



## **An Evaluative Comparison of Chronological Age and Dental Age Using Kvaal’s Method and Digital Radio Visiography**

<sup>1</sup>Parkhi Bhatnagar, Senior Lecturer, Department of Paediatric and Preventive Dentistry, Faculty of Dental Sciences, Rama University, Kanpur, Uttar Pradesh.

<sup>2</sup>Anil Kohli, Professor & HOD, Department of Paediatric and Preventive Dentistry, Faculty of Dental Sciences, Rama University, Kanpur, Uttar Pradesh.

<sup>3</sup>Santwana Tripathy, Post Graduate Student, Department of Paediatric and Preventive Dentistry, Faculty of Dental Sciences, Rama University, Kanpur, Uttar Pradesh.

**Corresponding Author:** Parkhi Bhatnagar, Senior Lecturer, Department of Paediatric and Preventive Dentistry, Faculty of Dental Sciences, Rama University, Kanpur, Uttar Pradesh.

**Citation this Article:** Parkhi Bhatnagar, Anil Kohli, Santwana Tripathy, “An Evaluative Comparison of Chronological Age and Dental Age Using Kvaal’s Method and Digital Radio Visiography”, IJMSIR- April - 2022, Vol – 7, Issue - 2, P. No. 403 – 408.

**Type of Publication:** Original Research Article

**Conflicts of Interest:** Nil

### **Abstract**

**Introduction:** Age determination is vital in children, and as a Pediatric Dentist, it is important to be well informed on the age factor of children, thus assessment must be done with time.

**Aim:** Comparison of dental age and chronological age of children of age group 6-8years.

**Methods:** For examination of teeth digital radiography was used for determination along with following measurement “maximum tooth length, pulp length, root length on mesial side, pulp width at the cemento-enamel junction (Level-A), mid-root level (Level C) Level B (Mid-point of C and A).

**Results:** The IBM SPSS VERSION 13 SOFTWARE was used to compute the results. The average age of the subjects was 6.93. The estimated and actual ages were compared using the student’s t-test. The comparison of actual and assessed ages revealed that there was no

significant difference between the estimated and actual ages for any children ( $P>0.05$ ).

**Conclusion:** Kvaal's method, a non-invasive process, can be used to assess both dental and chronological age.

**Keywords:** Kvaal’s method; Chronologic age; Dental age; Age determination; Digital Radio mapping; Pulp volume ration; Child’s age

### **Introduction**

Age estimation is one of several indicators employed to establish identity in forensic cases. It can be calculated using a variety of methods, including chronological age, skeletal age, and dental age.<sup>1</sup> It is crucial for identifying accident and crime victims. In the case of adopted children who do not have valid identification documents, confirmation of chronological age is essential in order to access civil rights and social benefits, particularly in a multicultural culture where legal and illegal immigration is on the rise.<sup>2,3</sup>

The first known attempts that used teeth as an indicator of age originated from England during the early 19<sup>th</sup> century. Edwin Saunders, a dentist, was the first to publish information regarding dental implications in age assessment by presenting a pamphlet entitled “Teeth a Test of Age” to the English Parliament in 1837. Various methods used to estimate dental age are morphological, biochemical and radiographical techniques.<sup>3,4</sup>

The morphological method necessitates the extraction and preparation of microscopic sections of at least one tooth from each individual.<sup>4</sup>

Biochemical approaches are based on amino acid racemization, in which L-Aspartic Acid is transformed to D-Aspartic Acid, and thus the quantities of D-Aspartic Acid in human enamel, dentin, and cementum rise with age.<sup>3</sup>

The radiographic methods neither require tooth extraction nor processing. They utilize radiographic images for age estimation and relies on the developmental stages of teeth, especially in children.<sup>3</sup> Kvaal’s method is one such non-destructive radiographic strategy based on reduction in pulp chamber which was at first conducted using IOPA radiographs and later on OPGs for assessing the age of children and adolescents.<sup>5</sup> RVGs being precise, accurate and having reduced radiation exposure provides better results amongst all.<sup>6</sup>

The current study aimed to determine patients' chronological ages based on pulpal changes in teeth utilising Kvaal's radiographic approach on Radio Visio Graphy. The objectives were to assess the relationship between chronological age and tooth and pulp chamber dimensions, to compare the computed age to the individuals' chronological age, and to assess the validity of Kvaal's method in a specific population utilising Radio Visio Graphy.

## Materials and methods

The study sample consisted of 115 participants aged between 6-8 years, who visited the Department of Pediatric and Preventive Dentistry, Rama Dental College, Hospital and Research Centre, Kanpur, and required Radio Visio Graphy (RVG) for various reasons of diagnosis and treatment planning. Informed consent was collected from the parents in the local language.

### Inclusion Criteria

RVGs within the age groups of 6-8years having mandibular permanent first molar, either left or the right side.

### Exclusion Criteria

Patients data base that had pathologies, traumatized teeth, malposed teeth, or teeth having radiopaque fillings, caries and pathologic process in the apical bone were excluded.

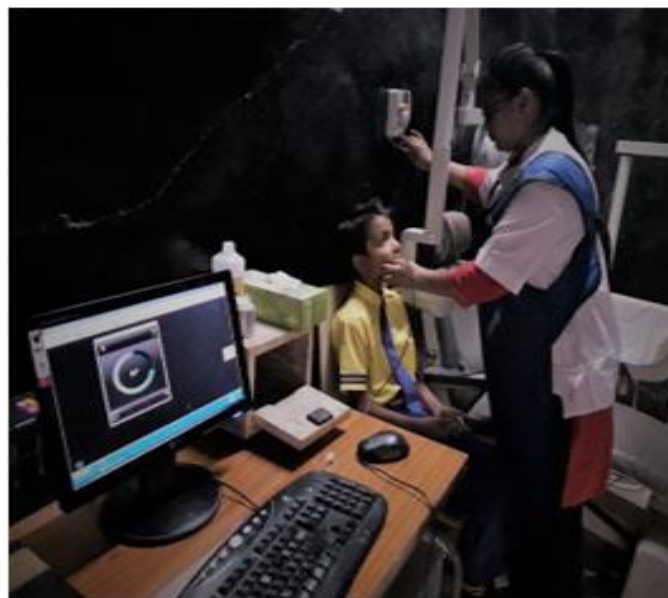


Figure 1: Preparation of a child for RVG shooting.

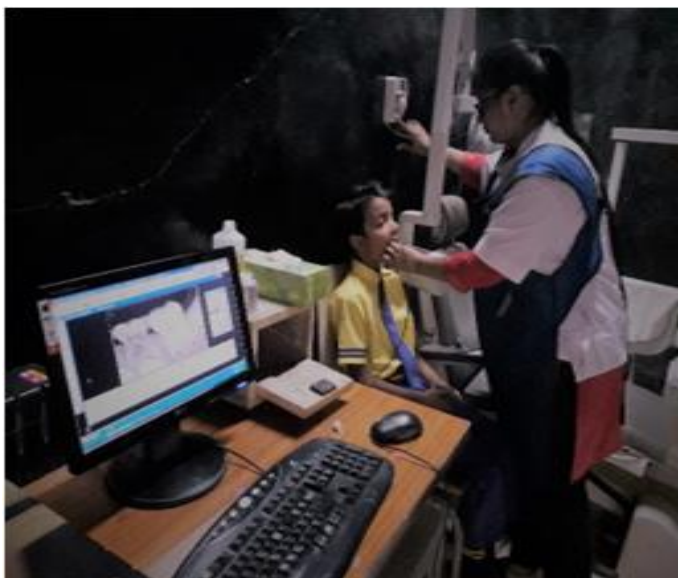


Figure 2: Preparation of a child for RVG shooting

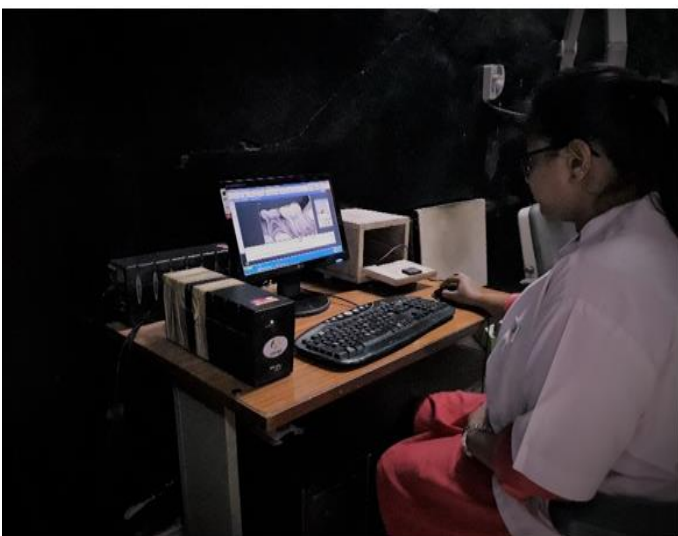


Figure 3: Measuring for Kvaal's method using RVG All

the guidelines was followed as per the ALARA principle while subjecting the subject to RVGs. Ethical approval for the study was obtained by the ethical committee of Rama Dental college Hospital & Research centre with a reference of. 02/IEC/RDCHRC/2022-23/055. Review of Kvaal's Method Kvaal's method is a volume measurement of teeth using pulp to tooth ratio method for accurate estimation. In order to reduce the possible effects of variation and magnification and angulation of radiographs, the following ratios were calculated:

1. Root length/ Tooth length(T)
2. Pulp length/ Tooth length (R)
3. Pulp length/ Root Length (P)
4. Pulp width/ Root level at level a (A)
5. Pulp width/ Root level at level b (B)
6. Pulp width/ Root level at level c (C)
7. Mean values of all the ratios (M)
8. Mean values of width ratios from levels b and c (W)
9. Mean values of length ratios P and R (L)
10. Differences between W and L (W-L)

Measurements were done using Kodak Dental Software (Trophy window patient file).

The patient's evaluated age was then compared to their actual age, and the data were tabulated.

Sn.	P	T	R	A	B	C	M	W	L	W-L
1.	0.61	0.68	0.44	0.52	0.47	0.52	0.63	0.49	0.89	-0.1
2.	0.60	0.62	0.45	0.45	0.46	0.53	0.61	0.495	0.82	-0.325
3.	1.1	0.57	0.58	0.45	0.48	0.51	0.60	0.495	0.795	-0.30
4.	1.21	0.63	0.77	0.44	0.47	0.50	0.67	0.485	0.99	-0.50
5.	1.38	0.51	0.71	0.58	0.57	0.57	0.71	0.54	1.045	-0.50
6.	1.04	0.52	0.55	0.46	0.47	0.58	0.60	0.52	0.795	-0.275
7.	1.22	0.45	0.55	0.47	0.57	0.68	0.65	0.62	0.88	-0.26
8.	0.74	0.50	0.37	0.49	0.58	0.49	0.52	0.53	0.55	-0.02
9.	1.05	0.62	0.65	0.52	0.52	0.52	0.64	0.52	1.075	-0.55
10.	1.08	0.52	0.57	0.46	0.43	0.47	0.58	0.46	0.82	-0.36
11.	1.23	0.58	0.71	0.45	0.42	0.44	0.63	0.43	0.97	-0.34
12.	1.06	0.53	0.56	0.53	0.57	0.50	0.64	0.58	0.81	-0.23

Table 1: correlation between age (6 to 8 years) and ratios of measurement.



Figure 4: Application for Kvaal's method using RVG

**Results**

The IBM SPSS version 13 software was used to compute the results. The subjects' average age was 6.93 years. Using the student's t-test, the estimated age was compared to the chronological age. The comparison of actual and assessed ages revealed that there was no significant difference between estimated and actual ages for any ( $p > 0.05$ , significant). [Table 1 and 2]

	N	Mean	Std. Deviation	Std. Error mean
P	115	1.0267	.24956	.07204
T	115	.5608	.06694	.01932
R	115	.5758	.11966	.03453
A	115	.4850	.04338	.01252
B	115	.5008	.05835	.01685
C	115	.5258	.06186	.01786
M	115	.6233	.04755	.01373

W	115	.5138	.05108	.01475
L	115	.8700	.14136	.04081
W-L	115	-.3133	.15717	.04537

Table 1: One-Sample Statistics.

**Discussion**

Age is an important aspect in determining a person's identity.<sup>7</sup> Human age estimation is a technique used by anthropologists, archaeologists, and forensic scientists. In routine casework, a forensic expert's precise age estimation is a critical stage in establishing a person's biological profile. If the age is correctly determined, it will profoundly limit the pool of probable personalities. Nowadays, forensic odontologists are routinely confronted with various cases of age estimation in both living and deceased individuals. The need of a trustworthy tool for age assessment in living humans is rather essential since legal repercussions (valid results) are entirely unanticipated if a subject of unknown age is assessed to be a juvenile or an adult.

Different methods for determining age are available; however, the invasion approach, which uses extracted teeth, ribs, or femurs, cannot be applied on living persons.<sup>8</sup>

Radiographic age estimation methods based on teeth are superior to other approaches because they are non-invasive, provide data collectability, and are simple to estimate.<sup>3</sup>

The current investigation used Radio Visiography. Digital systems have advanced significantly over the previous few decades and are now regarded a viable technology for clinical usage in dentistry. However, several prior authors mentioned difficulty in distinguishing reference points on digital images as shown on a monitor screen; hence, establishing the relative distance between two separate places, the

quantification of which is in pixels, is required. When compared to conventional radiographs, digital radiographs have an advantage in terms of superior picture recording, fewer radiation exposure, contrast control, and immediate image generation.

Literature suggested that the dental indicator provides a higher accuracy rate for age estimation as compared to skeletal indicators.<sup>9,10,11</sup>

The current study was carried out to assess the applicability of Kvaal's technique age estimation formula on the Kanpur population utilising mandibular first permanent molars with age groups 6-8 years, using RVG. Because Kvaal's method had a larger inaccuracy in age estimation, a new age estimation formula was created from the obtained length and breadth ratios. The created formula was subsequently tested on 115 more participants.

**Limitations**

1. Results were not based on gender.
2. Only young permanent mandibular molars were included in the study.

**Conclusion**

To summarise, this study attempted to use Kvaal's method with RVG to access and compare dental age and chronological age in children. It is a non-invasive method that is feasible for such clinical trials.

**References**

1. Limdiwala P, Shah J. Age estimation by using dental radiographs. Journal of Forensic Dental Sciences. 2013;5(2):118.



2. Stavrianos ch, Mastagas D, Stavrianou I, Karaiskou O. Dental age estimation of adults: A review of methods and principals. *Res J Med Sci* 2008;2:258-68.
3. Bosmans N, Ann P, Aly M, Willems G. The application of Kvaal's dental age calculation technique on panoramic dental radiographs. *Forensic Science International*. 2005;153(2-3):208-212.
4. Puranik, Manjunath & Priyadarshini, C & Uma, Shankarachari Rajgopalachari. (2015). Dental Age Estimation Methods: A Review. *International Journal of Advanced Health Sciences*. 1. 19-25.
5. Kvaal S, Kolltveit K, Thomsen I, Solheim T. Age estimation of adults from dental radiographs. *Forensic Science International*. 1995;74(3):175-185.
6. Schulz R, Zwiesigk P, Schiborr M, Schmidt S, Schmeling A. Ultrasound studies on the time course of clavicular ossification. *International Journal of Legal Medicine*. 2008;122(2):163-167.
7. Reppien K, Sejrsen B, Lynnerup N. Evaluation of post-mortem estimated dental age versus real age: A retrospective 21-year survey. *Forensic Science International*. 2006;159:S84-S88.
8. Azrak B, Victor A, Willershausen B, Pistorius A, Hörr C, Gleissner C. Usefulness of Combining Clinical and Radiological Dental Findings for a More Accurate Non-invasive Age Estimation. *Journal of Forensic Sciences*. 2007;52(1):146-150.
9. Kvaal S, Kolltveit K, Thomsen I, Solheim T. Age estimation of adults from dental radiographs. *Forensic Science International*. 1995;74(3):175-185.
10. Erbudak H, Özbek M, Uysal S, Karabulut E. Application of Kvaal et al.'s age estimation method to panoramic radiographs from Turkish individuals. *Forensic Science International*. 2012;219(1-3):141-146.
11. Paewinsky E, Pfeiffer H, Brinkmann B. Quantification of secondary dentine formation from orthopantomograms-a contribution to forensic age estimation methods in adults. *International Journal of Legal Medicine*. 2004;119(1):27-30.