



GLOBAL JOURNAL OF MEDICAL RESEARCH: J  
DENTISTRY AND OTOLARYNGOLOGY  
Volume 14 Issue 1 Version 1.0 Year 2014  
Type: Double Blind Peer Reviewed International Research Journal  
Publisher: Global Journals Inc. (USA)  
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

## Estimation of Age for Sudanese Adults using Orthopantomographs

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**Objectives:** The aim of this study was to determine the usefulness of Orthopantomographs (OPGs) in the assessment of the Sudanese adult age compared to chronological age.

**Materials and Methods:** The study was obtained in Mursi Medical Center from the period of January to August 2011. The OPGs of 99 Sudanese individuals of both gender (49male and50 female) with known chronological age, ranging from 15 to 30 years, were selected .The pulp –root length ,root length, pulp/root ratio , total tooth length ,crown length of the mandibular canine were measured in mm and the estimated age was recorded using the mandibuler canine measurements .Patients were classified into three groups ,A was of age <20 years old ,B was of 20 to 27 and C was of age >27.

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**GJMR-J Classification :** NLMC Code: WU 300



ESTIMAT I ON OF AGE FOR SUDANESE ADULTS USING ORTHOPANT - OMOGRAPHS

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# Estimation of Age for Sudanese Adults using Orthopantomographs

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**Results:** the estimated age in A and C groups were well correlated with the chronological age in both genders and no significant difference was detected, but in B group there is a significant difference between the estimated and chronological age and between males and females measurements.

Mandibular canine measurements can be used significantly in ages < 20and > 27, but cannot give the exact age for ages between 20 to 27 for Sudanese adult subjects.

**Keywords:** age estimation, sudanese, orthopantomography.

## I. INTRODUCTION

OPG is one of the imaging modalities that produce a complete view of both dental arches and their adjacent structures with minimal geometric distortion and with minimal overlap of anatomic details from the contra lateral side. [Allan E, 2010]

Age estimation, is necessary especially in a multicultural society [Nathalie Bosmansa, 2005], different methods for dental age calculation were used including morphological and radiological techniques. The morphology technique required extraction, which cannot be used in living individuals where it is not acceptable to extract teeth for ethical reasons. In such circumstances, a radiographic approach, offers a

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relatively nondestructive method and eliminates the need for extraction of teeth.[ Ridhima Sharma and Anurag Srivastava,2010]

The dental pulp development and regressive changes can be related to chronological age.[ Reppien K., Sejrnsen B., Lynnerup N.,2006] The size of the pulp decreases with age due to the deposition of the secondary dentin, and this is a continuous process that occurs throughout life [Nanci A.,2008],dental pulp can be used as a parameter to assess the age of an individual during later periods of life.

Kvaal et al. reported a new method for estimating the chronological age of adults based on the relationship between age and the pulp size on periapical dental radiographs [Kvaal SI,et al1995] as well as on orthopantomographs (OPGs) for estimating the age of an individual.[ Smans N.,2005]

Therefore the Objectives of this study are to assess the dental age for Sudanese population using OPG as one of the radiological methods as well as to determine the usefulness of OPG in dental morphology assessment for the age compared to chronological age using Kvaal's method and to evaluate the applicability of dental age in forensic sciences for Sudanese

## II. MATERIALS AND METHODS

The study was done at Mursi Medical Center during the period from March 2011 to August 2011.OPG machine GENDEX was used by applying 47 Kv, 10 mAs. 99 subjects with known chronological ages between (15-30 years old), from panoramic x-ray department were involved in this study, the best presented mandible canine on the orthopantomograph and suited for measurement were chosen. The subjects with impacted teeth, opaque fillings, crowns, pathological processes in the apical bone visible on the radiograph and extracted canine and ages more than 30 were not selected. Orthopantomograms showing badly positioned teeth or teeth with large areas of enamel overlap between neighboring teeth were also excluded. The ethics and research committee approved the study and consent was obtained from all patients prior to the examination.All subjects were examined in sitting position; and in proper manner to ensure that the teeth and jaws are within the image. All foreign objects, including dental appliances, spectacles and earrings were removed. The patient's head was positioned

correctly; the patient rested the tongue against the palate to prevent a radiolucent band appearing above the maxillary teeth. Dental panoramic tomography was carried out with intensifying screens to limit the radiation dose. The Study chooses the mandible canine in both genders to apply the measurements. The variables were defined as: P= the length of the pulp, T= the length of the root from cervical area to the apical end, C= the length of the crown from the cervical area to the incisal edge, Total length of the tooth. The four variables were measured in (mm) and the pulp/tooth area ratio of the canine was calculated. Age was calculated using the Indian formula derived:  $(\text{Age} = 64.413 - (195.265 \times \text{PTR}))$ , where PTR is the pulp/tooth area ratio. The Indian specific equations [Babshet M., et al 2010] were applied for Sudanese subjects and examined its use in age prediction; the suspected age was compared to the known chronological age.

### III. STATISTICAL ANALYSIS

The data were analyzed by using SPSS, version 16.0. The data are expressed using mean, standard deviations and percentages and p value at 0.05 to test the degree of significances.

### IV. RESULTS

The 99 Sudanese subjects studied consist of 50 (50.5%) female and 49(49.5%) male

The total sample is divided into three groups (A-B-C) according to age:

Group (A): age less than 19 years old.

Group (B): age more than 20 and less than 27 years old.

Group (C): age more than 26 years old.

#### a) Results of Group A (Age <20)

**Table 1 :** The mean and standard deviation of the variables that collected from the sample (12 males, 16 females)

	Gender	Number	Mean	Std. Deviation
Chronological age	Male	12	16.533	1.5675
	Female	16	15.469	.6700
Estimated age	Male	12	16.600	1.5949
	Female	16	15.562	.8318
PRL(P)	Male	12	16.83	3.010
	Female	16	12.94	1.526
TRL (T)	Male	12	19.58	1.832
	Female	16	16.25	2.408
CIL(C)	Male	12	11.00	.853
	Female	16	10.88	.957
Total length	Male	12	30.67	2.535
	Female	16	26.50	3.795
PTR ratio	Male	12	85.1417	7.78921
	Female	16	80.1250	4.25167

*Number of Subjects are 28 for both gender (Age < 20), (P) stands for the length of the pulp, (T) for the length of the root from cervical area to the apical end, (C) for the length of the crown from the cervical area to the incisal edge, Total length of the tooth. And (PTR) is the pulp/tooth area ratio*

**Table 2 :** The average mean and STDV of the variables collected from both males and females

	Chronological age	Estimated age	PRL (P)	TRL (T)	CILC (C)	Total length	PTR ratio
Number	28	28	28	28	28	28	28
Mean	15.925	16.007	14.61	17.68	10.93	28.29	82.2750
Std. Deviation	1.2403	1.3015	2.973	2.722	.900	3.876	6.41501

Number of Subjects are 28 for both gender (Age < 20) The ages are measured in years and the variables measurements are taken in (mm)

**Table 3 :** The Correlation between the Chronological and Estimated Age

	Number	Correlation	Significant
Chronological & Estimated age	28	.939	.000

Number of Subjects are 28, Age < 20 years, P-value is significant at 0.000

## b) Results Of Group B (Age &gt; 19 and age &lt; 27)

**Table 4:** The average mean and standard deviation of the variables collected from the sample B(24 males and 28 females)

	Gender	Number	Mean	Std. Deviation
Chronological age	Male	24	23.717	1.7307
	Female	28	22.157	1.2612
Estimated age	Male	24	23.850	1.5946
	Female	28	22.532	1.3389
PRL(P)	Male	24	20.50	.834
	Female	28	16.61	3.957
TRL (T)	Male	24	16.79	1.103
	Female	28	14.46	3.737
CIL(C)	Male	24	11.04	.690
	Female	28	11.25	.799
Total length	Male	24	27.75	1.359
	Female	28	25.71	3.886
PTR ratio	Male	24	122.5042	8.08286
	Female	28	115.7700	6.85635

Number of Subjects are 52 for both gender ,with Age > 19 and age < 27,(P) stands for the length of the pulp, (T)for the length of the root from cervical area to the apical end, (C)for the length of the crown from the cervical area to the incisal edge, Total length of the tooth. And (PTR) is the pulp/tooth area ratio

**Table 5:** The average mean and STDV of the variables collected from both genders

	Chronological age	Estimated age	PRL (P)	TRL (T)	CIL (C)	Total length	PTR ratio
Number	52	52	52	52	52	52	52
Mean	22.877	23.140	18.40	15.54	11.15	26.65	118.8781
Std. Deviation	1.6761	1.5924	3.527	3.052	.751	3.143	8.11432

Number of Subjects are 52 both gender (Age > 19 and age < 27)  
The ages are measured in years and the variables measurements are taken in (mm)

**Table 6:** The correlation between the chronological and estimated age

	Number	Correlation	Significant
Chronological & Estimated age	52	.955	.182

Number of Subjects are 52, (Age > 19 and age < 27), P-value is significant at 0.000

## c) Results Of Group C (Age &gt; 26)

**Table 7:** The average mean and standard deviation of the variable collected from the sample c (14 males and 5 females)

	Gender	Number	Mean	Std. Deviation
Chronological age	Male	14	30.229	1.6790
	Female	5	30.320	1.8130
Estimated age	Male	14	30.736	2.0167
	Female	5	29.620	1.3424
PRL(P)	Male	14	19.29	.726
	Female	5	19.60	1.140

TRL (T)	Male	14	12.29	1.069
	Female	5	13.00	1.225
CIL(C)	Male	14	10.71	.611
	Female	5	10.60	.548
Total length	Male	14	23.00	1.177
	Female	5	23.60	1.517
PTR ratio	Male	14	157.4143	10.52096
	Female	5	151.0200	6.83974

Number of Subjects are 19 for both gender ,(Age > 26) ,(P) stands for the length of the pulp, (T)for the length of the root from cervical area to the apical end, (C)for the length of the crown from the cervical area to the incisal edge, Total length of the tooth. And (PTR) is the pulp/tooth area ratio

Table 8 : The average mean and STDV collected from variables for both genders

	Chronological age	Estimated age	PRL (P)	TRL (T)	CIL (C)	Total length	PTR ratio
Number	19	19	19	19	19	19	19
Mean	30.253	30.442	19.37	12.47	10.68	23.16	155.7316
Std. Deviation	1.6638	1.8954	.831	1.124	.582	1.259	9.93518

Number of Subjects are (Age > 26) The ages are measured in years and the variables measurements are taken in (mm)

Table 9 : The correlation between the chronological and estimated age

	Number	Correlation	Significant
Chronological & Estimated age	19	.894	.000

Number of Subjects are 19 (Age > 26) P-value is significant at 0.000

d) Results of the Groups A and C (Age <= 20 or age > 26 years)

Table 10 : The average mean and standard deviation of the variables collected from the sample A&C

	Gender	Number	Mean	Std. Deviation
Chronological age	Male	26	23.908	7.1431
	Female	21	19.005	6.5579
Estimated age	Male	26	24.212	7.4081
	Female	21	18.910	6.2064
PRL(P)	Male	26	18.15	2.412
	Female	21	14.52	3.234
TRL (T)	Male	26	15.65	3.979
	Female	21	15.48	2.581
CIL(C)	Male	26	10.85	.732
	Female	21	10.81	.873
Total length	Male	26	26.54	4.329
	Female	21	25.81	3.586
PTR _ratio	Male	26	124.057	37.87195
	Female	21	7	31.30921

Number of Subjects are 47 for both gender (Age <= 20 or age > 26 years),(P) stands for the length of the pulp, (T)for the length of the root from cervical area to the apical end, (C)for the length of the crown from the cervical area to the incisal edge, Total length of the tooth. And (PTR) is the pulp/tooth area ratio

*Table 11:* The average mean and STDV collected from variables for both genders

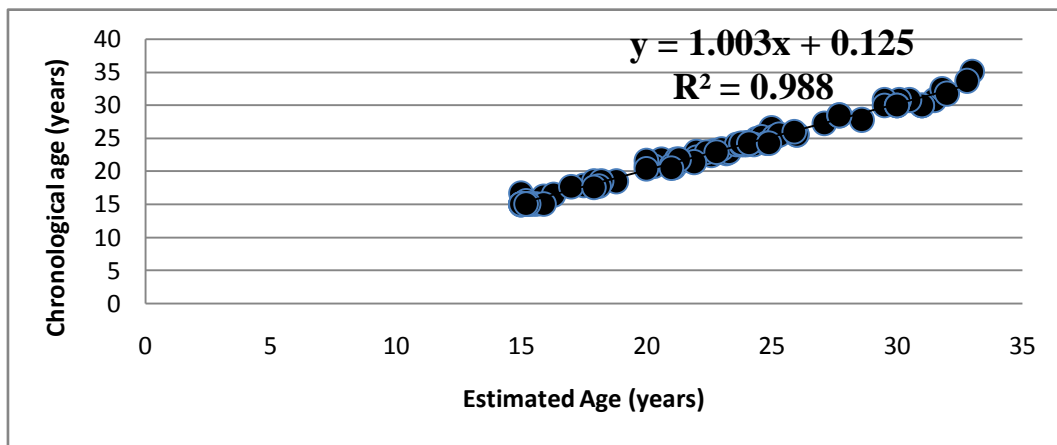
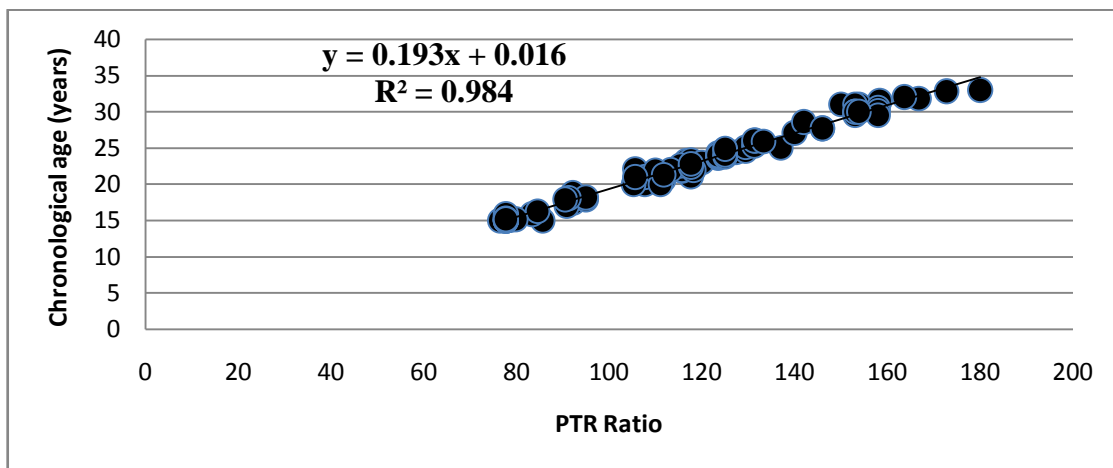
	Chronological age	Estimated age	PRL ( P)	TRL (T)	CIL (C)	Total length	PTR ratio
Number	47	47	47	47	47	47	47
Mean	21.717	21.843	16.53	15.57	10.83	26.21	111.9702
Std. Deviation	7.2456	7.3262	3.322	3.393	.789	3.989	37.28985

Number of Subjects are 47 (Age <= 20 or age > 26/ years),the measurements are taken in (mm) for the variables

*Table12:* The correlation between the chronological and estimated age

	Number	Correlation	Significant
Chronological & Estimated age	47	.996	.000

Number of Subjects are 47, Age <= 20 or age > 26 years P-value is significant at 0.000

*Fig. 1:* shows the relation between the chronological age and estimated age*Fig. 2:* Shows the relation between the chronological age and PTR Ratio

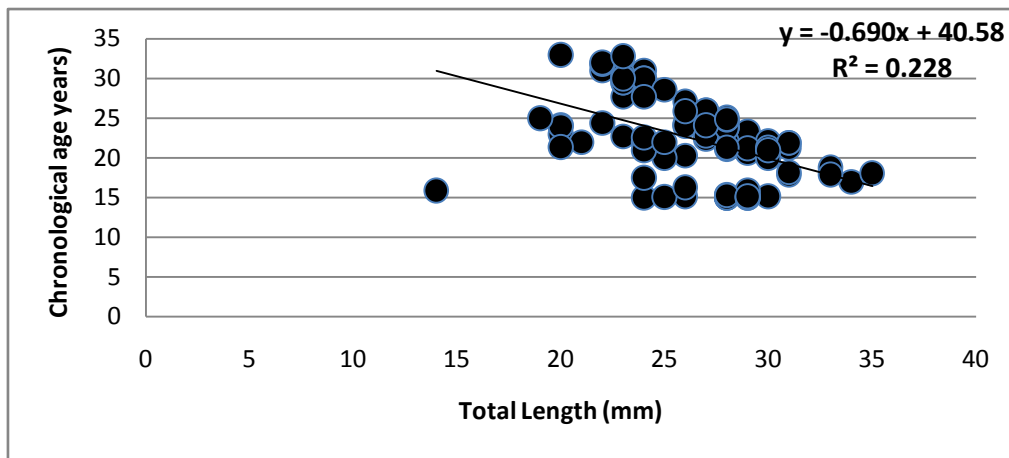


Fig. 3 : shows the relation between the chronological age and Total Length

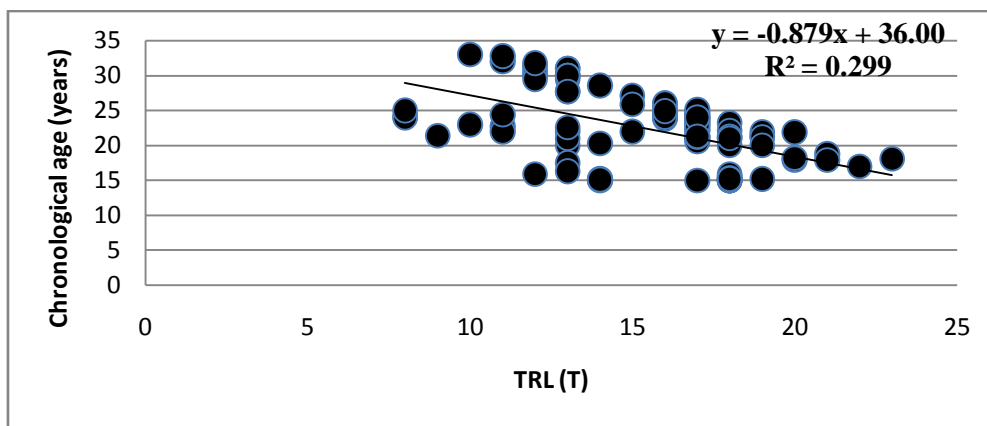


Fig. 4 : shows the relation between the chronological age and TRL

## V. DISCUSSION

Age estimation plays an important role in forensic medicine and dentistry. [Maber M, 2006] Radiology plays an indispensable role in human age determination. Radiological age estimation in adults would be challenging as the development of dentition is completed.

In adulthood, teeth undergo time-related changes representing biological aging, and many studies have shown that several features of aging can be used for age determination [Paewinsky E. 2005] including volume of pulp cavity and the third molar development as well as the morphology of the teeth.

The main objective of this study was to assess the dental age using OPG as a routine method used in dentistry. The study used five variables including: The pulp-root length, root length, pulp/root ratio, total tooth length, crown length of the mandibular canine in both genders using mean values and standard deviation.

The sample was divided into 3 groups, group A was of ages <20, [Table 1, 2] shows that the mean age and standard deviation were found to be For PRL (P) and TRL (T), CIL(C) it was found to be  $14.6 \pm 2.9$ ,  $17.7 \pm 2.7$ ,  $10.9 \pm .9$ , and the total length of the mandible

canine was found to be  $28.3 \pm 3.9$  where the PTR ratio was found to be  $82.3 \pm 6.4$ .

The Indian equation mentioned by [Babshet M. 2010] was applied using the PTR to calculate the subjects suspected age, the mean age and standard deviation were found to be  $15.9 \pm 1.24$ ,  $16.0 \pm 1.30$  for Chronological age and estimated age respectively. The correlation between the chronological and estimated age of this group was found to be 0.000 at p-value of 0.005. [Table 3]

Results of Group B (Age > 19 and age < 27) were found to be: for PRL (P), TRL (T), CIL(C), were found to be  $18.4 \pm 3.5$ ,  $15.5 \pm 3.1$  and  $11.2 \pm .8$  and the total length were found to be  $26.7 \pm 3.1$  and the PTR - ratio was  $118.9 \pm 8.1$ .

The mean age and standard deviation were found to be  $22.9 \pm 1.7$ ,  $23.1 \pm 1.6$  for Chronological age and Estimated age respectively, and The correlation between the chronological and estimated age of this group was found to be 0.184 that means that a significant difference between the estimated and chronological age was detected in this group. [Table 4, 5, 6]. This may be due to the different stages of dental development which should be associated with caution

to maturation stage or skeletal age as mentioned by [Carlos Estrela, José Valladares Neto, 2010]

Results of Group C (Age > 26) the results shows that the mean PRL-P was  $19.4 \pm 0.8$  and TRL -T was  $12.5 \pm 1.124$  and CILC was  $10.7 \pm 0.6$  where the total length was found to be  $23.2 \pm 1.3$ , and PTR ratio was  $155.7 \pm 9.9$ . The mean age and standard deviation were found to be  $30.3 \pm 1.7$ ,  $30.4 \pm 1.9$  for Chronological age and estimated age respectively, The result showed that there were significant relationships detected when calculating the estimated age in group (A and C) with the chronological age in both genders, but there is a significant difference between the estimated and chronological age in group (B). [Table 7, 8, 9]

On similar grounds, a study was carried out to examine the application of the pulp/tooth area ratio by digital periapical images of upper and lower canines as an indicator of age. It was concluded that canines can serve to predict the age of an individual [Cameriere et al, 2007]

Results of the Groups A and C (Age  $\leq 20$  or age > 26 years) showed a significant relation between the chronological age and estimated age [tables 10, 11, 12]

The relation between the chronological age and PTR Ratio was studied, it was increased by  $0.19 \pm 0.02$ ,  $R^2$  was 0.98 this ;because of that with advancing age, secondary dentine is deposited along the wall of the dental pulp chamber, leading to a reduction in the size of the pulp cavity. [Prapanpoch S, 1994] this ratio is good indicator for ages less than 20 and more than 26 it consigned with the estimated age gained by the Indian equation but in ages of twenties the exact age was not estimated significantly when using PTR ratio. [Figures 1, 2]. The relation between the chronological age and Total Length was also been evaluated, it was found that the total tooth (canine) length was decreased by increasing the age, and TRL was also decreased with age as it appears in [Figures 3, 4]. Similar findings was found [Babshet M. 2010, Kvaal S.I, Solheim T, 1994, Landa M.I. 2009]

To conclude ;this study is an attempt to assess the age using OPG in Sudanese population in both gender using mandibular canine for PTR, the result suggested that The Indian formula for mandibular canine measurements can be applied to estimate the dental age for Sudanese significantly with the chronological age in ages less than 20 and more than 27 in both male and female, but in the ages between 20 to 27 there is a significant difference between chronological and estimated age as well as between males and females measurements.

Also it gives a scope for future studies on larger sample size, and measuring the molars and premolars as an age indicator.

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