

# Estimation of Biological Ages with Kvaal Method Using Panoramic Radiography in Semarang City

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## ABSTRACT

**Introduction:** Forensic odontology is a branch of dentistry that has disciplines learn about the examination of evidence derived from teeth, and how to deal with the evidence for legal concerns.

**Purpose:** The aim of the study was to describe biological age estimates by using Kvaal method in Semarang, and the difference between biological and chronological age by using the Kvaal method in Semarang. This study was descriptive with crosssectional design. **Materials and Methods:** One of the methods in determining the estimated age by using teeth is the Kvaal method. Kvaal method determines the estimated age based on the pulp size using radiography. **Result:** The results showed the difference between biological and chronological age was  $\pm 4,57$  years. This result is lower than Kvaal's previous study result which was  $\pm 9,5$  years. **Conclusion:** Based in the findings above, it can be concluded that the difference of chronological and biological age using Kvaal method in Semarang was  $\pm 4,57$  years within 15-60 years old individuals in Semarang.

**Keywords:** Kvaal method, biological age, panoramic radiograph.

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## INTRODUCTION

Radiography is a radiographic images that use non-ionizing and ionizing energy. In the field of therapy and diagnostics, which includes non-ionizing energy are radio waves, microwaves, infrared rays and ultraviolet rays. Neutrons, alpha particles, beta particles, gamma rays and X rays are ionizing energies.<sup>1</sup> The use of X-rays in medical field is very helpful in establishing diagnosis, prognosis and determining treatment plans.

Forensic identification is an attempt by medical personnel with the aim of helping investigators to determine a person's identity by comparing data when the person's still alive (ante mortem) and after death data (post mortem). Forensic identification results can be obtained information about sex, race, age, height and blood type. The method commonly used in forensic science is a primary examination that has very individualistic characteristics, namely the need for fingerprint data, tooth data and DNA.<sup>2</sup>

Forensic odontology identification examination is the main means of the body being destroyed and unknown, both due to accidents, fire, explosion, etc.<sup>3</sup> Teeth are one part of the body that is very important in the identification of forensic odontology process. This is due to the nature of the teeth that have the fewest biological changes so that they can be used even if other parts of the body are destroyed, burned, decomposed or become skeletal remains. So that teeth can be used as great and precise indicator to determine the estimated age.

One of the method in determining the estimated age is the Kvaal method. Kvaal et al., stated that this method can be used to estimate a person's biological age based on pulp size using radiography. Kvaal et al conducted a study of the relationship between age and dental pulp size in individuals aged over 20 years using periapical radiographs.<sup>5</sup> Age changes result in changes in the pulp due to continuous deposition of dentinal tissue during

pulp life and dentin deposition secondary to stimuli resulting in pulp chamber size, root canal size and pulp volume shrinking.<sup>6</sup>

The aim of this study was to determine the difference between biological age and chronological age using the Kvaal method in Semarang. The benefits of this study are expected to be able to find out the difference in the Kvaal method in determining the difference in chronological age and biological age in Semarang City.

## MATERIALS AND METHODS

128 panoramic radiographs from patients aged 15-60 years (according to the age range that can be estimated using the Kvaal method) and radiograph quality is excellent or diagnostically acceptable, in the other word, canines or mandibular first premolars to be measured must be in a well-read condition. from 3 hospitals in Semarang (with the code Hospital X, Y, Z) were used in this study. All procedures were approved by the Health and Medical Research Ethics Commission of the Faculty of Dentistry Sultan Agung Islamic University Semarang (No. 058/B.1-KEPK/SA-FKG/XI/2018) and the ethics committee at Hospital X, Y, Z. Measurement of age estimation using direct digital panoramic radiographs data meeting the inclusion criteria was done using graphic application of RadiANT DICOM and CorelDraw X7. Radiographic data measurements were performed on the mandibular canines by measuring pulp-tooth (P), pulp-root length (R), tooth-root length (T), pulp-root width in CEJ (A), pulp-root width at the midpoint between C and A (B), and the pulp-root width in the middle root (C), which is the width of the pulp at the root of the tooth in the middle of the root, and average the value of the whole ratio (M).

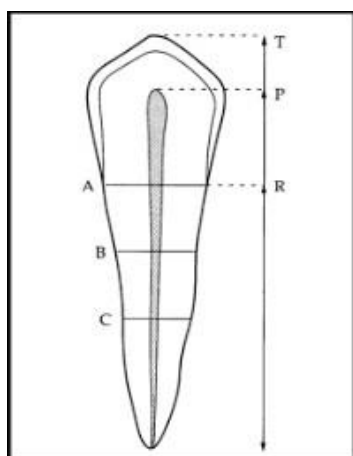


Figure 1. Measurement of the Kvaal et al., (1995)

Explanation :

P : pulp length / root length

R : pulp length / tooth length

a : pulp-root width at CEJ

b : pulp-root width at the midpoint between c and a (b)

c : pulp-root width in the middle of the root

The measurement results were calculated using the Kvaal method formula :

$$\text{Age} = 158,8 - (255,7 \times M)$$

Explanation :

M :  $(P+R+a+b+c)/5$

Chronological age recording was done by 2 observer according to the age at the time of making radiographic photographs. Data was presented in descriptive statistics using SPSS v. 20

## RESEARCH RESULT

The results of measurements of biological age and chronological age are as follows

Table 1. Descriptive statistical test results of biological age and chronological age

	Mean	SD
Biological Age	37,54	±18,79
Chronological Age	32,97	±10,92

It can be determined that using the Kvaal method there is an age difference of 4.57 years (Table 1). Furthermore chronological age is grouped into 3 groups, namely group I with ages 15-30 years, group II with ages 31-45 years and group III with ages 46-60 years.

Table 2. Descriptive statistical test results for age groups I, II and III

	Chronological Age		Biological Age	
	Mean	SD	Mean	SD
Age 15 - 30	23,85	±3,70	32,24	±12,00
Age 31 - 45	36,44	±4,34	36,9	±17,29
Age 46 - 60	52,83	±3,96	54,32	±29,68

Group I with 48 panoramic radiographs, there was an age difference of 8.39 years. Age group II with 54 panoramic radiographs, obtained an age difference of 0.46 years. Age group III with the number of panoramic radiographs of 18, obtained an age difference of 1.49 years. Next, grouping by sex was carried out on 128 panoramic radiographic photo samples (Table 2).

Table 3. Results of descriptive statistics grouping gender test

	Chronological Age		Biological Age	
	Mean	SD	Mean	SD
Male	34,08	±10,44	37,94	±17,29
Female	32,3	±10,27	35,11	±12,86

Based on table 3, in the male sex group with 51 panoramic radiograph samples, an age difference of 3.86 years was obtained. The age difference in the female sex group was 2.81 years with 77 panoramic radiograph samples. In previous studies with populations in India and showed an age difference of ± 6.4-7.8 years with modified calculations and measurements on 6 teeth. The difference can be influenced by several factors such as diet, lifestyle and race.

In certain races found a narrow jaw bone condition causes smaller tooth size, so that the structure of the pulp is also smaller and affects the calculation due to the narrowed pulp space. Pulpal reaction that occurs when in contact with antagonistic teeth during the mastication process also affects the formation of secondary dentin deposition caused by first forming of this type of dentin when the erupted tooth completely and the mastication process.<sup>8</sup>In the study conducted, the number of male samples was 51 and 77 women. There were differences in biological and chronological age, namely in men by 3.86 years and the age difference in women by 2.81 years. This is not in accordance with the Saxena study which conducted research on 60 men and 60 women with populations in India. The results of these studies in the male and female groups did not show differences between biological age and chronological age. The difference in results is due to calculations using different regression formulas because the characteristics of the Kvaal method have been modified the calculations on the different races and teeth used are different. The teeth used in this study were mandibular canines, but if the mandibular canines cannot be read properly they were transferred to the mandibular first premolar. In the Saxena study only used mandibular canines.<sup>9</sup>

The results of this study in general can be concluded that the Kvaal method can be applied effectively in Indonesia. This is based on the difference between the biological and chronological age in this study conducted in the city of Semarang of  $\pm 4.57$  years. The difference is smaller than Kvaal's research with the population in the Caucasoid race (population in Norway) with an age gap of  $\pm 9.5$  years. This might be because in this study using digital panoramic radiographs which have advantages that can be used for evaluation of all teeth and alveolar bones in both jaws, and also digital panoramic can be obtained using standard techniques with high reproducibility.<sup>10</sup>

In addition the radiation dose of the patient can also be minimized.<sup>11</sup>

However, according to Landa, et al,<sup>12</sup> if the radiographic data is in the form of digital data, determining the reference point on the monitor screen will reduce the accuracy so that a good resolution is needed. The patient's unfavorable position when taking a radiograph also affects the calculation of the estimated age, due to distortion and sharpness from the results of the poor photograph. This can be overcome by the selection of panoramic digital radiographs with good resolution.

## CONCLUSION

The average of discrepancy between chronological age and biological age using the Kvaal method in Semarang City is  $\pm 4.57$  years in individuals aged 15-60 years and the average was 37.54 years, and the average difference between chronological age and biological age using the Kvaal method in Semarang City was  $\pm 4.57$  years in individuals aged 15-60 years.

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