

Modification of Kvaal Method for Age Estimation

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Abstract

Age calculation has become increasingly important in forensic dentistry. The method for dental age calculation is based only on radiological measurements in periapical dental radiographs. The purpose of the present study was application of Kvaal technique for age estimation from orthopantograms. On calculating age based on measurements of all six teeth or three maxillary teeth, no significant differences were found between the chronological age and calculated age.

Kvaal's technique may be applied for age estimation from orthopantograms while keeping suitable criteria and good quality radiographs.

Keywords

Forensic dentistry, orthopantograms, kvaal technique, age estimation.

Introduction

Age estimations of living individuals are increasingly important in criminal matters. If doubts arise regarding the age of a person suspected of a criminal offence, forensic age estimation is prompted by the need to ascertain whether the person concerned has reached the age of criminal responsibility and whether general criminal law in force for children or adults is to be applied. The main criteria for forensic age determination in the relevant age group based on odontological examination are tooth eruption and tooth mineralization, both developmental biological features. Tooth mineralization is evaluated based on what is known as an orthopantomogram, a radiograph of the complete dentition. For the evaluation of tooth mineralization, various stage classifications have been put forward¹⁻³.

Kvaal et al.⁴ reported a method for age estimation from radiological measurements. They investigated periapical radiographs by examining the relationship between chronological age and the two-dimensional dental pulp size in individuals older than 20 years of age. Length and width measurements of tooth and dental pulp were analyzed stereomicroscopically on apical radiographs of six teeth. Ratio between the length and width measurements of the same tooth were calculated in order to avoid measurement errors due to differences in magnification of image on the radiograph. Regression formulas were calculated for dental age estimation based on the analysis of either all six teeth, or any three teeth of maxillary or mandibular, or each individual tooth only.

The aim of the present study was to apply Kvaal's technique⁴ (Manual) on digital orthopantograms of adults and accuracy of this method.

Materials and methods

Three hundred and nine orthopantograms of digital origin were collected from Deptt. of Orthodontics, Govt. Dental College associated with Pt. B.D. Sharma PGIMS, Rohtak (Haryana). The radiographs were from 30 individuals with age ranging from 19 to 25 years. While studying the radiographs the observer had no idea about the chronological age of the individuals. On each of the orthopantograms the original six teeth were selected as previous study⁴. Best side of orthopantogram was selected for the measurements using same criteria exclusion criteria used by Kvaal et al.⁴ and all parameters were studied manual

The following measurements were carried out on orthopantograms for all six types of teeth with manual: maximum tooth length, the pulp length, the root length on the mesial surface from enamel cementum junction to the root apex ; the root and pulp width at the enamel cementum

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junction, at the mid root length and at mid point between the enamel cementum junction and mid root level. The data were analyzed by SPSS and differences between chronological and

observed ages were analyzed using student t-test. Pearson correlation (r) between chronological age and calculated from measurements ratio were also calculated.

Results

Table I
Mean (M) and Standard Deviation (SD) of all teeth between chronological age and observed age (in years)

Number of Teeth	Age difference (in years) (M±SD)
Three maxillary teeth	6.32 ± 3.2*
Three mandibular teeth	6.39 ± 1.72*
Three maxillary and three mandibular teeth	5.37 ± 0.42
Mandibular lateral incisors	8.25 ± 2.52*
Mandibular canines	7.32 ± 6.28*
Mandibular first bicuspid	8.62 ± 2.63*
Maxillary control incisors	7.83 ± 3.42*
Maxillary lateral incisors	7.96 ± 3.34*
Maxillary bicuspid	8.65 ± 2.52*

No significant differences were found between chronological age and calculated age for the results obtained based on the original regression formulas including all six teeth or including the three maxillary teeth only.

Discussion

In Salheim (1993)⁶ reported on morphological technique which until today seems to be the most elaborate and statistically sound for dental age

estimation. Kvaal et al. (1995)⁴ reported a method which combines radiological and morphological measurements, and therefore extraction was still required, while present method required only radiograph. Kvaal’s original technique⁴ requires that standard apical radiographs are taken of the selected teeth. This study reports a non significant correlation for most of teeth examined between the chronological age and ratio of length of pulp to

Table II

Pearson Correlation Coefficient between chronological age and calculated age from ratio's (length of the pulp / length of the root, length of pulp / length of tooth, width of the pulp / width of the root at enamel cementum (A) junction, width of the pulp / width of the root at mid root level (B) and width of pulp / width of the root at midpoint between (A and B) of maxillary teeth (central incisor, lateral incisor, bicuspids), mandibular teeth (central and lateral incisor, first bicuspids), three maxillary, three mandibular and maxillary and mandibular teeth.

Parameters (Ratios)	Maxillary and mandibular teeth	Maxillary central incisor	Maxillary lateral incisor	Maxillary bicuspid	Mandibular lateral	Mandibular canines	Mandibular canines	Mandibular first bicuspids	Three maxillary	Three mandibular
Length of the pulp/ length of root	-0.51	-0.43	-0.45	-0.52	-0.32	-0.42	-0.42	-0.72	-0.44	-0.45
Length of pulp/ length of tooth	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Length of pulp/ length of root	-0.54	-0.54	-0.42	-0.43	-0.45	-0.56	-0.56	-0.52	-0.57	-0.32
Width of pulp/ width of root at enamel – cementum (A) junction	-0.57	-0.68	-0.48	-0.47	-0.43	-0.47	-0.47	-0.54	-0.53	-0.35
Width of pulp/ width of root at mid (B) root level	-0.56	-0.53	-0.46	-0.56	-0.42	-0.46	-0.46	-0.48	-0.52	-0.54
Width of pulp/ width of root at midpoint between A and B	0.54	-0.72	-0.48	-0.54	-0.62	-0.63	-0.63	-0.64	-0.62	-0.56

length of tooth. And significant correlation between the chronological age and ratio of length of the pulp to length of root, width of the pulp to width of the root at enamel cementum (A), width of the pulp to width of the root at midroot level (B), and width of pulp to width root at midpoint between A and B. [$p < 0.05$] (Table 2) was observed accuracy of proving this method. No significant differences were found between chronological age and calculated age for the results obtained based on the original regression formulas including all six teeth or including in three maxillary teeth.

Conclusion

From this study it can be concluded that Kvaal's method may be used for age estimation from the orthopantogram if at least selection criteria are suitable and good quality radiographs without requirement of apical radiographs.

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