Age Changes in Dentin and Dental Pulp: A Radiographic Study

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ABSTRACT

Introduction: We are all biologically unique and become more diverse as we age, enhancing the spice of life with increasing variety. In many ways, the teeth are unique organs of the body; they are the most durable part of the skeleton. The gradual changes taking place in the dental tissue after the teeth are fully formed are of clinical importance and need to be recognized by the dental surgeon as being a normal finding and not a part of the disease process.

Aims and Objectives: The aim of this study is to estimate relationship between size of the pulp and the dentin with age and to know if there is a significant difference in size of the pulp and the dentin among various age groups. The clinical significance of the study will be to use the average tooth length and width obtained by this study as the standard guideline for age estimation and to utilize the results of the present study in forensic science and anthropology and as an aging biomarker.

Results: From the study, it was concluded that in both males and females there is decrease in root canal length and width with increasing age, which is attributed to secondary dentin formation. In the age group of 11–60, the length and width of pulp canals of mandibular central and lateral incisors decreased with the advancing age and this difference is statistically significant with the p value of less than 0.000.

Conclusion: In the future computer-assisted measurements, i.e., latest digital radiographic techniques are suggested to measure the above parameters; this may could throw light on forensic applications, medicolegal issues, and legal issues regarding age estimation by measuring root canal length and width.

Keywords: Age estimation, Pulp chamber width, Root canal width, Secondary dentin.

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INTRODUCTION

We are all biologically unique and become more diverse as we age, enhancing the spice of life with increasing variety.[1] In many ways, the teeth are unique organs of the body; they are the most durable part of the skeleton.[2] The gradual changes taking place in the dental tissue after the teeth are fully formed are of clinical importance and need to be recognized by the dental surgeon as being a normal finding and not a part of the disease process.[3] Teeth are the hardest bodily structures. Fully formed teeth show aging changes that mirror those seen systemically. Teeth can be used to give the age range for forensic science and anthropology.

AIMS AND OBJECTIVES

Aims

- To estimate relationship between size of the pulp and the dentin with age.
- To know if there is a significant difference in size of the pulp and the dentin among various age groups.

Objectives

- To use the average tooth length and width obtained by this study as the standard guideline for age estimation.
- To utilize the results of the present study in forensic science and anthropology and as an aging biomarker.

MATERIALS AND METHODS

Source of Data

A study was carried out in Department of Oral Medicine and Radiology, NIMS Dental College, Jaipur, to estimate relationship between size of the pulp and the dentin with age.

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Method of Collecting the Data

Inclusion Criteria

The study group comprised 200 apparently healthy subjects in the age group of 11–60 years of both sex, drawn from those attending the OPD of the Oral Medicine and Radiology Department/rural dental camps, which satisfied the inclusion criteria with patients' written consent.

Exclusion Criteria

- Mandibular incisors with any caries, attrition, abrasion, erosion, fracture, and restoration
- Patients having any systemic disease that can cause calcification of the root canal

- Patients who have undergone/undergoing corticosteroid therapy
- If the radiographs of 31, 32, 41, and 42 show more than one root canal, then those radiographs will not be included in the study
- Patient with severe periodontal disease

Methodology

A total of 200 normal subjects are divided into six age groups with equal sex distribution in the age range of 11–60 years.

EXAMINATION OF THE SUBJECTS

- The subjects were made to sit comfortably on the physiological dental chair with artificial illumination. Then, diluted 0.2% chlorhexidine gluconate mouth wash was given to rinse the oral cavity.
- Wearing sterile hand gloves and mouth mask, the subjects were examined under artificial illumination. The clinical examination was carried out by adopting the methods of Kerr, Ash, and Millard (1983), and relevant data were recorded.

STATISTICAL ANALYSIS

Formulae used for analysis:

$$\text{Mean, } x = \frac{\Sigma x_i}{N} \, i = 1, 2, \& \, n$$

$$\text{Standard Deviation, SD} = \sqrt{\frac{\Sigma \left(x_i - \bar{x} \right)^2}{n-1}}$$

$$\text{Variance} = SD^2$$

$$\text{Standard Error, } SE = SD\sqrt{n}$$

Multiple Group Comparison (Age Groups)

Analysis of variance—one-way classification
Snedecor's F test

Variance ratio $F =$

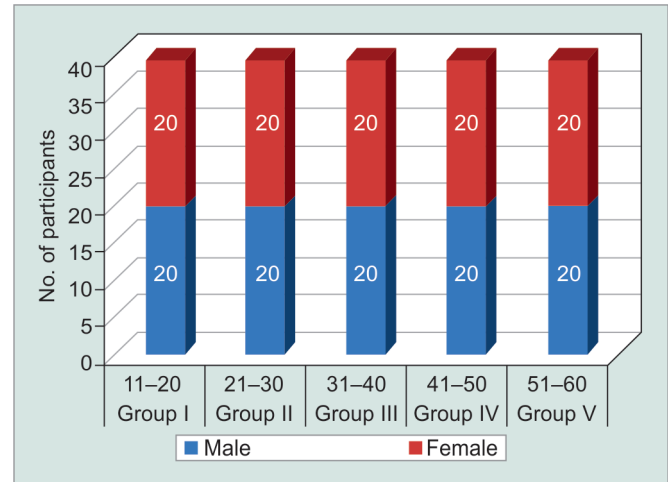(Between group variation) / (Within group variation)

RESULTS

- Patients from NIMS Dental College and Hospital were selected and divided into five age groups, i.e., 11–20 years, 21–30 years, 31–40 years, 41–50 years, and 51–60 years.
- Each age group comprised of 40 subjects including 20 males and 20 females (Table 1 and Fig. 1), and intraoral periapical (IOPA) radiographs of mandibular anterior teeth were made using the paralleling technique and interpretation was made with the help of the Nikon profile projector.
- Radiographic observations of 200 subjects were compiled and results were statistically analyzed (Figs 2 to 9).
- With the increasing age, there is root canal width in mandibular lateral incisors in both males and females among the different age groups, which was statistically high significant difference ($p < 0.000$) (Tables 2 to 9).

DISCUSSION

- The present study is conducted to estimate the relationship between the size of the pulp and the dentin with age, among

Table 1: Distribution of age groups and sex

Groups	Age (in years)	Male	Female	Total
Group I	11–20	20	20	40
Group II	21–30	20	20	40
Group III	31–40	20	20	40
Group IV	41–50	20	20	40
Group V	51–60	20	20	40
Total	11–60	100	100	200

Fig. 1: No. of participants

various age groups (11–20 years, 21–30 years, 31–40 years, 41–50 years, 51–60 years) in males and females using root canal length and width of mandibular central and lateral incisors.
- The findings were found to be highly significant with $p < 0.00$, suggesting decrease in total root canal length and width with advancing age. These findings are in the accordance to those of Morse[4] in which the mean root canal length for the 17–29 years age group is 18.54 mm, 30–39 is 17.40 mm, 40–49 is 16.40 mm, and 50–59 is 14.43 mm. There is corresponding decrease in root canal length with advancing age.
- The measurements indicated a definite decrease in root canal width both in males and females as age increased in increments of 10 years from 11 years to 59 years. These findings are in accordance with Morse in which root canal length decreased with the advancing age due to continued deposition of the secondary dentin.
- Siddiqui[5] stated that dentin thickness and pulp space width show variation with age due to continued dentin deposition, which can be a factor affecting the success of treatment for different age groups as thickness of the dentin and width of the pulp space go on decreasing with age with $p < 0.05$ which is statically significant, which is in the favor of present study with $p < 0.00$ which is highly significant.
- Mjor,[3] Lucy, Pollard[6] and Kvaal et al.[7] stated that secondary dentin deposition is a valuable age factor and measurements of root canal from mandibular central incisors have shown a significant difference between the 10 years age group and there is resultant obliteration of the pulp chamber as the age advances, which is in favor of our study where root canal width is decreasing with age.[8,9]
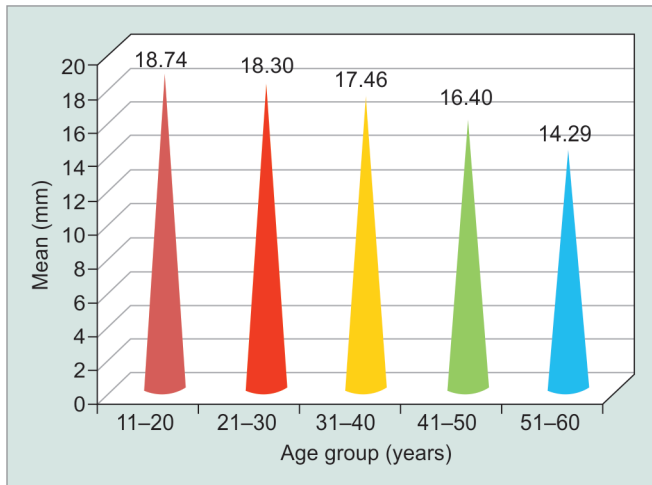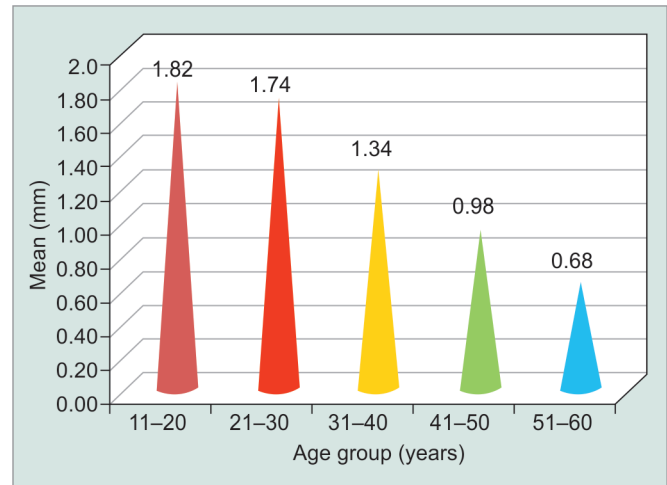
Fig. 2: Root canal length
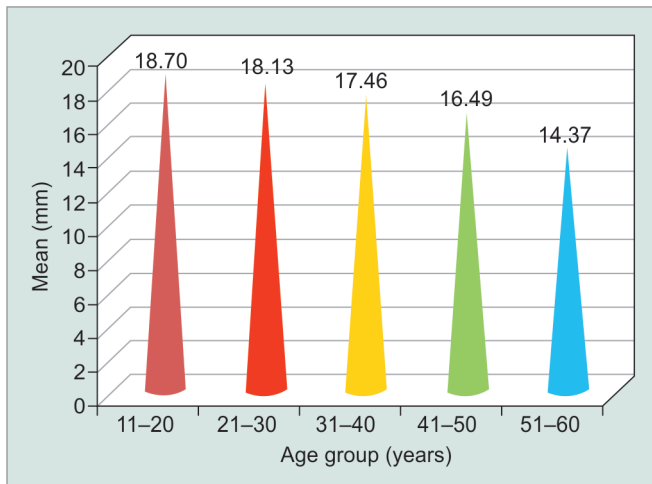

Fig. 3: Root canal width

Fig. 4: Root canal length

Fig. 5: Root canal width

Fig. 6: Root canal length

Fig. 7: Root canal width

CONCLUSION

From the study, it can be concluded that in both males and females:

- There is decrease in root canal length with increasing age.

- There is decrease in root canal width with increasing age, which is attributed due to secondary dentin formation.
- In the age group of 11–60 years, the length and width of pulp canals of mandibular central and lateral incisors decreased with

Fig. 8: Root canal length

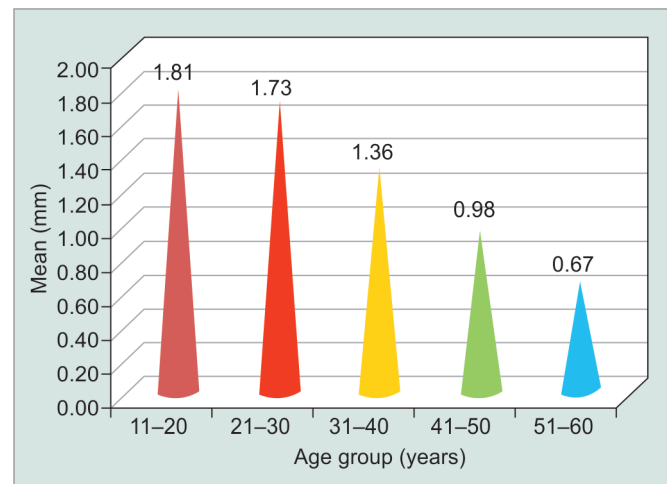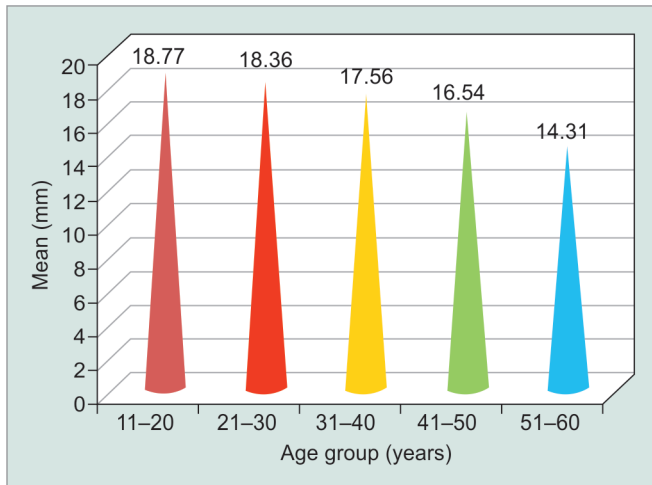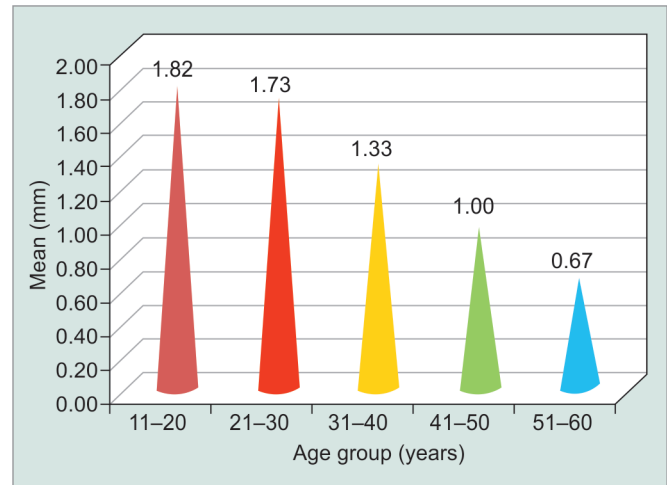**Fig. 9:** Root canal width

Table 2: Root canal length in mandibular central incisors in males

Age group (years)	n	Mean	Std. deviation	Std. error	Minimum	Maximum
11–20	20	18.7490	0.34408	0.07694	18.13	19.30
21–30	20	18.3005	0.19088	0.04268	18.05	18.75
31–40	20	17.4688	0.27975	0.06256	17.01	18.02
41–50	20	16.4163	0.37950	0.08486	15.93	17.01
51–60	20	14.2975	0.30644	0.06852	13.67	14.70
Total	100	17.0464	1.62375	0.16238	13.67	19.30

$F = 668.960, p = 0.000$ (highly significant)

Table 3: Root canal width in mandibular central incisors in males

Age group (years)	n	Mean	Std. deviation	Std. error	Minimum	Maximum
11–20	20	1.8177	0.09287	0.02077	1.73	2.03
21–30	20	1.7371	0.01859	0.00416	1.70	1.77
31–40	20	1.3410	0.04241	0.00948	1.27	1.42
41–50	20	0.9835	0.08261	0.01847	0.64	1.03
51–60	20	0.6756	0.01262	0.00282	0.66	0.72
Total	100	1.3110	0.44199	0.04420	0.64	2.03

$F = 1338.057, p = 0.000$ (highly significant)

Table 4: Root canal length in mandibular central incisors in females

Age group (years)	n	Mean	Std. deviation	Std. error	Minimum	Maximum
11–20	20	18.7030	0.26941	0.06024	18.13	19.10
21–30	20	18.1278	0.28031	0.06268	17.60	18.60
31–40	20	17.4625	0.34973	0.07820	16.70	18.05
41–50	20	16.4878	0.13849	0.03097	16.10	16.70
51–60	20	14.3703	0.24375	0.05450	13.85	14.85
Total	100	17.0303	1.55009	0.15501	13.85	19.10

$F = 820.833, p = 0.000$ (highly significant)

the advancing age and this difference is statistically significant with p value <0.000. Thus, this noninvasive, nondestructive, and easily accessible method can be employed to assess the age changes.

- Use of areas of the tooth for estimation of age is promising as also has been suggested by others. Further, in the future computer-assisted measurements, i.e., the latest digital radiographic technique, are suggested to measure the above parameters;

Table 5: Root canal width in mandibular central incisors in females

Age group (years)	n	Mean	Std. deviation	Std. error	Minimum	Maximum
11–20	20	1.8091	0.11475	0.02566	1.56	2.00
21–30	20	1.7380	0.01831	0.00409	1.70	1.79
31–40	20	1.3310	0.04745	0.01061	1.25	1.41
41–50	20	0.9808	0.02935	0.00656	0.94	1.05
51–60	20	0.6661	0.01058	0.00237	0.65	0.68
Total	100	1.3050	0.44302	0.04430	0.65	2.00

$F = 1428.141$, $p = 0.000$ (highly significant)

Table 6: Root canal length in mandibular lateral incisors in males

Age group (years)	n	Mean	Std. deviation	Std. error	Minimum	Maximum
11–20	20	18.6980	0.29243	0.04624	18.26	19.55
21–30	20	18.2978	0.22702	0.03590	17.52	18.81
31–40	20	17.5488	0.19062	0.03014	17.17	18.13
41–50	20	16.5116	0.22766	0.03600	15.97	17.13
51–60	20	14.4009	0.28441	0.04497	13.55	14.85
Total	100	17.0914	1.56077	0.11036	13.55	19.55

$F = 2824.343$, $p = 0.000$ (highly significant)

Table 7: Root canal width in mandibular lateral incisors in males

Age group (years)	n	Mean	Std. deviation	Std. error	Minimum	Maximum
11–20	20	1.8058	0.08373	0.01872	1.74	2.02
21–30	20	1.7330	0.03898	0.00872	1.61	1.78
31–40	20	1.3583	0.04635	0.01036	1.26	1.43
41–50	20	0.9808	0.02935	0.00656	0.94	1.05
51–60	20	0.6692	0.00880	0.00197	0.65	0.68
Total	100	1.3094	0.43973	0.04397	0.65	2.02

$F = 2035.964$, $p = 0.000$ (highly significant)

Table 8: Root canal length in mandibular lateral incisors in females

Age group (years)	n	Mean	Std. deviation	Std. error	Minimum	Maximum
11–20	20	18.7660	0.32651	0.07301	18.32	19.55
21–30	20	18.3605	0.21508	0.04809	17.95	18.81
31–40	20	17.5558	0.13008	0.02909	17.33	17.83
41–50	20	16.5355	0.29327	0.06558	15.97	17.13
51–60	20	14.3068	0.31755	0.07101	13.55	14.85
Total	100	17.1049	16.7830	17.4268	13.55	19.55

$F = 889.784$, $p = 0.000$ (highly significant)

Table 9: Root canal width in mandibular lateral incisors in females

Age group (years)	n	Mean	Std. deviation	Std. error	Minimum	Maximum
11–20	40	1.8245	0.08984	0.01421	1.74	2.02
21–30	40	1.7329	0.03090	0.00489	1.61	1.78
31–40	40	1.3339	0.04810	0.00761	1.24	1.43
41–50	40	0.9958	0.03800	0.00601	0.94	1.11
51–60	40	0.6700	0.00712	0.00113	0.65	0.68
Total	200	1.3114	0.44040	0.03114	0.65	2.02

$F = 3710.212$, $p = 0.000$ (highly significant)

this may could throw light on forensic applications, medicolegal issues, and legal issues regarding age estimation by measuring root canal length and width.

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