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"Advancing Dentistry with Innovative Sciences and Technology"

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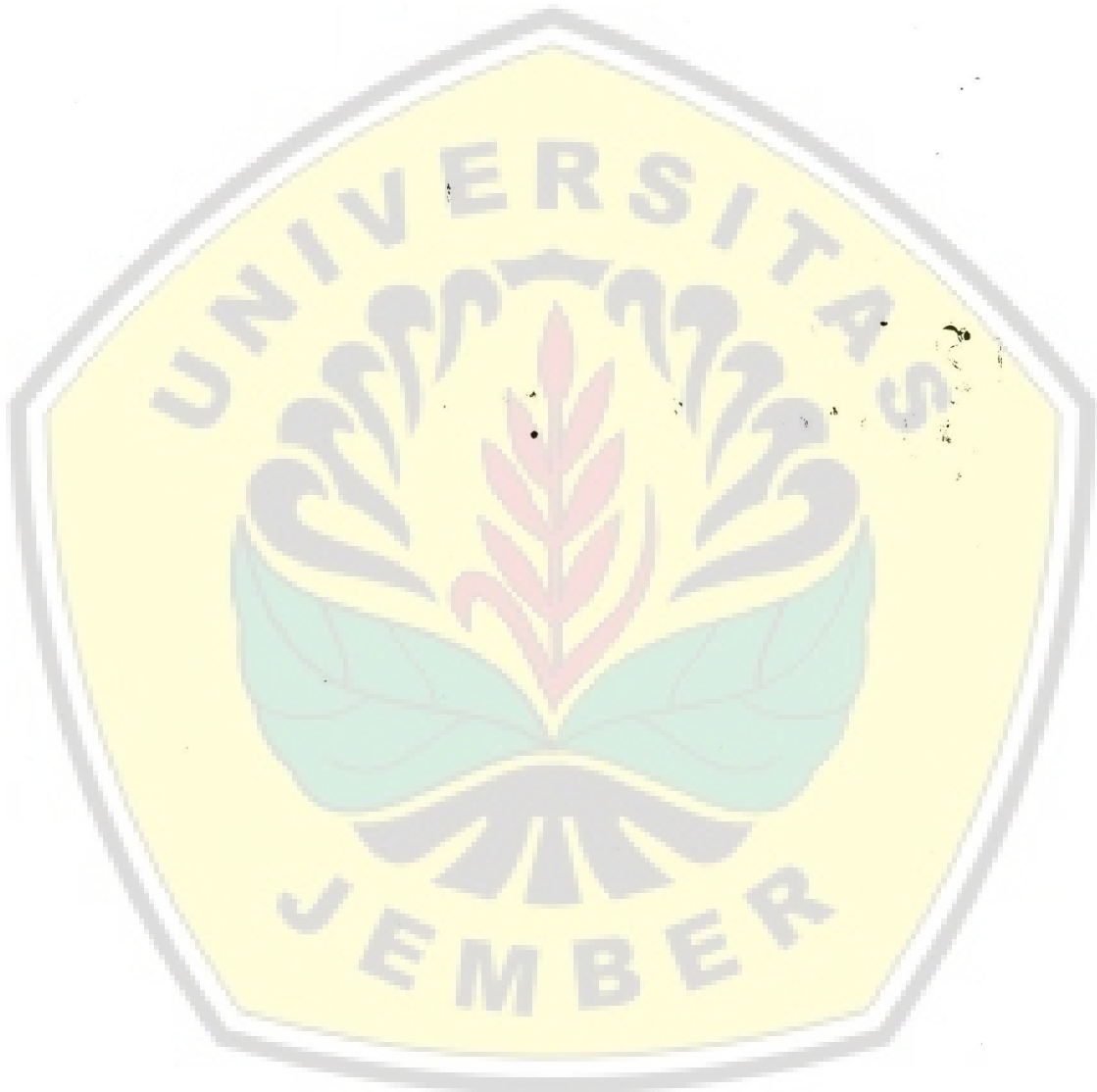
LSKI

**Proceeding of The 14th FDI-IDA Continuing
Dental Education Programme**

“Advancing Dentistry with Innovative Sciences and Technology”



Novotel Manado Convention Center, Manado September 20-22, 2018



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editor :

Aurelia Steffanie Rachel Supit

Dinar Arum Wicaksono

Mirsarinda Anandia Leander

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FOREWORD

Continuing dental education is a lifelong process for dentists who seek excellence in providing the best and current service to their patients. Scientific and technological advances in dentistry has been progressing rapidly in the last few years. Consequently, patients' needs and expectations to receive the highest standard of dental care has also increase.

World Dental Federation (FDI) in conjunction with Indonesian Dental Association hold international scientific meeting and dental exhibition annually. This year, the event will be organized in Manado. It provides a great opportunity for dentists and dental students, in the eastern part of Indonesia especially, to gain knowledge and update their skills.

The theme of this year's meeting is "Advancing Dentistry with Innovative Sciences and Technology" which will enable an international platform for the discussion of the latest findings and future technologies in dentistry.

Chairman,
Sanil Marentek



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RESEARCH

Age Estimation with Tooth Coronal Index (Tci) Method on Mandibular Secondmolar at Age 11-25 Years Old

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Abstract

Introduction: Age estimation is a part of human identification process. The Tooth Coronal Index (TCI) is an age estimation method based on the relationship between chronological age and pulp cavity size. Mandibular second molar tooth provides a good anatomical detail on the periapical radiograph. This study aimed to determine the age estimation based on periapical radiograph analysis of mandibular second molar tooth at age 11-25 years old with TCI method. **Method:** Coronal Height (CH) and Coronal Pulp Cavity Height (CPCH) measurements were performed using a caliper on 120 periapical radiographs. The formula $TCI = CPCH \times 100 / CH$ were used, then analyzed to determine the relationship between the chronological age and the TCI score. **Result:** The result showed no significant difference in the TCI score between the sexes and inter-tooth region. The age estimation formula based of data analysis is $40.717 + (-0.872)TCI$ with strong negative correlation ($r = -0.884$). **Conclusion:** Individual age estimation of 11-25 years old can be determined by periapical radiograph analysis of mandibular second molar tooth by TCI method without being influenced by sexes and tooth-region.

Keywords: age estimation, periapical radiograph, second molar, TCI

Introduction

Indonesia is a country that has geographical, geological, hydrological, and demographic areas prone to various disasters, both natural and human-induced [12]. Mass disasters occurring in Indonesia often involve the casualties, thus requiring the identification process [7]. Identities that can support the identification of a victim may be biological and nonbiological identities. Nonbiological identities can be identified by identity cards, driver's licenses, clothing, etc. Biological identity can be known through bones, teeth, blood, fingerprints, hair, DNA profile and identity on the lips [23].

One of the role of teeth in the identification process is as age estimation medium. Age estimation through tooth generally involved with non-invasive methods without dental extraction that is radiographic [28]. The periapical radiograph is a type of intraoral radiograph that can provide a good anatomical detail of the teeth. The periapical radiograph can display the entire anatomy of the tooth and surrounding supportive tissue [27].

Implementation of individual age estimation process can be done with various methods, one of them is Tooth Coronal Index (TCI) [19]. This method is based of the correlation between chronological age and dental pulp cavity size, including Coronal Height (CH) and Coronal Pulp Cavity Height (CPCH) score, then converted to $TCI = CPCH \times 100 / CH$ [18]. The TCI method is often applied to the posterior teeth compared to the anterior teeth. The posterior mandibular teeth showed more visible portion of the pulp cavity than the maxillary teeth [2].

In this study, we chose to use mandibular second molar teeth as a research object because those teeth are better than the other posterior mandibular teeth. The premolars (the first and second premolars) are the most frequently be extracted teeth to support an orthodontic treatment [4], the first molar is susceptible to caries with a prevalence of 68.1% [14] and mandibular third molar is a vulnerable tooth experienced impaction with a prevalence of 67.7% [6]. The mandibular second molar teeth are erupted teeth at age 11-12 years old [5] and begin experiencing attrition at age 17-25 years old [8]. Based on the description above, the researcher intends to conduct a study of age estimation with TCI method on mandibular second molars at age 11-25 years old.

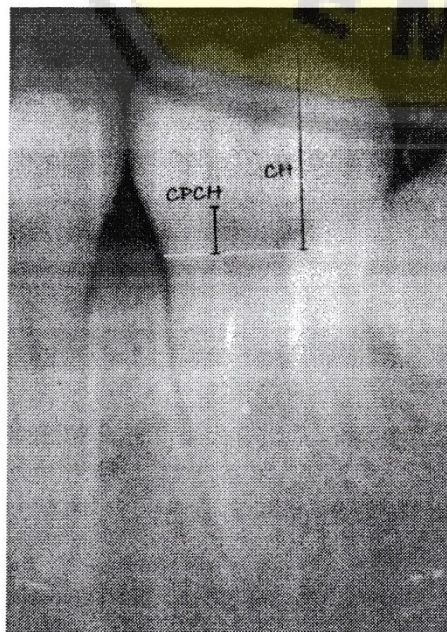
Methods and Materials

This type of research is an observational analytic research with cross sectional approach. The study was conducted at Radiology Installation of Dental and Oral Hospital of Jember University in February to March 2018. The study population are male and female at age 11-25 years old in Jember district where 120 samples were chosen by purposive sampling.

The research procedure involves the preparation stage that was forming of informed consent and continuing the process of taking a periapical radiograph photo with parallel technique. Further radiographs were measured using the TCI method using a caliper with a precision of 0.05 mm (Fig. 1).

The next procedure is data analysis. The data were tested for normality with Kolmogorov-Smirnov, homogeneity test with Levene Test, and then performed difference test with Independent T-test to see if there was any difference between TCI inter-sexes and also inter-tooth region. Difference test also performed with Oneway-Anova to see whether there were differences in TCI scores among each age and continued with Pearson correlation test to find out how strong the relationship between chronological age and TCI score. TCI score data of mandibular second molars and chronological age will analyzed by simple linear regression test to determine the linear mathematical relationship between independent and dependent variables.

Fig. 1 Application of TCI method at mandibular second molar tooth



Code : SP19-R1
 CH : Coronal Height
 CPCH : Coronal Pulp
 Cavity Height
 CEJ : Cemento-Enamel
 Junction

Results

The result of the research on age estimation by TCI method in the mandibular second molar at age 11-25 years old showed that the mean of TCI scores is decreased by increasing chronological age (Table 1).

Table 1 TCI score average at each age

Chronological Age	Tooth Coronal Index	
	Average	Standard Deviation
11 years old	32,70	1,24
12 years old	31,01	2,02
13 years old	30,57	1,26
14 years old	29,35	2,46
15 years old	28,81	1,85
16 years old	28,43	1,43
17 years old	27,21	1,57
18 years old	26,32	2,75
19 years old	25,43	2,38
20 years old	23,53	2,82
21 years old	22,82	2,27
22 years old	22,10	1,96
23 years old	21,29	2,11
24 years old	20,68	1,48
25 years old	19,87	1,09

The result of normality test with Kolmogorov-Smirnov and homogeneity test with Levene Test showed $p > 0,05$ which means that the data is normal distributed and homogeneous data. Different test result with Independent T-test showed no significant difference between TCI score with chronological age between sexes ($p = 0,578$) and inter-tooth region ($p = 0,896$). The inter-age TCI difference test with Oneway-Anova showed $p < 0,05$ which means there is a significant difference between the TCI values at each age. Furthermore, to test the correlation found strong negative correlation result ($r = -0,884$). The result of the graph below also showed a negative correlation between TCI score and chronological age (Fig. 2).

The result of linear regression test showed the constant of regression ($a = 40,717$) and the coefficient of regression ($b = -0,872$) so that it could produce the following age estimation formula.

$$Y' = a + bX$$

$$\text{Age Estimation} = 40.717 + (-0.872)TCI$$

Information:

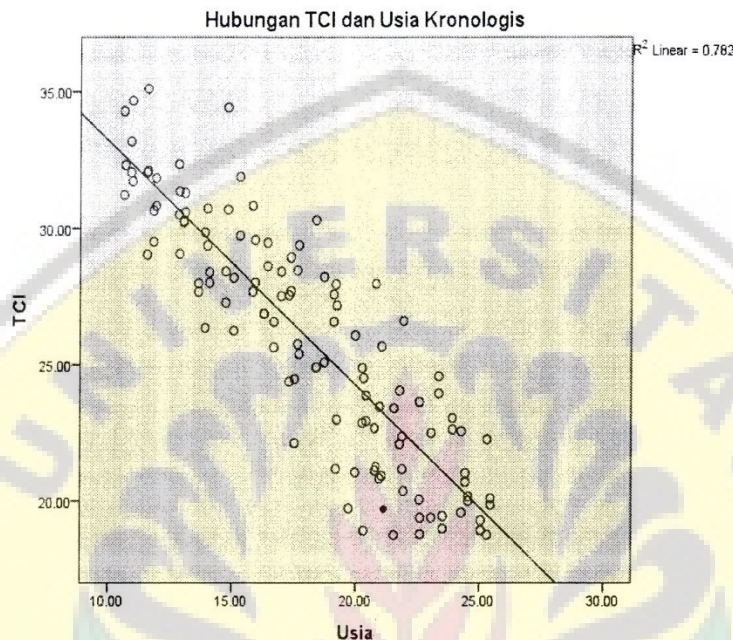
Y' = age estimation

X = TCI

a = the constant of regression (the score of Y' if X = 0)

b = the coefficient of regression

Fig. 2 Graph of the relationship between TCI score and chronological age



Discussion

The difference test result in this study showed that TCI score of male and female subjects did not show significant differences ($p = 0.578$). These result is similar with the research conducted by Drusini (2008) which states that the TCI score of male and female showed no significant difference [2]. TCI method is a method for age estimation involved coronal height and coronal pulp cavity height [18]. The shape of dental pulp will follow the shape of the tooth coronal, both in male and female [22]. That caused no significant difference between male and female TCI score in this study.

Similar result can also be seen on the difference test result of TCI score in the right and left tooth region. Difference test result showed the score $p > 0.05$ ($p = 0.896$) which means there is no significant difference between both of tooth region. This result is similar with previous research which states that TCI score in the right and left tooth region showed no significant differences [2]. Based on anatomical features of the teeth, the mandibular second molar in both the right and left tooth region has the similar anatomical form [5]. The mandibular right and left second molar teeth both have four cusps which if sorted from the highest ones are mesiolingual, distolingual, mesiobuccal, and distobuccal [22]. The similarity of this anatomical form that causes no significant differences between the TCI score in the right and left tooth region in this study.

In the TCI difference test result among each ages, there was a significant difference with $p < 0.05$. This formation forms a negative relationship which can be seen in the graph of the relationship between TCI score with chronological age (Fig. 2). The graph shows the decreasing in the TCI score at each chronological age increasing. The correlation of TCI score can also be seen from correlation test result that showed $r = -0,884$. The negative sign on the

correlation test result indicate that between the TCI score with chronological age has a negative correlation.

This decreasing of TCI scores indicates a narrowing of the pulp cavity as chronological age increasing. It accordance with the physiological conditions of human beings where the increasing age of a person, then the dental pulp cavity will further narrow. The narrowing of the pulp cavity is related to the presence of secondary dentin formation which is produced unevenly on the surface of the primary dentine and has an incremental pattern and irregular tubular structure compared to primary dentin [26]. Secondary dentine is produced by a special cell called odontoblasts. These cells coat the pulp cavity and the formation of secondary dentine will continue during the pulp in intact or vital conditions [22]. Secondary dentin deposition occurs more rapidly in the roof portion of the pulp cavity than in the proximal, buccal or labial, and lingual or palatal portions of the pulp cavity. The formation of secondary dentine always leads to one direction that is towards the pulp cavity and consequently the pulp cavity will further narrow with increasing age [15].

In the difference test result between the sexes and the inter-tooth region previously discussed, there was no significant differences among them, so for the determination of the age estimation formula there was no need for different formulas for both male and female subjects, or for the mandibular second molars in the left and the right tooth region. Based on a simple linear regression analysis, the formula founded: Age Estimation = $40.717 + (-0.872)$ TCI. The formula then applied to estimate the age of 120 samples of this study. The result showed the difference in age estimation with a considerable chronological age of under five years.

The result of estimating age is closely related to the previous calculation of TCI where there are variations of measurement result among the three observers. This condition can be caused by two things, that is the skill of the observer in measuring and also the quality of the radiograph that will be measured. The skill of the observer relates to the difference of accuracy and concentration level of each observer in determining the reference point in the radiograph, that is determining the Cemento-Enamel Junction (CEJ) line and determining the highest point when measuring the CH and CPCH scores [15]. According to Kolltveit et al., the main source of error in measurement appears to be the difficulty in determining the reference point on the radiograph. When the three-dimensional pulp is reproduced on a two-dimensional radiograph, the ends of the pulp horn become blurry, so that when measurements are not possible there may be variations in measurement result from each observers [24].

The quality of the radiograph produced from the local radiology laboratory may also influence the measurement process. The quality of the radiograph refers to the clarity, sharpness and precision of the image of the anatomical structure shown in the radiograph [15]. In this study, the quality of the resulting radiograph is mostly good, but there were still some contrasting radiographs that make the observer more observant in determining the measurement reference point. A practitioner should check to see if the density or contrast of the radiograph has been degraded properly or not, examine the detailed anatomical features of the teeth shown on the radiograph, so that the resulting radiograph can provide a good quality image before proceeding to the analysis process [27].

The age estimation formula generated through the using of TCI method on mandibular second molar, which is a fairly simple method to apply. Previous studies have suggested that the mandibular posterior teeth gives a good anatomical display of the radiograph so that it can be used as an age estimation medium by the TCI method [2]. The mandibular posterior teeth that is first premolar [15], second premolar [3], first molar [2] and second molar that have a strong correlation between TCI score with chronological age. Mandibular second molar teeth

can be used as medium of age estimation when other mandibular posterior teeth are not good enough to be used. The first molar is susceptible to caries [14], whereas first and second premolars are often be extracted to support orthodontic treatment [4]. However, if the mandibular posterior teeth are still in good condition, then both premolar and molar teeth can be used as a supporting medium of identification.

Conclusions

The conclusion of this study is that the age estimation at age 11-25 years old can be determined by analyzing periapical radiograph of mandibular second molar with TCI method without any significant differences in TCI score between the sexes and the inter-region of teeth. The age estimation formula based on this study was $40.717+(-0.872)TCI$ with a strong negative correlation between TCI score and chronological age. The suggestion for this research is that it can do a similar study with a larger number of research subjects and a wider range of sampling areas. This study can also be developed by comparing different research subjects with different races and comparing the application of TCI methods to premolar and molar.

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