females were 40.

Table II: Pearson correlation of morphometric measurements of the cervical vertebrae and skeletal age

Gender	Concavity			Anterior height		angle	
	C2	C3	C4	C3	C4	C3	C4
Boys							
Correlation coefficient	0.65	0.68	0.68	0.77	0.71	0.24	0.08
P value	0.04	0.01	0.04	0.01	0.05	0.01	0.01
girls							
Correlation coefficient	0.59	0.71	0.71	0.75	0.76	0.37	0.36
P value	0.01	0.03	0.01	0.04	0.05	0.01	0.02

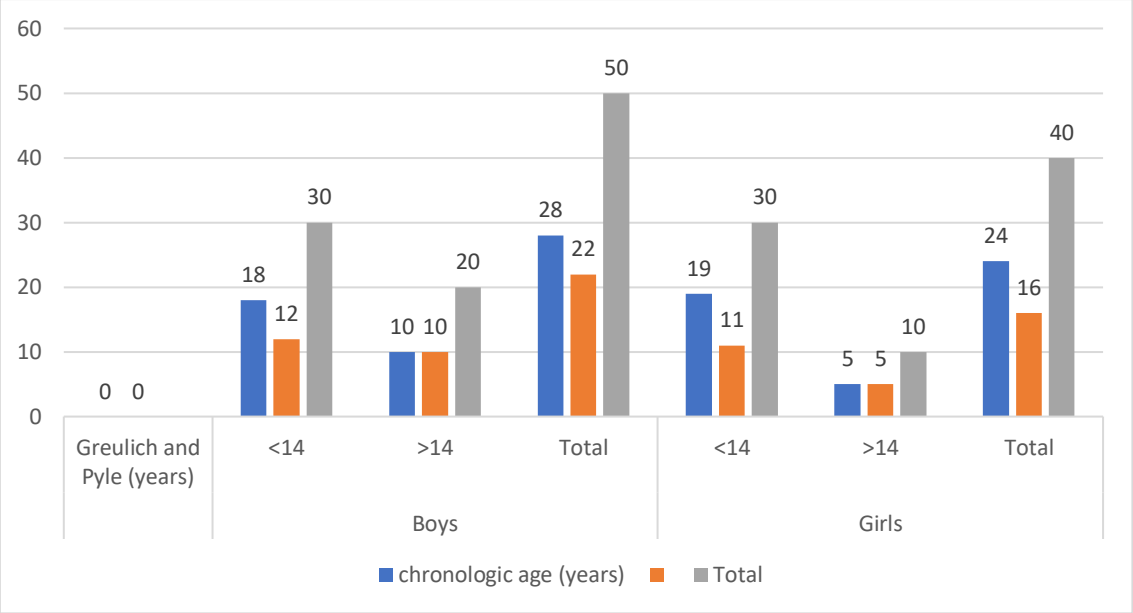
Table II shows excellent correlations for concavity of C2,C3, and C4 as well as for anterior height of C3 andC4 was observed. Angle C3 had only a low correlation coefficientand angle C4 had no correlation.

Graph I: Agreement of calculated skeletal age (CSA) of the Greulich and Pyle hand-wrist assessment



Graph I shows that there was agreement of calculated skeletal age (CSA) of the Greulich and Pyle hand-wrist assessment.

Graph II: Agreement of chronologic age with the Greulich and Pyle hand-wrist assessment



Graph II shows that there was an agreement of chronologic age with the Greulich and Pyle hand-wrist assessment.

DISCUSSION

The evaluation of skeletal age is essential in many orthodontic treatment approaches, especially regarding the correction of skeletal imbalance.[9] In functional orthopedics, which aims to exploit mandibular growth, success is intimately linked to growth potential. But growth of the mandible is not linear throughout development.[10,11] Chronologic age has been deemed an inadequate indicator to identify stages of growth because of individual variations in timing, velocity, and duration of growth.[12]The periods of acceleration and deceleration during growth are based on the complex endocrine regulation of craniofacial growth.[13]The present study was conducted to assess skeletal age using hand-wrist and cervical vertebrae radiography.

We found that out of 90, males were 50 and females were 40. Mahajan et al[14]assessed the validity of cervical vertebrae radiographic assessment to predict skeletal maturation.Left-hand wrist and lateral cephalometric radiographs of 100 children aged 8-18 years, divided into 10 groups of 10 subjects each with equal distribution of males and females, were measured. On left-hand wrist radiograph, the classification of Fishman was used to assess skeletal maturation. Cervical vertebrae maturation was evaluated with lateral cephalometric radiograph, using the stages developed by Hassel and Farman. The changes in hand wrist and cervical vertebrae wassignificant association was observed between skeletal maturation indicator stages and cervical vertebrae maturation indicator stages. Correlation coefficient was found to be significant (P<0.0001).The results of the study indicated that the cervical vertebrae maturation and hand wrist skeletal maturation was significantly related.

We observed that excellent correlations for concavity of C2,C3, and C4 as well as for anterior height of C3 andC4 was observed. Angle C3 had only a low correlation coefficientand angle C4 had no correlation.We found there was agreement of calculated skeletal age (CSA) of the Greulich and Pyle hand-wrist assessment. There was an agreement of chronologic age with the Greulich and Pyle hand-wrist assessment.Beit et al[15]assessed 730 sets of radiographs of untreated subjectsfrom a growth study, each sex as a separate sample. Skeletal age was determined on the hand-wrist radiographs. Concavity of C2, C3, and C4; anterior height of C3 and C4; and the angle of C3 correlated with skeletal age highly significantly in both sexes, and calculated skeletal age was established based on a linear regression. The agreement between the method of Greulich and Pyle and calculated skeletal age was modest (limits of agreement: boys, 63.5 years; girls, 63.3 years) and substantially weaker than the agreement between the method of Greulich and Pyle and chronologic age. Similarly, calculated skeletal age resulted in considerably more false predictions of peak height velocity (boys, 18.9%; girls, 12.9%) than did chronologic age (boys, 7.1%; girls, 7.4%).

CONCLUSION

Authors found that morphometric assessment of age-dependent changes in chronologic age had advantage over cervical spine.

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