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Original Research

Assessment of skeletal age based on hand-wrist and cervical vertebrae radiography

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ABSTRACT:
Background: The evaluation of skeletal age is essential in many orthodontic treatment approaches, especially regarding the correction of skeletal imbalance. The present study was conducted to assess skeletal age assessment based on 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 Frank for thorizontal plane was set parallel to the floor, and the teeth 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 120, males were 50 and females were 70.Excellent correlations were found for concavity of C2,C3, and C4 as well as for anterior height of C3 andC4. Although statistically highly significant, angle C3 had only a low correlation coefficient and angle C4 did not correlate at al. 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 cephalographs

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INTRODUCTION

The evaluation of skeletal age is essential in many orthodontic treatment approaches, especially regarding the correction of skeletal imbalance. 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. Chronologic age has been deemed an inadequate indicator to identify stages of growth because of individual variations in timing, velocity, and duration of growth.[1]

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.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.[2]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 (as low as reasonably achievable) principle.[3] The periods of acceleration and deceleration during growth are based on the complex endocrine regulation of craniofacial growth.[4] Although a novel approach with insulin-like growth factor I as an indicator for the pubertal growth spurt has been described in scientific literature, this method has not yet reached clinical applicability.[5]The present study was conducted to assess skeletal age assessment based on hand-wrist and cervical vertebrae radiography.

MATERIALS & METHODS

The present study comprised of 120 subjects of both genders. The consent was obtained from all enrolled patients.

Data such as name, age, gender etc. was recorded. In all subjects, 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). Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Total- 120		
Gender	**Males**	**Females**
Number	50	70

Table I shows that out of 120, males were 50 and females were 70.

Table II Pearson correlation of morphometric measurements of the cervical vertebrae (C2, C3, and C4) and skeletal age

Gender	Concavity			Anterior height		angle	
	C2	C3	C4	C3	C4	C3	C4
Boys							
Correlation coefficient	0.64	0.67	0.68	0.77	0.71	0.23	0.09
P value	0.05	0.01	0.04	0.01	0.05	0.01	0.01
girls							
Correlation coefficient	0.58	0.70	0.71	0.75	0.76	0.35	0.37
P value	0.01	0.02	0.01	0.04	0.05	0.01	0.02

Table II shows that Excellent correlations were found for concavity of C2,C3, and C4 as well as for anterior height of C3 andC4. Although statistically highly significant, angle C3 had only a low correlation coefficientand angle C4 did not correlate at al.

Table III Agreement of calculated skeletal age (CSA) of the Greulich and Pyle hand-wrist assessment

Gender	Skeletal age according to Greulich and Pyle (y)	CSA (years)		Total
		<14	>14	
Boys	<14	20	10	30
	>14	10	10	20
	Total	30	20	50
Girls	<14	25	30	55
	>14	5	10	15
	total	30	40	70

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

Table IV Agreement of chronologic age with the Greulich and Pylehand-wrist assessment

Gender	Skeletal age according to Greulich and Pyle (y)	chronologic age (years)		Total
		<14	>14	
Boys	<14	18	12	30
	>14	10	10	20
	Total	28	22	50
Girls	<14	23	32	55
	>14	5	10	15
	total	28	42	70

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

DISCUSSION

Adolescence is a period during which the rate of growth accelerates, reaches a peak velocity and then decelerates until adulthood is achieved.[6,7] 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.[8] 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.[9]Knowledge of maturation status of a child plays an important role in the diagnosis, treatment planning and eventual outcome of the treatment.[10,11] 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.[12,13]The present study was conducted to assess skeletal age assessment based on hand-wrist and cervical vertebrae radiography.

We found that out of 120, males were 50 and females were 70. Beit et al[14]analyzed 730 sets of radiographs (cephalogram and hand-wrist) of untreated subjects (352 boys, 378 girls; age range, 6-18 years) from a growth study, each sex as a separate sample. 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) and tested for correlations with the method of Greulich and Pyle. All correlating variables were included in a multiple linear regression to generate a calculated skeletal age. To establish the agreement between the method of Greulich and Pyle and calculated skeletal age, Bland-Altman plots were made, limits of agreement were identified, and cross-tables (before and after peak height velocity) were computed. Similarly, the agreement between the method of Greulich and Pyle and each subject's chronologic age was estimated for comparison. Results: 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%)

We found that excellent correlations were found for concavity of C2,C3, and C4 as well as for anterior height of C3 andC4. Although statistically highly significant,angle C3 had only a low correlation coefficientand angle C4 did not correlate at al.

We found that there was agreement of calculated skeletal age (CSA) of the Greulich and Pyle hand-wrist assessment. We found that there was an agreement of chronologic age with the Greulich and Pyle hand-wrist assessment.Mahajan et al[15]determined the validity of cervical vertebrae radiographic assessment to predict skeletal maturation. Left-hand wrist and lateral cephalometric radiographs of 100 Bangalore 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 were

Significant 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.

CONCLUSION

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

REFERENCES

1. Baccetti T, Franchi L, Kim LH. Effect of timing on the outcomes of 1-phase nonextraction therapy of Class II malocclusion. Am J Orthod Dentofacial Orthop 2009;136:501-9.
2. Fishman LS. Chronological versus skeletal age, an evaluation of craniofacial growth. Angle Orthod 1979;49:181-9.
3. H€agg U, Taranger J. Maturation indicators and the pubertal growth spurt. Am J Orthod 1982;82:299-309.
4. Pirinen S. Endocrine regulation of craniofacial growth. Acta Odontol Scand 1995;53:179-85.
5. Masoud M, Masoud I, Kent RL Jr, Gowharji N, Cohen LE. Assessing skeletal maturity by using blood spot insulin-like growth factor I (IGF-I) testing. Am J Orthod Dentofacial Orthop 2008;134:209-16.
6. Franchi L, Baccetti T, McNamara JA. Mandibular growth as related to cervical vertebral maturation and body height. Am J Orthod Dentofacial Orthop 2000;118:335-40.
7. H€agg U, Taranger J. Menarche and voice change as indicators of the pubertal growth spurt. Acta Odontol Scand 1980;38: 179-86.
8. Greulich WW, Pyle SI. Radiographic atlas of skeletal development of the hand and wrist. 2nd ed. Redwood City, Calif: Stanford University Press; 1959.
9. Fishman LS. Radiographic evaluation of skeletal maturation. Angle Orthod 1982;52:88-112.
10. Flores-Mir C, Nebbe B, Major PW. Use of skeletal maturation based on hand-wrist radiographic analysis as a predictor of facial growth: a systematic review. Angle Orthod 2004;74:118-24.
11. Tanner JM, Whitehouse RH, Cameron N, Marshall WA, Healy MJR, Goldstein H. Assessment of skeletal maturity and prediction of adult height (TW2 method). 2nd ed. London, United Kingdom: Academic Press; 1975. 1
12. Hassel B, Farman AG. Skeletal maturation evaluation using cervical vertebrae. Am J Orthod Dentofacial Orthop 1995;107:58-66.

13. Baccetti T, Franchi L, McNamara J. An improved version of the cervical vertebral maturation (CVM) method for the assessment of mandibular growth. Angle Orthod 2002;72:316-23.
14. Beit P, Peltomäki T, Schätzle M, Signorelli L, Patcas R. Evaluating the agreement of skeletal age assessment based on hand-wrist and cervical vertebrae radiography. American Journal of Orthodontics and Dentofacial Orthopedics. 2013 Dec 1;144(6):838-47.
15. Mahajan S. Evaluation of skeletal maturation by comparing the hand wrist radiograph and cervical vertebrae as seen in lateral cephalogram. Indian J Dent Res 2011;22:309-16.