A CROSS-SECTIONAL STUDY TO ASSES CORRELATION BETWEEN DENTAL AGE AND CHRONOLOGICAL AGE AMONG CHILDREN AGED 6-14 YEARS IN M. G. M. MEDICAL COLLEGE & L. S. K. HOSPITAL, KISHANGANJ, BIHAR

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ABSTRACT

Background and objectives: Age estimation of an individual has a great significance in forensic medicine. Age determination is an integral part of job & it's a legal duty of a forensic expert & dental surgeon in so many medicolegal cases where question arises regarding Criminal responsibility, Marriage contract, Rape, Attainment of Majority, Eligibility for employment etc., in court of law. Age estimation of a person can be done through many ways, and an analysis of all possible method is best for an overall estimate. Study of Tooth development is one of the principal means, which help a forensic expert to form a fairly accurate opinion regarding the age of a person. Dental age has been used to determine a child's developmental age. Dental development is a regulated biological process. If any step of these developmental processes is disturbed or over-exaggerated, due to any reason, changes can occur in teeth development. Also, various factors, such as disputed birth records, premature birth, legal problems, and the need to verify a birth certificate for various purposes (such as admittance to a school, adoption, marriage, employment, or immigration) make identification and age determination increasingly important today. Different populations have had differing success when using bone age, dental age, or a combination of the two to evaluate growth. This study is an attempt, to determine dental age of children aged 6 to 14 years and to establish interrelationship, amongst the dental and chronological ages and their differences if any exits.

Material and Method: A total of 800 patients aged 6 to 14 years who visited the Dental department at LSK Hospital in MGM Medical College Kishanganj Bihar as outpatients from January 2021 to December 2021 were screened for this cross-sectional study. The Demirjian method was used to calculate dental age. Pearson's and Spearman's correlation tests were used to determine the association between chronological and dental in the study population.

Result: There was a strong positive correlation between age, dental age, and all stages of MP3 development in the male population. The same was true for females, with the exception of a moderate correlation between chronological age and dental age in the H stage of the MP3 region that was not statistically significant.

Conclusion: The results of this study showed a statistically significant correlation between chronological age, dental age, and skeletal age for all subjects, with females maturing before males.

Keywords: Demirjian technique, Modified MP3 method, Age estimation

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INTRODUCTION

A person's growth is affected by their genes, race, food, hormones, environment, and climate [1, 2]. Many different factors, such as one's chronological age, one's biological age, one's morphologic age, one's skeletal age, one's dental age, one's circumpubertal age, one's behavioral age, one's mental age, and one's self-concept age, can be used to estimate one's age [2]. Even while chronological age is the most straightforward and simple measure of developmental age, it is not a good indicator of stage of development because it varies from person to person [2,3]. Therefore, researchers attempted to establish a correlation between a child's dental age. While both tooth emergence and calcification can be used to estimate a person's age in terms of their teeth, the latter is generally considered more reliable [3-7] because to its reduced sensitivity to environmental and lifestyle factors. Dental age was determined using Demirjian's method, which takes into account the progression of calcification. The ease of use and radiographic and schematic depictions of tooth development make this approach the most popular [4, 8].

In contrast, the ossification of epiphyseal centers follows a predictable pattern that can be used to estimate a person's age [9]. Fishman LS [10] recommended using ossification centers found in hand wrist radiographs and cervical vertebrae in lateral cephalograms. Radiation risks, high costs, bulky equipment, and a lack of visualization of the vertebrae limit its application in juvenile patients [10,11]. Ossification of the MP3 area of the middle phalanx can be described using a method developed by Hagg U and Taranger J [11]: MP3F, MP3FG, MP3G, MP3H, and MP3I. Low radiation exposure, high correlation with the six stages of cervical vertebrae growth, the absence of superimposition of bones or changes in posture, and the lack of the need for specialized X-ray equipment are only a few of the benefits of this method over others. The first person to use intraoral periapical radiographs to evaluate the validity of MP3's five phases was Abdel Khader HM [12]. The MP3 method was further enhanced by Rajagopal R and Kansal S, who included the MP3HI step [13]. It's common knowledge that a kid's actual age doesn't necessarily match up with where they are in terms of development. However, dental and skeletal age have substantial correlations and are more reliable and accurate than chronological age in assessing a person's level of development [14, 15]. In this study, participants' dental ages were correlated with their chronological ages.

Material and Methods:

This cross-sectional study was conducted in the Department of Forensic Medicine and Toxicology at MGM Medical College and LSK Hospital, Kishanganj, Bihar over a period of 06 months after approval from the institutional ethics committee via letter no. MGM/PRI-511/2020. Only 50 subjects between the ages of 6 and 14 years old were chosen for the study out of a total of 800 screened children after applying exclusion criteria. A total of 800 patients aged 6 to 14 years who visited the dental department at LSK Hospital in Mata Gujri Memorial Medical College, Kishanganj Bihar as outpatients from January 2021 to December 2021. The study included well-nourished children of Indian descent having no history of any past chronic illness or growth affecting disorder with pure ancestral background from India who needed skeletal maturity assessment for orthodontic evaluation. Subject should have a complete mandibular permanent dentition (erupted or not). Determination of dental age was based upon the rate of development and calcification of tooth buds. Demirjian's method was used for estimating dental age by reference to the radiological appearance of teeth. Chronologic age of all children was calculated by subtracting the birth date from the date on which the radiographs were exposed for that individual.

Statistical Analysis

A single evaluator logged the data and analyzed it statistically using SPSS version 17.0. The association between chronological age, dental age, and skeletal age in the study population was analyzed using Pearson's and Spearman's tests. Twenty subjects were selected at random and remeasured by a third researcher who was blind to the initial findings to ensure the accuracy of the results. There was little to no noticeable variation between the values obtained by each researcher.

RESULT

The results of this investigation showed a statistically significant correlation between patients' chronological age, dental age (using the Demirjian method), and MP3 skeletal stages. There was a strong correlation between age (both biological and dental) and all MP3 stages in males. The situation in females was almost identical to that in males, apart from a substantial but non-significant correlation between chronological age and dental age in the H stage of ossification of the middle phalanx in the MP3 region. Males showed a strong positive Spearman's correlation between the ossification stages of the middle phalanx in the

MP3 region and both the continuous variables of chronological age and dental age, while females showed a weaker but still significant correlation.

Table 1: The relationship between chronological age and dental age

Stage	Mean chronological age (years)	Mean dental age (years)	Correlation coefficient
F	8.29±0.47	9.14±0.31	0.61
FG	10.11±2.01	10.74±1.58	0.72
G	10.12±0.27	12.65±0.24	0.69
H	11.20±0.34	11.78±0.52	0.80
HI	12.78±0.69	13.25±0.83	0.81
I	13.35±0.41	14.56±0.47	0.68

To keep track of the x-rays, they were given unique identifying numbers. Patients' chronological ages were calculated by subtracting their birth dates from the date of their radiographs. Exposures of 8 MA, 71 kvp, and 14.1 seconds were used on a digital panoramic radiography equipment to take extraoral images. The seven permanent teeth on the patient's left side of the jaw were assigned letter grades from A to H. The scores were determined by comparing dental blueprints to x-rays in accordance with Demirjian's criteria for each developmental stage. Demirjian's normative tables for girls and boys were used to convert the ratings into scores.

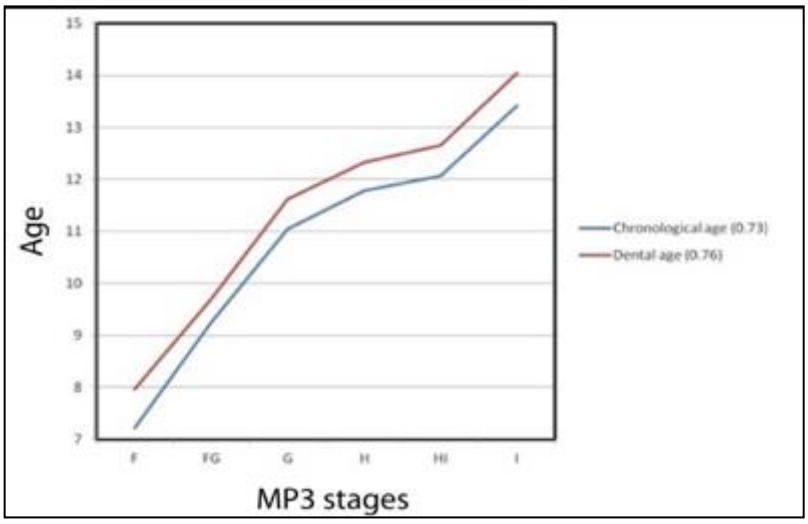
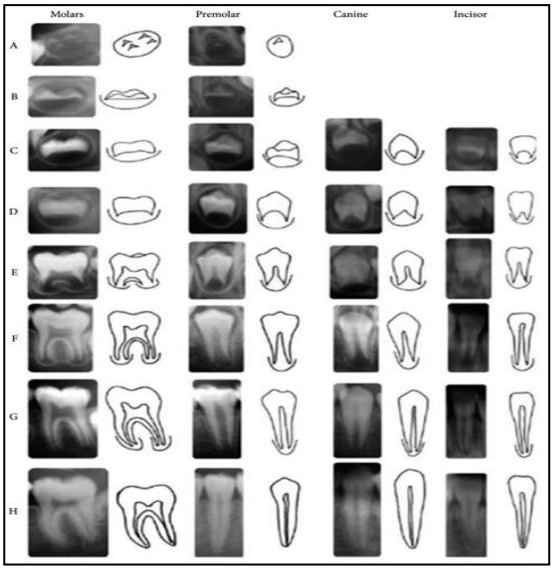


Figure 1: Relationship between men's chronological age and dental age



(a)

(b)

(c)

Figure 2: (a) Demirjian's method for estimation of dental age, (b & c) Orthopentamograph

The seven teeth were added together to determine an overall maturity score. This maturity score is easily converted into dental age using the Demirjian normative tables for girls and boys. In this investigation, an MP3 radiograph was used to establish the modified MP3 technique; this type of digital radiography makes use of exposure parameters of 8 MA, 70 kvp, and 0.32 seconds.

DISCUSSION

The medical and dental communities can benefit from accurate age assessment because it aids in the detection of age-related diseases and conditions. Early repair of skeletal and dental defects in children is substantially aided by accurate assessment of the patient's age and stage of development, which in turn affects the course of treatment and its ultimate success. In the current investigation, we used the child's birth date (obtained from the birth records) to determine the child's chronological age. It was calculated by deducting the date of radiographic exposure from the date of birth. Decimals were employed to simplify statistical computations based on annual age estimates. Skeletal age was calculated using a modified MP3 methodology and digital radiography [14-16], while dental age was assessed using the Demirjian method.

Since ossification changes in bone structure and size may be observed directly, skeletal age is regarded as more reliable and accurate than chronological age. There are concerns about the increased radiation exposure, but the method developed by Fishman LS, which uses the four stages of bone maturation at six anatomic sites on the hand and wrist, is becoming increasingly popular. To predict whether or not a person will continue to grow and develop normally after being exposed to radiation, Goto S et al. used the degree of ossification of the distal phalanx of the first digit. Abdel-Kader HM used these MP3 stages visible on IOPA films to evaluate skeletal maturity, and he later listed several benefits of digital radiography over conventional radiography, including shorter exposure times (5x faster) and the absence of darkroom procedures (improved image clarity). As Low as Reasonably Achievable is also a tenet of this method [17, 18].

This study examines children's chronological, dental, and skeletal ages to shed light on the debate surrounding the correlation between skeletal and dental development. Lewis AB and Gran SM found no statistically significant difference between skeletal and dental maturation in their study of children in Ohio. However, in a study of 153 Caucasian children ages 8 to 12 who were receiving orthodontic treatment, Sierra A. M. found a significant correlation between dental and skeletal age [19, 20].

A substantial statistical significance was found among males in the current study between chronological age, dental age, and skeletal age. When comparing dental age to chronological age, Hegde RJ and Sood PB came to the same conclusions. The high correlation between tooth calcification stages and skeletal maturation stages found in a study by Uysal T et al. suggests that tooth calcification stages may be therapeutically important as a maturity indicator for pubertal growth. Another study including 80 children aged 8 to 14 years old found a significant correlation between dental and skeletal age [21, 22].

The current study demonstrated a statistically significant link between chronological age, dental age, and skeletal age in females, except for the H stage of MP3. Females reached skeletal maturity before their chronological and dental ages, but later than males. Girls typically reach adulthood before

boys, according to studies conducted by Uysal T. et al. on 500 Turkish children and Soegiharto BM. et al. However, studies conducted on 140 Caucasian youngsters by Chertkow S. and Paul F. and 261 Thai participants by Krailassiri S. et al. discovered no statistically significant difference between the sexes. There was a substantial difference between the HI and I stages when comparing boys and girls based on the correlation between dental and skeletal age [23]. Researchers Madhu S et al. found that the average chronological ages of boys and girls in the Mangalore community varied with respect to MP3 phases. Differences in the population's age, ethnicity, diet, and estimation method might account for the discrepancy.

Applying Demirjian's approach to a sample of children between the ages of 6 and 14, the researchers found that the method was highly accurate, with an overestimation of only 0.63 years in boys and 0.59 years in females. Overestimation was determined to be 0.14 years by Hegde RJ and Sood PB, 3.04 years by Koshy S and Tandon S, 1.20 years by Prabhakar AR et al., and 0.04 years by women. Demirjian's approach may overestimate a person's age based on their teeth because of disparities in nutrition, socioeconomic status, ethnicity, and standard tables developed for the French-Canadian population [22–24].

Numerous studies have been conducted to determine whether or not there is a correlation between chronological age, skeletal age, and dental age; however, very few studies have been reported in the literature correlating all three parameters. Though it's easy to determine chronological age, it's not a reliable indicator of development. Although the Demirjian method has high reproducibility and reliability, its usefulness and widespread acceptability in cases of anodontia, ethnic disparity, and disparities in age estimation across geographic regions remain unclear. Since a simple digital radiograph of MP3 can be chosen that satisfies all criteria, including low radiation exposure in accordance with the ALARA principle, easier estimation, reliability, and good reproducibility, skeletal age assessment methods with a high accuracy in determining a person's growth status can be selected. Although there is a strong correlation between skeletal and dental age, it cannot be considered the only correct indicator in measuring growth. There is no agreed-upon method for measuring a person's age, however the stages of dental calcification may be useful as a complement to skeletal maturity [23-26].

Limitations of the study: We had a limitation that, this was a single-centre study with a small sample size.

CONCLUSION

Because of the limitations of chronological age as a measure of maturity, researchers have looked into dental and skeletal ages as potential alternatives. The correlation between chronological and dental age was strong in both sexes. In the sample used for this analysis, females matured before their male counterparts, and the correlation between chronological and dental age differed significantly between the HI and I phase of MP3 for both sexes. Bone age might be determined with greater accuracy, convenience, and with a lower radiation dosage with the proposed method of employing MP3 with digital radiography.

Key take-home message: The novelty of the knowledge emerging from this original research is relevant to the interest of the journal readers who are in Forensic expert and Dental care providers.

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There is no conflict of interest.

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