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Assessing age using Nolla's method and comparing its efficacy with skeletal age from hand wrist radiographs: A clinico-radiographic study.

Dental Science

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ABSTRACT

Aim: to assess dental age using Nolla's method and to find the correlation amongst the skeletal, dental, and chronological ages.

Material and methods: Ninety Indian healthy children in the age group 9–13 years, comprising equal number of males and females, were included in the study. The children were radiographed for hand-wrist of the right hand and intraoral periapical X-ray for right permanent maxillary and mandibular canine.

Results: There was high correlation between skeletal maturation indicator and canine calcification stages for both male and female children (0.635, 0.891).

Conclusion: Chronological age showed inconsistent correlation with dental and skeletal ages.It was concluded that canine calcification stages can also be used for assessing skeletal maturity.

KEYWORDS:

Chronological age, canine, dental age, hand-wrist, skeletal age

INTRODUCTION

Individual identification and age assessment is a subtle concept and often one of the important priorities in mass disasters, road accidents, air crashes, fires, and even in the investigation of criminal cases. When entire skeleton is available, age can be assessed with 10% accuracy but in cases of mass disaster where usually fragmented bones are left, it is based on whatsoever information that can be collected from the site.[1] The most reliable measures of age identification include assessment of dental age, skeletal age and biological methods like DNA profiling. However, when soft tissues of human remain become putrid or is burnt or DNA is severely damaged, DNA analysis cannot be carried out. Thus, identity of the remains can only be determined by anthropological methods. [1]

Among various methods of dental age assessment, Nolla's method which was introduced in 1960 serves as a reliable indicator for age. It comes under age determination during the first two decades of life. Present study is conducted to assess age of children by using Nolla's method and also to compare its efficacy with skeletal age assessment using hand wrist radiographs.

Generally chronologic age is considered poor indicator for estimating the degree of skeletal maturity due to significant individual growth variations among children of the same or calendar age group. [2]The hand wrist radiograph has been one of the most popular biological indicator used to assess skeletal development, however routine use of hand wrist radiograph has been recently questioned due to ethical issues. Additionally radiation exposure is the primary concern. [3]Tooth formation is suitable for estimation of age because it is continuous, progressive process that can be followed radiographically from the crypt stage to the closure of root apex. Also tooth development is uniform and is less influenced by external factors such as malnutrition, diseases and mental stress. If strong association exists between skeletal maturity and dental calcification stages the stages of dental calcification can be used as a first level diagnostic tool to estimate the timing of the pubertal growth spurt. [1,3]

MATERIALS AND METHODS

The present study was conducted on randomly selected 90 healthy children in the age group of 9–13 years. Forty-five males (10–13 years) and forty-five females (9–12 years) were selected. The sample was selected from the outpatient Department of Orthodontics and Dentofacial Orthopedics, Hazaribagh College of Dental sciences, Hazaribagh, Jharkhand, India.

The criteria for inclusion in the study population was as follows; all the subjects selected were moderately built and were of growing age with no history of deformities, bone diseases, and major illness in the past . None of the subjects showed any facial asymmetry or history of trauma or surgery in the dentofacial region or had undergone orthodontic treatment. The subjects with muscular dystrophy, congenital abnormalities affecting growth and development, or traumatic lesions of cervical vertebrae, jaw, and handwrist were excluded. All the subjects were divided into two groups: Group 1 consisted of males and Group 2 consisted of females. Each group was further divided into three subgroups on the basis of age as shown in Table 1.

Table 1: subject grouping

S.no	Group 1 (Male subjects)			Group 2 (Female subjects)		
	Subgroup	Age	No. Of subjects	Subgroup	Age	No. Of subjects
1	A1	10-11	15	A2	9-10	15
2	B1	11-12	15	B2	10-11	15
3	C1	12-13	15	C2	11-12	15

Hand-wrist radiograph was taken by placing the left and right hand-wrist on the cassette with fingers slightly separated using 8X10 films. Screen film and target film distance was 90 cm. The film was exposed to 20 mA current for an average of 0.5 s. Intraoral periapical (IOPA) radiograph of maxillary and mandibular right canine region was taken by using bisecting angle technique with film size 31x 41 mm Kodak. The film was exposed to 60 kV power for 1.4 s. All the radiographs of each subject were taken on the same day.

In the present study, radiographic interpretation was made as per the

system developed to interpret skeletal maturation given by-

1. Fishman[2] (1982): Hand-wrist radiographs for SMI as shown in Figure 1. Hand-wrist radiographs were assigned according to the standards given in the "Radiographic Atlas of Greulich and Pyle."[4]
2. C. M. Nolla[5] (1960): IOPA radiographs of maxillary and mandibular permanent right canine were assessed for dental age according to Nolla's[5] calcification stages. Figure 2.

RESULTS

Table 2 shows age assessment as per Fishman's method, the norms for maturation of canines
for boys and girls and correlation of age by SMI and by calcification stages of maxillary and mandibular right canine.

Table2: Comparison of age by skeletal age assessment & dental age assessment methods

Age assessment by SMI			Norms for maturation of permanent teeth				
				Boys		Girls	
Skeletal maturity indicator	Male age (in years)	Female age (in years)	Age (in years)	Mandibular right canine growth stage	Maxillary right canine growth stage	Mandibular right canine growth stage	Maxillary right canine growth stage
SMI 1	11.0	9.0	3	3.2	3.0	3.4	3.3
SMI 2	11.7	10.6	4	4.2	3.9	4.4	4.3
SMI 3	12.1	10.9	5	5.1	4.8	5.4	5.3
SMI 4	12.3	11.2	6	5.9	5.6	6.3	6.2
SMI 5	13.0	11.6	7	6.7	6.3	7.2	7.0
SMI 6	13.8	12.0	8	7.4	7.0	8.0	7.8
SMI 7	14.4	12.3	9	8.0	7.7	8.7	8.5
SMI 8	15.1	13.1	10	8.6	8.4	9.2	9.1
SMI 9	15.5	13.9	11	9.1	8.8	9.7	9.5
SMI 10	16.4	14.8	12	9.6	9.2	10.0	9.8
SMI 11	17.4	16.1	13	9.8	9.6		10.0

Correlation of age by SMI, age by maxillary right canine and age by mandibular right canine

Correlation between age by SMI and age by right maxillary canine		Correlation between age by SMI and age by right maxillary canine	
Group 1	0.635**	Group 1	0.697**
Group 2	0.891**	Group 2	0.869**

DISCUSSION

Chronologic age conveys only a rough approximation of the maturational status of a person, hence dental and skeletal ages have been explored as maturity indicators since decades. Assessing maturational status can have a considerable influence on diagnosis, treatment planning, and the eventual outcome of orthodontic treatment. Growth modulation procedures which bring about changes in the skeletal base such as use of extra oral orthopaedic forces or functional appliances are based on active growth periods.[2,4]

The study of morphological pattern of teeth on dental X ray of children is more reliable than most other methods and is commonly used to determine age in humans.The identification of the skeletal maturation level provides very useful means of identifying specific points along the progressive path of adolescent growth. A skeletal age could be assessed by time-tested hand-wrist radiographs or by canine calcification stages on periapical radiographs; the latter is easier and cheaper to procure than hand-wrist X rays. Assessment of the maturation is of utmost importance in certain orthodontic protocols like, for myofunctional therapy, before starting with rapid maxillary expansion, and for timing of ortho-surgical procedures (surgery for mandibular setback should be carried out only after mandibular growth has completed).[1,3,5]

In the present study, there was a significant difference between chronological age and skeletal age assessed by SMI. This supported the fact that skeletal maturation showed variation in comparison to chronological age. Hence, use of chronologic age to assess maturation status is questionable. This study was supported by studies done by Hunter,[6] and Schour and Masseler.[7]

Correlation between age assessed SMI and canine calcification stages of maxillary and mandibular right canine was highly significant for males and females. Considering this study, it could be stated that canine could also be used as an SMI. As per this study, canine calcification stage 9 was related to capping of the third middle phalanx and appearance of the adductor sesamoid of the thumb. Hence, maxillary and mandibular canine calcifi cation stage 9 confirmed the attainment of peak height velocity (PHV). Intermediate stage of canine calcification between 8 and 9could be used to identify the early stage of pubertal growth spurt. As these stages could be assessed on IOPA, this could prove more economical and convenient as armamentarium required is much simpler and even radiation dose is less.

It can be inferred that chronological age could not be used reliably for assessing skeletal maturity, but strong correlation was observed between SMI and maxillary and mandibular canine calcification stages. This confirmed the reliability and validity of canine calcifi cation stages to be used as SMI. This also eliminated the use of additional radiographic exposure (hand-wrist radiograph) of patients in orthodontic practice because canine is recorded on panoramic radiograph.

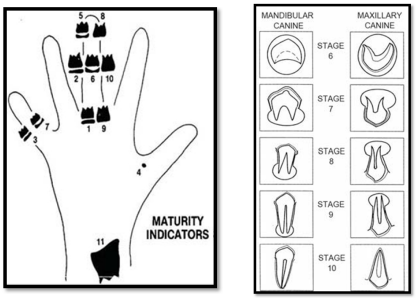
In this study, females were ahead in skeletal maturation than males in all the age groups. This is supported by Castellanous et al,[8] Results of the present study show insignificant difference in dental development in males and females. The study was supported by Nolla.[5] The technique has the advantages of being simple, using low patient radiation dose, and exhibiting high degree of clarity of the radiographs. The equipment required is available in most dental clinics. For both the sexes, skeletal age (from hand-wrist) and dental age do not show high correlation with chronological age in all the age groups in this study. This indicates that the chronological age has no sufficient correlation with individual maturational development. Similar findings have been reported by Koshy,[9] Demirjian et al[10].

CONCLUSION

1. Skeletal maturation was more advanced in comparison to chronological age in both males and females.
2. There was good correlation between age assessed by SMI and canine calcification stages.
3. Canine calcification stages could also be used as a skeletal maturity indicator besides SMI.

Legends for figures and tables

Table 1: Subject grouping
Table 2: Comparison of age by skeletal age assessment & dental age assessment methods
Fig.1: Eleven skeletal maturity indicator
Fig.2: Nolla's developmental stages of permanent teeth



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