CHAPTER I

INTRODUCTION

1.1 Research Background

Forensic science is a study that apply scientific methods and techniques to the law or legal matters and also investigation of crimes (Senn and Stimson, 2010). Forensic anthropology is one of the branches of forensic science in which the American Board of Forensic Anthropology offers the following definition: application of physical anthropology’s standard technique in identifying human remains or in assisting detection of crime, which plays great importance for legal and humanitarian objectives (Klepinger, 2006).

Forensic anthropologists often work alongside forensic pathologists, odontologist and homicide investigators in identifying a decedent and discovering evidence of foul play and post-mortem interval. Other than that, they also work to suggest the age, sex, ancestry, stature, and unique features of a decedent from the skeleton (Klepinger, 2006). In the other hand, forensic archaeology is the application of archaeological methods to the resolution of medical-legal issues. Specifically, forensic archaeologists perform the controlled recovery of human remains and other evidence at forensic scenes (Nawrocki, 1996).

Forensic odontology was defined by Kaiser-Nielson 1970 as a branch of dentistry which, in interest of justice deals with proper handling and examination of dental evidence, and with the proper evaluation and presentation of dental findings (Verma, et al., 2014). Teeth is one of the human parts that were used in
estimating age because they have the benefit to be preserved long after other
tissues and unlike bones, they can be examined directly in living individuals. In
historical perspectives, dentition was pointed out as reliable standard after a series
of historical law cases. The cases mainly involved juvenile crimes and laws,
where the suspect couldn’t be identified as a child or adult. Compared to other
parameter such as height calculation to determine their age, Edwin Saunders, in
1897, pointed out that the dentition is a more reliable standard (Nitul, 2013).

Age estimation is a sub-discipline of the forensic sciences and should be an
important part of every identification process. Identification of individuals is
important for legal and ethical issue, and declaration of death reports. The
methods of age estimation are divided into three categories; morphological
method, biochemical method and radiographic method (Priyadarshini, et al.,
2015). In estimating the age of an adult, the pulp chamber volume can be used as
age predictor. This is because the volume of pulp increases with age due to
secondary dentine deposition.

Pulp-dentin complex are specialized connective tissues of mesodermal origin,
formed from the dental papilla of the tooth bud. Pulp is circumscribed
peripherally by a specialized odontogenic area made up of the odontoblasts, the
cell free zone and the cell rich zone. The dentin forming the initial shape of the
tooth is called primary dentin. Secondary dentin are deposited by odontoblasts
after root formation is complete although the process is slower but continuous,
and eventually caused pulp recession. It is unevenly deposited around periphery of
pulp chamber, especially in molar. Different than the secondary dentin, tertiary
Dentin are known as reparative dentin deposited as a reaction to stimuli such as attrition, caries and restoration. It is deposited at specific sites in response to injury (Nanci, 2003).

Pawon Man is the name for the 7 skeletal findings in Pawon Cave located in the limestone area Citatah, in the village of Mount Magisit, Cipatat district, West Bandung regency, West Java founded by Bandung Archaeology Centre in 2003 and 2004 (Yondri, 2009). Other than the skeletal findings of Pawon Man, there are other relics found all over the cave that may show insights about the living condition during the prehistoric time.

In conjunction with the findings, in recent years, there are several research in the scope of forensic odontology were done on Pawon Man including sex determination based on mandibular arc shape, DNA analysis and race identification based on mandibular dental arch shape and also age estimation. By finding out the lifespan of the ancient human, we may decipher the living conditions or ancestral backgrounds during the ancient time. In a research conducted by Elizabeth (2016), the results from her research showed that age estimated for Pawon Man based on Johanson method were more specific whereas in a research conducted by Hardianto (2016), there are fluctuation in the results of age estimated for Pawon Man based on Kvaal method in teeth from the same skeleton.

In 2015, a research was made by Ge et al. on the age estimation based on pulp chamber volume of first molars in Chinese population and concluded that it is a useful index for the estimation of human age. The research was done by taking
samples of maxillary and mandibular first molars with known age and sex. Then, the pulp chamber volume were calculated, and logarithmic regression analysis were done to estimate the relationships among variable. Few mathematical models were established with one of it generally for all teeth being: \( \text{AGE} = 117.691 - 26.442 \times \ln(\text{pulp chamber volume}) \) and were then tested for the precision and accuracy. The regression was statistically significant \((p = 0.000 < 0.01)\), with a very high coefficient of determination \((R^2)\) of 0.564. There is a mean absolute error of 8.122 and root mean square error of 5.603 between actual age and estimated age for all the tested teeth. Therefore, researcher intended to assess the accuracy of age estimation from pulp chamber volume of first molar teeth and estimate the age of Pawon Man by applying the mathematical model established by Ge et al. (2015).

First molars are the largest and strongest teeth in each arch of jaws and generally molars play major role in mastication of food. The pulp chamber of maxillary first molars is broader buccolingually than mesiodistally following the crown shape, and is often constricted near the floor of the chamber while the pulp chamber of maxillary first molars is broader mesiodistally than buccolingually. The pulp chamber is normally deep to, or some distance from, the occlusal surface, located within the cervical part of the root trunk. The floor is flat in young teeth but may become convex in adult due to the dentin deposition (Scheid and Weiss, 2012).
The title of this research is part of a sub-research in the field of Forensic Odontology on a research roadmap of age estimation with person in charge of research Fahmi Oscandar, drg., M.Kes., SpRKG; Yuti Malinda drg., MM., M Kes; Nani Murniati, drg., M.Kes.; Murnisari Dardjan, drg., MS and Dr. Lutfi Yondri, M.Hum.

1.2 Problem Identification
The problem identification of this research is what are the age estimation of Pawon Man based on the pulp chamber volume of first molar teeth.

1.3 Purpose of Research
To estimate age based on pulp chamber volume of first molars of Pawon Man teeth.

1.4 Uses of Research
Theoretical: To provide information to community about age estimation in human fossil using pulp chamber volume of first molars teeth.

Applicative: To apply and contribute in the field of forensic archaeology/odontontology back in Malaysia due to its growing potentials and number of sources.
1.5 Conceptual Framework

In forensic science, identification of a person becomes an important question as it is an important basis for legal and ethical issues and declaration of death reports (Morsi, et al., 2015). In identifying human identity, teeth have long been used as source of identification. Teeth are highly resistant to mechanical, chemical or physical impacts and time, and age-related changes of tooth are minimally influenced by the nutrition, environment and living conditions that an individual is submitted to, many age estimation methods based on teeth have been established (Ge, et al., 2015).

Pawon Man is the name for the 7 skeletal findings in Pawon Cave located in the limestone area Citatah, in the village of Mount Magisit, Cipatat district, West Bandung regency, West Java founded by Bandung Archaeology Centre in 2003 and 2004 (Yondri, 2009). From 5 of the skeletons, first molars were only available in Pawon I, Pawon III and Pawon IV.

Examination of the pulp space offers new opportunities in dental age identification and a commonly used method found to be effective is the evaluation of secondary dentine deposition (Jagannathan, et al., 2011). As stated by Babshetet et al., radiographic evaluation of secondary dentine may be the only non-invasive approach to estimate age from fully developed teeth (Afify, et al., 2014).

Regression analysis are used to establish mathematical model by Ge et al. 2015 for age estimation based on the pulp chamber volume. Formula established for a population may not be applicable for another population due to anthropological differences between various ethnic populations (Kumar, Set et al., 2016).
CBCT 3D is very beneficial in supporting the accuracy of odontology forensic cases. This is because CBCT 3D can display 3-dimensional model that is very helpful in providing quantitative information in the diagnosis. Computed tomography (CT) enables three-dimensional analysis of the pulp cavity and has already been tested with regard to age estimation (Sakuma, Makino, and Yajina, 2013).

Diagram 1.1 Flow Chart of the Conceptual Framework
1.6 Methodology of Research

The method used in this research is descriptive method. The population of this research is radiographic CBCT image of first molars of skeletal findings of Pawon I (teeth 26 and 36), Pawon III (teeth 36) and Pawon V (Teeth 36 and 46 collected from Radiology Installation in RumahSakit Gigi danMulut, Sekeloa, Bandung. The variable of this research is the age estimation of Pawon Man based on the pulp chamber volume of first molar teeth. The materials and tools needed for this research are ITK Snap, CBCT radiographs and compact discs CD.

1.7 Time and Location of Research

The research will be conducted in Forensic Odontology department in RSGM, Bandung approximately from July to May 2018.

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