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Skeletal Maturity on Evaluation by using Dental Calcification as Diagnostic Tool

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ABSTRACT

Objective: To determine the correlation of skeletal maturity with chronological age by using the dental calcification.
Study Design: Cross sectional study.
Place and Duration of Study: The Department of Dentistry, Sandeman Provincial/Civil Hospital, Quetta Pakistan from Jun to Dec 2019.
Methodology: Fifty individuals with permanent mandibular teeth, either gender was included. Chronological age was noted and dental maturity was assessed by using dentalx-ray tooth (Ortho-pantomogram) having calcification first and second premolartoothas per Demirjian criteria. Pearson's correlation coefficient was calculated with *p*-value≤0.05 kept as significant.
Results: The mean chronological age of individuals was 43.71±22.31 years. There were 28(56%) males while 22(44%) females. The mean dental calcification age was 42.90±22.05 years. There was significantly strong positive correlation between dental calcification & chronological age i.e. r=0.995 (*p*<0.001).
Conclusion: Thus dental calcification can be applied to determine the chronological age, especially for identification offorensic cases or autopsy cases.

Keywords: Chronological age, Dental calcification, Dental X-ray, Orthopantomogram, Pearson'scorrelation, Skeletal maturity.

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INTRODUCTION

Indisputable evaluation of an individual is of principal importance in forensic & judicial in routine. Estimation of age is a very important factor, which is applied in order to correctly identify an individual. Generally, the teeth can be preserved for prolonged period making them reliable objects for the age estimation. During the phenomena of tooth growth, it is potential to approximate the age of an individual by comparing different stages of eruption of the teeth.[1] Age estimation is usually considered after 14 years of an individual's age, as all the permanent teeth, excluding the 3rd molars would achieve the complete development. For medico-legal determinations, the execution of 18 years age is very important cut-off point. The correct estimation of age during this time period might be needed not only to distinguish the status from adolescence and adult but also to assess the age concerning the social welfares, occupation and matrimonial. The wisdom tooth represents the only too still in the developmental processin this age and is thus very important for the calculation of dental age.[2]

In developing countries, the rationale for the impetus on estimation of chronological age is varied. First and foremost, 80% of Indian population resides in rural areas where the awareness for registration of childbirth is minimal. Hence, individuals are not aware of their definite date birth.[3] Many researchers have reported relationships of calcification stages of an individual teeth with skeletal maturity. A few studies are available in the literature about Indian populations.[4]

Currently, there is an alarming rise in the crimes ratein young adults and of mass devastation, which highlight the dominance of the estimation of specific age. Out of several methods use for estimation of age, the dental age assessment and its correlation with actual age has very great importance during recent years.[5] Assessment of dental maturation is the only valuabletool to diagnose the pre-pubertal and post-pubertal growth periods.[6]

Development of the dental arch or tooth has been investigated extensively as one of the potential predictor for the skeletal maturation. Dental development can be evaluated by using the method of stages of calcification in the tooth. It is also considered to be a very reliable way to estimate the age of an individual.[7]

Previous trials have already assessed the correlation between stages of skeletal maturation and calcification of tooth by comparing several methods in different population groups.[8-11] Dental maturity is a vital factor in the field of forensic medicine, particularly in abandoned cases, dead bodies or autopsies. Dental calcification has been reported very closely correlated

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with individuals' actual age. But no local evidence found in literature, which could help the implementation of dental calcification for correct estimation of age. We conducted this study to get the reliability evidence of dentalcalcification maturation to predict he chronological age before undergoing any procedure or in case of identification of unowned dead bodies. So this study would provide us the evidence which can help us to determine the maturation phase of an individual by using dental calcification, which is based on dentalx-ray of the tooth (Orthopantomogram, OPG) instead of going for other maturation procedures.

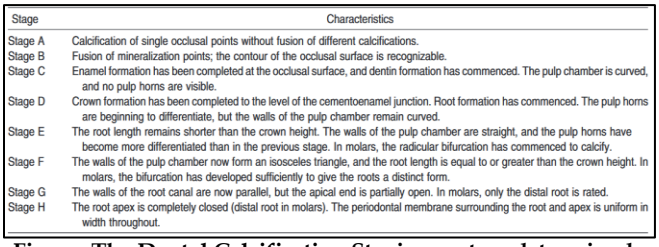
METHODOLOGY

The study was conducted at the OPD of Department of Dentistry, Sandeman Provincial/Civil Hospital, Quetta Pakistan, for Six months i.e. from June 2019 to December 2019. The sample size of n=25 cases was estimated by applying formula of correlation coefficient i.e. type-I error=5%, type-II error=10% with previously reported correlation coefficient i.e. r=0.777 between dental calcification and chronological age. The individuals were recruited in the study by applying then on-probability, consecutive sampling technique, because of the following selection criteria.

Inclusion Criteria: Individuals aged 10–90 years, of both genders who had permanent erupted teeth were included.

Exclusion Criteria: Patients with abnormal growth and development, chromosomal disease, impaction, transposition, and congenitally missing teeth, previous orthodontic treatment were excluded from the study.

Informed consent was taken before enrollment and their demographic details were noted. The assessment of dental calcification was done by usingdental x-ray tooth (Orthopantomogram) having calcification of first premolar and second premolaras per definition of Demirjian in Figure. All the procedures were done by researcher.



Stage	Characteristics
Stage A	Calcification of single occlusal points without fusion of different calcifications.
Stage B	Fusion of mineralization points; the contour of the occlusal surface is recognizable.
Stage C	Enamel formation has been completed at the occlusal surface, and dentin formation has commenced. The pulp chamber is curved, and no pulp horns are visible.
Stage D	Crown formation has been completed to the level of the cementoenamel junction. Root formation has commenced. The pulp horns are beginning to differentiate, but the walls of the pulp chamber remain curved.
Stage E	The root length remains shorter than the crown height. The walls of the pulp chamber are straight, and the pulp horns have become more differentiated than in the previous stage. In molars, the radicular bifurcation has commenced to calcify.
Stage F	The walls of the pulp chamber now form an isosceles triangle, and the root length is equal to or greater than the crown height. In molars, the bifurcation has developed sufficiently to give the roots a distinct form.
Stage G	The walls of the root canal are now parallel, but the apical end is partially open. In molars, only the distal root is rated.
Stage H	The root apex is completely closed (distal root in molars). The periodontal membrane surrounding the root and apex is uniform in width throughout.

Figure: The Dental Calcification Staging system determined by Demirjian Index,12

The SPSS v.21 was used toenter the collected information to generate a data sheet and analyze it. Dental calcification and chronological age were presented as mean and standard deviation and correlation coefficient was calculated between dental calcification and chronological age by using Pearson's correlation, keeping significance at *p*-value ≤0.05.

RESULTS

The mean chronological age of individuals was 43.71±22.31 years. There were 28(56%) males and 22 (44%) females. The mean age of individuals based on dental calcification was 42.90±22.05 years. Table-I.

Table-I: Demographic information of the Study Participants (n=50)

Variables	n(%)
Age	43.71±22.31
Gender	
Male	28(56%)
Female	22(44%)
Dental Age	42.90±22.05 years

There was significantly strong positive correlation observed between dental calcification and chronological age i.e. r=0.995 (p<0.001). Among males, the correlation between calcification and chronological age was also positively strong i.e. r=0.995 (p<0.001) and also among females the correlation is very strong and positivei.e. r=0.995 (p<0.001). Table-II.

Table-II: Correlation between Chronological Age and Dental age (n=50)

	n	Pearson correlation	*p*-value
Overall	50	0.995	<0.001
Male	28	0.995	
Female	22	0.996	

DISCUSSION

Estimation of age of an individual is a very precarious step in the proof of identity of the sensitive cases in the field of forensic medicine. The assessment of maturational status and/or pubertal growth emission of an individuals has substantialimpact on the diagnosis, planning the treatment as well as the consequences of dental or orthodontic procedures.[13]

In dentofacial orthopedics and orthodontics, the skeletal maturity stage can be a significant predictor and have significant impact on the determination of particular diagnosis, treatment aims and planning, and the results of the orthodontics treatment. A perfect duration for the orthodontic treatment is dissimilar in many malocclusions and therapeutic mechanism.[14,15]

The skeletal age had already been evaluated by comparing theestimated maturation of the hand-wrist

with the stages of cervical vertebrae or stages of calcification of canines in the past and it had also been very closely linkedwith the craniofacial growth. The prominence of the pubertal growth spurt in several orthodontic treatmentoptions are already well-known.[16]

Demirjian's method considered as the gold standard is based on calcification of permanent seven teeth on left mandibular side. The calcification of a tooth is allocated in 8 stages. Each stage has been nominated a particular score. The scoring is different for males and females.[17,18] Although numerous studies have been done utilizing this method in different ethnic populations, the most commonly witnessed drawback is that the method is time consuming while less user friendly as numerous tables have to be referred to.[19,20]

The method is composed of the evaluation of stage of dental calcification to estimate the dental maturation for each tooth present in the dental arch for both mandible and maxilla, though observing the growth of the development of the tooth root and crown by using panoramic radiographs.[21,22] The maturation stages by calcification of maxillary canines, mandibular 2nd and 3rd molarsare the predictors of skeletal maturity, which could be clinically applied with consideration, up until this technique is prove dafter apply-ing on a larger sample of individuals.[23] In this study, we observed very strong positive and significant correlation between dental calcification and chronological age i.e. r=0.995 (p<0.001).

Nanda *et al.* also foundthat the positive correlation existamongst dental calcification & chronological age i.e. r=0.779 (p=0.000).[24] As well as Macha *et al.* observed a positive correlation in dental calcification & chronological age i.e. r=0.709 (p=0.000).[25]

In this study, therewas also significantly strong positive correlation observed between dental calcification and actual age among males i.e. r=0.995 (p<0.001) as well as among females i.e. r=0.995 (p<0.001). It has been observed that a strong significant correlation (r= 0.854 for male & r=0.866 for female) exist between dental age and cervical maturation.[12]

In contrast to findings of this study, Yadav *et al.* found that bivariate correlation ranged r=0.58-0.75 for male and r=0.73-0.84 for female, which is considered as weak relationship. Canine showed the highest correlation in males and second molar showed the highest correlation in females.[4]

CONCLUSION

Thus, dental calcification is highly correlated for identification of individual with specific chronological age. We found a significant strong correlation but further studies are required to be done on large sample size to get more reliable results and also correlation of dental calcification with other parameters like skeletal maturity and hand and wrist maturity.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

FN: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

NM: Critical review, concept, drafting the manuscript, approval of the final version to be published.

SH: Data acquisition, data analysis, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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