PATTERNING OF THE HUMAN DENTITION:

IMPLICATIONS FOR FORENSIC ODONTOLOGY

by

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Please note that images of deceased Australian Indigenous people are contained within this thesis

Table of contents

List of tables

List of figures

List of abbreviations

(All tooth notations in this thesis are presented using FDI notation e.g. 12 for permanent right lateral incisor)

MD	=	Mesiodistal
BL	=	Buccolingual
U	=	Upper
L	=	Lower
GMA	=	Geometric Morphometric Analysis
PCA	=	Principal Component Analysis
DFA	=	Discriminant Function Analysis
CVA	=	Canonical Variate Analysis

Abstract

Forensic identification may be required for a number of reasons. The identification process relies on the comparison of information gathered from known records with information from the unknown. Different scientific methods may be employed, but a primary identifier is a comparison of data concerning the status of the teeth. Conclusions regarding identity range from possible to positive identification. The presence of dental treatments or pathological conditions usually adds to the weighting of forensic identification. The availability of dental radiographs also strengthens the opinion where ante-mortem and post-mortem image comparisons can be made. This combination of dental treatments provides a reasonable choice for statistical modelling; however, such forms of variability are on the decline in populations with better oral health.

It is well established that teeth are derived and affected by a complex interplay of genetic, epigenetic and environmental factors, giving rise to significant natural variation in the arrangement, size, and shape of teeth that is generally stable through time. Modelling such variation should provide a useful mechanism for identification in cases where dental treatments are not present in the dentition. Arguments on the issue of individualisation have highlighted an obvious obstacle when tackling this issue as it is impossible to study each and every individual in the world.

The aim of the current project is to display the value of focussing on these normal variations rather than the 'problems'. The focus is on the measurement and comparison

of dental crown size and dental arch size and shape within and between six human populations. This information provides the foundation for future development of a more robust probabilistic model focussing on the normal morphological status of dentition.

Observations were made in six different ethnic groups including Australian Aboriginals, Europeans, and four major ethnic groups in Malaysia; Malays, Indians, Chinese and a Malaysian Indigenous group (*Orang Asli*). Measurements of these variations using both 2D and 3D imaging systems displayed reliable and repeatable methods to measure patterning of the human dentition using the normal morphology of teeth and dental arches. By using standardised eigenvalues derived from metric measurements, a probabilistic model was postulated to assess random match probabilities.

The findings from this current research add to our understanding of the variability of the human dentition and should improve the acceptance of using dental morphology as a means of identification. The results have shown that despite absence of dental treatments, the nature and extent of normal morphological variation in the human dentition can be quantified reliably and then applied in forensic and anthropological situations for identification purposes.

Thesis declaration

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Format of thesis

The thesis will be presented in nine main chapters. An introduction and findings from a literature review are presented in Chapters 1 and 2. A summary from the literature review will then lead to the main aims and objectives of this research. Chapter 4 presents the materials utilized in this research and the methodology employed to achieve aims and objectives highlighted in Chapter 3.

Chapters 5, 6 and 7 cover the results of this current research where Chapter 5 presents data and discussion on dental crown size, Chapter 6 presents data and discussion on dental arch size and shape, while Chapter 7 presents data and discussion on Geometric Morphometric Analysis of dental arch size.

Each chapter of results has a section of discussion and then Chapter 8 presents a general discussion of this research, highlighting its relevance, suggestions for further research and also highlighting collaborative efforts during the conduct of this research. Chapter 9 provides general conclusions. A list of references is provided at the end of this thesis, together with some appendices.

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