

HUMAN IDENTIFICATION DR. SAKHER ALQAHTANI BDS, MPHIL, MCLINDENT, PHD

**Forensic sciences** 

## HUMAN IDENTIFICATION

#### **Definition:**

- The determination of an individual, weather dead or alive, using certain physical characteristics

- relate a sample to:
  - Database
  - Single template
- It could be complete or partial



- Mass disasters
- Mass graves
- Homicides and suicides
- Absence of documents
- Unknown offender
- Criminal responsibility
- Identity theft



- Human right
- For burial purposes
- Identification of offenders
- Insurance benefits to next of kin
- Age determination in criminal liability
- Interchange of newborn babies in hospitals



- Personal identification
- Criminal identification
- Legal identification
- Civil identification

#### HUMAN IDENTIFICATION IN THE LIVING

#### By using:

- Trace evidence
- Functions
- Age estimation

#### HUMAN IDENTIFICATION IN THE DEAD

The body may be:

- Fresh and intact
- Putrefying
- Mutilated or dismembered
- Charred
- Skeletonized





- Anthropomtry
- Descriptive
- Photographs
- Dactylograpghy "Fingerprints"

Definition:

- It is the print of the patterns of epidermal ridges on finger tips on a surface
- The method of identifying these prints is called *Dactyloscopy*

Characteristics:

- Unique to the individual
- The patterns remain unchanged throughout life

#### • Types of fingerprints:

Arch



#### Loop



# Whorl

#### Tented arch



• When friction ridges come into contact with a surface that will take a print, material that is on the friction ridges such as the natural secretions of sweat from the eccrine glands, perspiration, oil, grease, ink or blood, will be transferred to the surface.

•Children's fingerprints are considerably more short-lived than adult fingerprints. The rapid disappearance of children's fingerprints was attributed to a lack of the more waxy oils that become present at the onset of puberty. The lighter fatty acids of children's fingerprints evaporate within a few hours

• Validity: the subjective nature of matching, despite a very low error rate, has made this forensic practice controversial

- Absence of fingerprints:
- medical condition:
  - Adermatoglyphia
  - Some forms of ectodermal dysplasia
- Medications:
  - The anti-cancer medication "capecitabine"
  - Bee stings
- Age: the ridges get thicker; the height between the top of the ridge and the bottom of the furrow gets narrow, so there is less prominence
- Mutilation:
  - Burning the fingertips, using acids
  - Plastic surgery



- Anthropomtry
- Descriptive
- Photographs
- Dactylograpghy "Fingerprints"
- Hand prints

# HAND PRINT







- Anthropomtry
- Descriptive
- Photographs
- Dactylograpghy "Fingerprints"
- Hand prints
- Foot prints

# FOOT PRINT





- Anthropomtry
- Descriptive
- Photographs
- Dactylograpghy "Fingerprints"
- Hand prints
- Foot prints
- Ear print

# EAR PRINT





- Anthropomtry
- Descriptive
- Photographs
- Dactylograpghy "Fingerprints"
- Hand prints
- Foot prints
- Ear print
- Vein outline

# **VEIN OUTLINE**



## HOW?

- Anthropomtry
- Descriptive
- Photographs
- Dactylograpghy "Fingerprints"
- Hand prints
- Foot prints
- Ear print
- Vein outline

Lip prints Bite marks

# LIP PRINT AND BITE MARK







# HOW?

- Anthropomtry
- Descriptive
- Photographs
- Dactylograpghy "Fingerprints"
- Hand prints
- Foot prints
- Ear print
- Vein outline

- Lip prints
- Bite marks
- Teeth

# TEETH



Postmortem full-mouth radiographic survey

# HOW?

- Anthropomtry
- Descriptive
- Photographs
- Dactylograpghy "Fingerprints"
- Hand prints
- Foot prints
- Ear print
- Vein outline

- Lip prints
- Bite marks
- Teeth
- Voice recognition
- Gait
- Thermal print
- Iris recognition
- DNA

## DNA

The molecule of DNA has two strands of sugar and phosphate molecules that are linked by combinations of four bases – adenine, thymine, cytosine and guanine – forming the double helix of DNA





Only about 10 per cent of the molecule is used for genetic coding (the active genes), the remainder being 'silent'. In these silent zones, there are between 200 and 14 000 repeats of identical sequences of the four bases

## DNA

The technique of determining the sequences is extremely complex, relying on cutting the DNA strands at predetermined points by the use of restriction enzymes. The fragments of DNA are separated using electrophoresis and the different fragments are then identified using a radioactive probe

From the presence of different bars in given positions, comparisons may be made with other samples, known or unknown – the classical forensic 'comparison technique'



At least 2 identification markers should be noted by the doctor in all medico-legal cases

#### **AGE ESTIMATION**

Relate chronological age

To biological age

Using known specific maturating events

### **HOW TO ESTIMATE AGE**

#### Select a feature of the developing individual that:

- Grows/matures over a long period of time
- Measurable stages
- Over a short period of time

#### Stable

Survives inhumation well

#### **HOW TO ESTIMATE AGE**

Stature/weight Sexual maturation Bone development Dentition... is the least influenced by environmental factors and survives inhumation very well

# DENTITION AND AGE



#### **DENTITION AS AN ESTIMATE FOR AGE**

Deciduous/primary dentition

#### Permanent dentition







#### **TOOTH DEVELOPMENT**

## initial mineralization, crown completion, and completion of the root apex.



## AIM OF MY RESEARCH

to develop a comprehensive evidence based atlas of tooth development and eruption for primary and permanent teeth from 28 weeks *in utero* through to maturity




### THE DESIGN

Retrospective

Cross sectional study of:

- Known age-at-death skeletal remains (N 176)

- Radiographs of known age individuals (N 528)

Total 704

### MATERIALS

### Ages: 28 weeks *in utero* to less than 2 years (176 in total)



Maurice Stack's collection: Hunterian Museum, Royal College of Surgeons of England

- 126 neonatal samples:
- 68 males
- 58 females

### MATERIALS

### Ages: 28 weeks *in utero* to less than 2 years (176 in total)

the Spitalfield's Collection: Natural History Museum, London

50 infant remains:
15 males
31 females
4 unknown sex



### MATERIALS

Ages: 2 years to 23 years (528 radiographs in total)

Archived High quality dental panoramic radiographs: each chronological year: 12 males 12 females

### **METHODS**

### Tooth development (crown and root):

#### Moorrees, Fanning and Hunt (1963).

Age Variation of Formation Stages for Ten Permanent Teeth. Journal of Dental Research 42: 1490–502





Tooth eruption: • Modified Bengston's stages

Relative to alveolar bone level

# Data for each tooth in each age group for all 704 individuals were tabulated



Computer finished illustration

### Drawings



# **METHODS**

### Data collection:

- Median identified for:
  - Each tooth stage in each age group

#### Intra observer error:

- staging was assessed twice at different occasions for:
  - 755 teeth (65 individuals)
  - (Kappa 0.85 )

# Diagrams



#### Median of 24 children

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L	4	4	4	4	4	1	1	1	1	1	2	1	-

# Diagrams







#### Atlas of Tooth Development and Eruption

#### Barts and The London

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Simplified Chinese

Traditional Chinese

Arabic

Farsi

French

German

Greek

Italian

#### Atlas of tooth development and eruption

We have developed a comprehensive evidence based atlas to estimate age using both tooth development and alveolar eruption for individuals between 28 weeks in utero to 23 years; it shows a sequence of diagrams representing a continuum of developmental ages without gaps or overlaps <sup>1</sup>.

Data was collected from developing teeth from 72 prenatal and 104 postnatal skeletal remains of known age-at-death were examined from collections held at the Royal College of Surgeons of England and the Natural History Museum, London, UK (M 91, F 72, unknown sex 13) <sup>2,3</sup>. Data were also collected from archived dental radiographs of living individuals (M 264, F 264) <sup>4</sup>. Median stage for tooth development and eruption for all age categories was used to construct the atlas. Tooth development was determined according to Moorrees, Fanning and Hunt <sup>5,6</sup> and eruption was assessed relative to the alveolar bone level <sup>7,8</sup>. Intra-examiner reproducibility was 0.85 calculated using Kappa on 755 teeth (65 individuals).

Diagrams were drawn to represent monthly dental development in the last trimester, 2 weeks around a full gestation (40 weeks) birth, quarterly development for the first year of life, and yearly development thereafter.

This atlas can be downloaded and used for teaching purposes or individual learning.

Electronic interactive software is now available to use for free



Japanese Malay Portuguese Romanian Russian Spanish Urdu Software app

#### Brief Communication: The London Atlas of Human Tooth Development and Eruption

S.J. AlQahtani, M.P. Hector, and H.M. Liversidge\*

Institute of Dentistry, Barts and The London School of Medicine and Dentistry, Queen Mary University of London, London E1 2AD, UK

*KEY WORDS* dental; age; estimation; forensic; odontology

ABSTRACT The aim of this study was to develop a comprehensive evidence-based atlas to estimate age using both tooth development and alveolar eruption for human individuals between 28 weeks in utero and 23 years. This was a cross-sectional, retrospective study of archived material with the sample aged 2 years and older having a uniform age and sex distribution. Developing teeth from 72 prenatal and 104 postnatal skeletal remains of known age-at-death were examined from collections held at the Royal College of Surgeons of England and the Natural History Museum, London, UK (M 91, F 72, unknown sex 13). Data were also collected from dental radiographs of living individuals (M 264, F 264). Median stage for tooth development and eruption

for all age categories was used to construct the atlas. Tooth development was determined according to Moorrees et al. (J Dent Res 42 (1963a) 490–502; Am J Phys Anthropol 21 (1963b) 205–213) and eruption was assessed relative to the alveolar bone level. Intraexaminer reproducibility calculated using Kappa on 150 teeth was 0.90 for 15 skeletal remains of age <2 years, and 0.81 from 605 teeth (50 radiographs). Age categories were monthly in the last trimester, 2 weeks perinatally, 3-month intervals during the first year, and at every year thereafter. Results show that tooth formation is least variable in infancy and most variable after the age of 16 years for the development of the third molar. Am J Phys Anthropol 142:481–490, 2010.  $\bigcirc$  2010 Wiley-Liss, Inc.



# TAKING THINGS FORWARD

### THE LONDON ATLAS SOFTWARE PROGRAM



### The London Atlas

Sakher AlQahtani, Mark Hector and Helen Liversidge

#### PLAYBACK

This section features dental development for males, females and mixed sex covering all age ranges between 28 weeks in-utero and 23 year. In this section you can follow the development of all teeth along the time line or select specific tooth/teeth or dentition and follow their development.



#### DATA ENTRY

GO

This section features a dental age calculator that enables you to enter data for tooth development. All illustrations of dental developmental stages are accompanied by written description, allowing you to select the right stage and enhancing performance measures.

#### COMPARISON

This section allows you to compare tooth/teeth development between two different ages from the same sex or between different sexes at the same age.



### Atlas of Tooth Development and Eruption



Queen Mary

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# AGE ESTIMATION FROM BONES

• Foetus and young infant: Look at the appearance of ossification centers in growing cartilage (complete by 5 years)

Child to young adult: Look at fusion of the epiphyses (secondary ossification centers (up to 25 years)

• Adult > 25 years: Look at wear and tear changes in teeth and bones.

# FACIAL RECONSTRUCTION



# listenines