ADULT FORENSIC AGE ESTIMATION USING MANDIBULAR SECOND MOLAR RADIOGRAPHS- A SHORT STUDY

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Abstract: Determination of age of an individual is one of the most important aspects of medico legal cases and anthropological research. Radiographs can be used directly to measure the rate of secondary dentin deposition.

Aims and objectives: The aim of the present study is to demonstrate a non- invasive and feasible method of age estimation using radiographs of multi rooted teeth for adults in Kadapa population.

Materials and methods: The study was conducted in the Department of Oral Medicine and Radiology at Government Dental College and Hospital, Kadapa. A total of 80 patients aged between 20-60 years were selected. A panoramic radiograph was taken for every patient. Pulp crown height (PCH) and crown root trunk height (CRTH) was recorded on the mandibular second molar followed by calculating pulp crown root trunk height ratio (PCTHR) & then a regression equation was derived. The radiological age is measured by using the regression equation & the disparity between the radiograph and chronological age was noted, the results were statistically analysed.

Results: It was observed that although there was weak negative co relation between age & PCTHR (r= -0.231), the results were statistically significant (p= 0.036). The regression equation thus derived though of minimum use in age group of 20-30 and 50-60 years , it gave excellent results in estimation age of individuals of 30- 40 years and 40-50 years with a mean difference of 3.41 and -4.80 respectively.

Conclusion: Assessment of pulp chamber height could be used to yield significant values and is a reliable parameter for age estimation in the field of forensic odontology.

Key words: PCH, CRTH, PCTHR, AGE ESTIMATION.

Introduction: Age estimation plays a crucial role and is of paramount concern that carries significant evidentiary value in the context of legal proceedings, identification of victims, in forensic studies & in clinical dentistry .Tooth is considered to be the most reliable body part for age estimation since environmental factors

have minimal influence on it [1, 2, 3]. Age estimation is usually done for a plethora of reasons. Some of them might include post mortem identification, verifying age in immigrants & refugees with disputed birth records in mass fatalities like tsunami or manmade catastrophes like terror attacks. Age estimation also helps in both civil & criminal cases making the dentists a part in investigating the crime. Hence the need for the precise and reliable method to estimate age, particularly adult age has become increasingly important[4]. And there is a continuous search for an age estimation which is simple, effortless, less time consuming. Thus the aim of the present study is to demonstrate a non invasive & feasible procedure of age estimation using radiographs of multi rooted teeth in adults.

Methods: The prospective study was conducted in the Department of Oral Medicine and Radiology, at Government Dental College and Hospital (GDCH, Kadapa). Ethical clearance was obtained from the institutional ethical committee. Subjects were selected for the present study with the inclusion criteria of subjects with known date of birth and subjects willing to participate in the study with no obvious dental disease and developmental disorders. Exclusion criteria were: impacted teeth, teeth with root canal treatment, severe regression changes, teeth with radio opaque fillings, developmental anomalies of teeth and pregnant women. A total of 80 panoramic radiographs were taken using a panoramic machine [Vatek, Pax 400c with Kvp 110/230 v weight 200kg].

The subjects were divided into 4 groups; each group consisting of 20 subjects and this 20 Consists of 10 subjects from each gender based on their chronological age: group I (20-30 Years); group ii (31-40 years); group iii (41-50 years); group IV (51-60 years) respectively. All the subjects underwent routine clinical examination and the relevant data was entered in a structured proforma. Patient's birth date was noted after analyzing their specific identity Proofs to record the chronological age.

The panoramic radiograph of each subject was assessed on the OPG connected computer monitor with the help of the measure option on the tool bar points were marked on the central fosse and the highest point on the root furcation and a line was drawn connecting these lines. The points on the roof and floor of pulp chamber bisecting this line were also marked. Points were marked on the central fossa and the highest point on the root furcation and a line was drawn connecting these lines. The points on the roof and floor of pulp chamber bisecting this line were also marked [figure 1]. Between chronological age and pulp chamber and floor of pulp chamber was recorded as pulp chamber height (PCH). A ratio is derived between pulp

chamber height and crown root trunk height; pulp chamber crown root trunk height ratio (PCH/CRTH = PCTHR) in order to avoid projection error. [All measurements were recorded by a single observer.]

Statistical analysis: Satatistical analysis was done using SPSS[statistical package for social sciences]version 20.The values were then subjected to paired t test and pearson's correlation was calculated.

Results: The co relation between the chronological height and pulpal crown height ratio was recorded (PCTHR) which showed a negative correlation and a scattered plot was made which revealed the same [figure 2]. Pearson correlation was done which yielded a negligible co relation between PCTHR and chronological age (r= -0.231) [table 4] But it was statistically significant (p=0.036), A regression equation was then calculated.

Estimated age =-18.940(PCTHR) +43.254; with a variation of 5.35% (r^{2} =0.053).

The regression equation thus obtained was used to calculate the radiograph age of subjects as a total sample, in males, females with respect to each age group. The mean difference between the chronological age and radiographic age was also noted [table 5], which revealed that in general there was an over estimation of +14.76 years in group 1 (20-30 y) & under estimation of -15.73 years in group IV (50-60Y); Where as in group II (31-40 y) & group III (41-50 y) the variation was found to be within 5years which is inacceptable range of forensic odontology.

Discussion: To determine the age of a human remain, many anatomical structures can be used, but the advantage of tooth over other means is that they are more resistant to peri and post mortem tissue altering affects. With an added advantage that teeth can be examined clinically and radiographs can be taken with minimal radiation exposure to living individuals. The assessment of morphological parameters of the teeth is considered to be more reliable compared to other methods of age estimation. One in particular is the assessment of pulp/tooth area ratio is the indirect quantification of the secondary dentin deposition. As this eliminates the affect of environmental factors this could be considered as an internal examination [(5)]. Bodecker in 1925 demonstrated that the apposition of secondary dentin correlated with age [(6)]. The previous studies on the radiographic methods of age estimation using pulp tooth ratio were done on single rooted tooth like central incisors, lateral incisors, canines, mandibular premolars [(7, 8, 9)]. Camerie et al in 2004 conducted a study which utilized pulp tooth ratio of mandibular 2nd molar for adult age estimation [(10)]. So this study was undertaken to demonstrate a radiographic method that was easy, less cumber some, and would need minimum

equipment with more reliable results. The minimum age of the person included in the study was 20 years and was maximum was 60 years. A difference of 10 years was considered because in a previous study conducted by Morse DR (1991) found statistically significant shrinkage in root canal due to dentin deposition was noticed with progression of 10 years of age [11]. From the results of group wise PCTHR it can be interpreted that as the age progresses the PCTHR decreases. The same was represented on a scattered plot.

The Pearson correlation co efficient between age and PCTHR depicted a weak negative co relation (r= -0.231) but it was statistically significant (p=0.036). A linear regression co efficient was derived, the regression equation was formulated. And the difference between the chronological age and radiographic age in total and gender wise was noted (Table 5, 6, 7). The result was as follows; the mean difference in the age Group I (20-30 years) was 14.76, Group ii (31-40 years) was 3.41, Group iii (41-50 years) was -4.80. Group IV (51-60 years) was -15.73 years. From the results it can be inferred that the formation of secondary dentin in younger individuals was less when compared to older subjects. Other factors like diet can also influence the pulp chamber height. Here in the local population of Kadapa do not have severe abrasive habits which explain the reason for the less reduction of pulp chamber in this group (20-30 years). Where as in the group IV there was underestimation of -14 years this may be contributed to the irregularity in the morphology of the tooth and less appreciation of pulp chamber height when compared to the clear visualisation of the morphology of tooth, pulp chambers in younger counterparts on radiographs. On the contrary in group IV (31-40 years) and group v (41-50 years) yielded excellent results with 3.41 and -4.80. Hence it can be inferred that the regression equation thus derived could be routinely incorporated for age estimation of adults in local population of Kadapa with a variability of ±5 years.

In the previous study conducted by George Matthew et al 2013 in Kerala population where the whole sample was considered as a unit [12], contrarily we performed specific age wise study in general and also gender specific which could be of good value in estimating the age of adults aged between 31-50 years.

Conclusion: The regression equation derived was statistically significant which could be used for the local population of Kadapa with a variability of 5 years in the age group of 31-50years. However, studies must be conducted on a larger population in the future to improve the accuracy and reproducibility of the equation to all age groups.

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Figure 1: Shows steps in measuring the crown root trunk height and pulp chamber height.

(a) Points marked on the central fossa and the highest point on the root furcation.

(b) A line drawn connecting these points(c) Points on the roof and floor of the pulp chamber bisecting this line marked.

Table 1: Shows study variables (PTH, CRTH, PCTHR) in total sample.

AGE GROUP	PTH	CRTH	PCTHR
20-30 years	2.34	8.91	0.26
31-40 years	1.71	8.81	0.19
41-50 years	1.21	8.34	0.16
51-60 years	0.98	8.04	0.15

Table 2: Shows study variables in Males.

AGE GROUP	PTH	CRTH	PCTHR
20-30 years	2.67	9.08	0.29
31-40 years	1.64	8.92	0.18
41-50 years	1.15	8.27	0.19
51-60 years	1.52	8.04	0.17

Table 3. Shows study variables in Females

AGE GROUP	PTH	CRTH	PCTHR
20-30 years	2.06	8.47	0.24
31-40 years	1.84	8.68	0.21
41-50 years	1.15	8.27	0.19
51-60 years	0.4	8.04	0.17

Figure 2: Shows scattered plot between chronological age and PCTHR

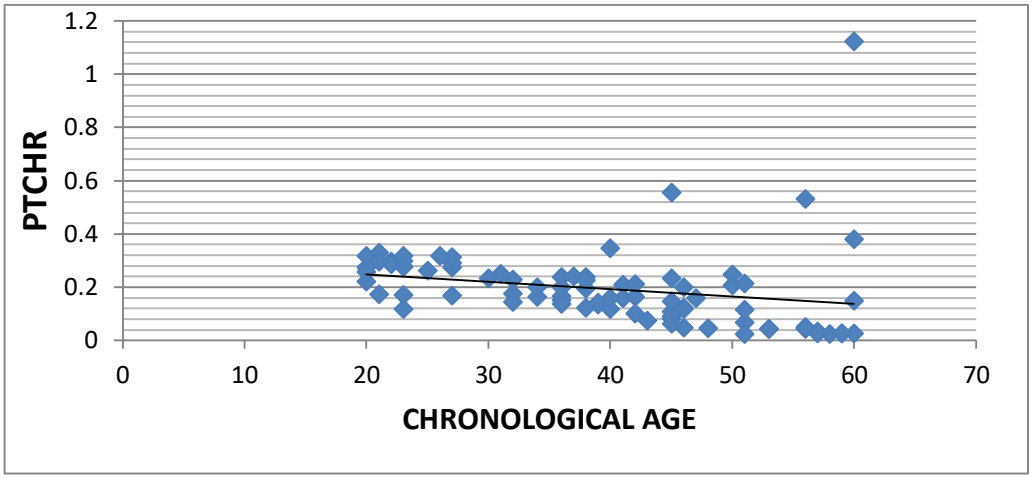

Table 4: Shows Pearson co relation between chronological age and PCTHR

* Correlation is significant at the 0.05 level (2-tailed).

		Age	PCTHR
Age	Pearson Correlation	1	-.231*
	Sig. (2-tailed)		.036
	N	83	83
PCTHR	Pearson Correlation	-.231*	1
	Sig. (2-tailed)	.036	
	N	83	83

Table 5: Shows estimated age and chronological age in total sample

AGE GROUP	CHRONOLOGICAL AGE	ESTIMATED AGE	MEAN DIFFERENCE
20-30 years	23.47	38.24	14.76
31-40 years	36.15	39.56	3.41
41-50 years	44.84	40.04	-4.80
51- 60 years	56	40.26	-15.73

Table 6: Shows estimated age and chronological age in Males.

AGE GROUP	CHRONOLOGICAL AGE	ESTIMATED AGE	MEAN DIFFERENCE
20-30 years	24.44	37.62	13.17
31-40 years	36.78	39.72	2.95
41-50 years	44.33	39.52	-4.81
51-60 years	55.56	39.997	-15.52

Table 7: Shows estimated age and chronological age in Females.

AGE GROUP	CHRONOLOGICAL AGE	ESTIMATED AGE	MEAN DIFFERENCE
20-30 years	22.44	38.55	16.11
31-40 years	35.33	39.25	3.92
41-50 years	45.22	40.90	-4.31
51-60 years	56.11	40.59	-15.52