

MA in Criminal Law & Forensic Science

NALSAR, University of Law
Truth Labs, Hyderabad

Forensic Odontology, Forensic Anthropology & Forensic Archaeology

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Getting familiar with the terms

Anthropology

The scientific study of humanity

Archaeology

Study of human past through material remains

Odontology

Scientific study of teeth – structure & diseases

Forensic

Relating to court of law

Human Remains

Parts of the bodies of dead people

- Why do you need to know these fields?
- Where will you apply these fields in a criminal law perspective?
- Investigation of unidentified bodies, decomposed bodies near/away from a crime scene, buried human remains, teeth in a crime scene...

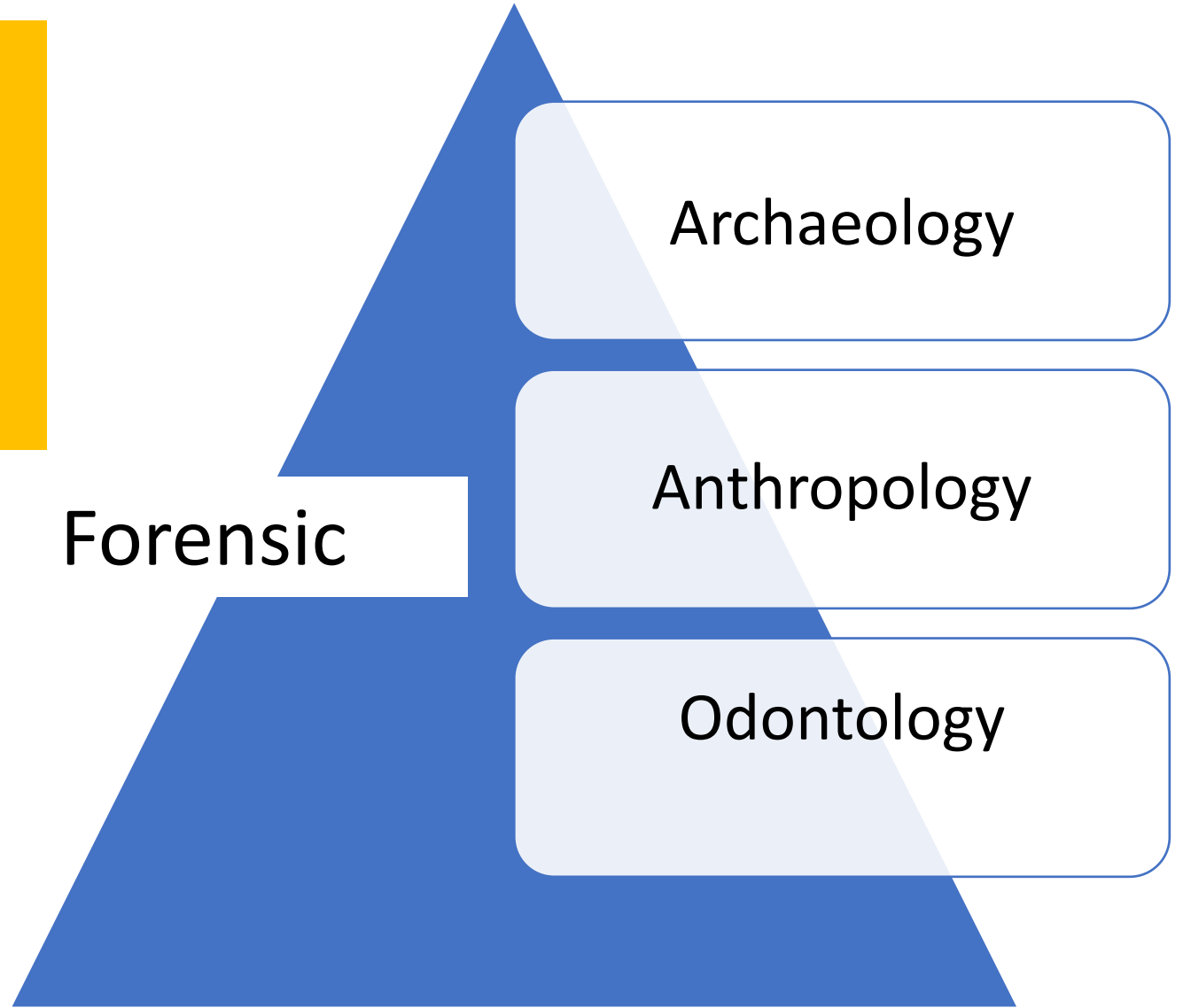
Forensic Examination of Human Remains

Forensic

Archaeology

Anthropology

Odontology





Forensic Archaeology

Forensic Archaeology

- Forensic Archaeology – application of excavation & archaeological skills to forensic contexts
- Locating bodies
- Understanding the relationship between the grave and other buried features (soil layers, personal effects, drainage ditches)
- Understanding what happens to the body in the ground (depositional & taphonomic processes)
- Excavating graves & creating detailed records of the relationships between objects, bodies/skeletons & features within the burial environment



Functional roles

- Help the police locate the site where a body and victim's personal items, or stolen goods are buried
- Help with excavation of graves
- Record and preserve every evidence found at every stage and depth
- Date items found in grave sites
- Excavation of mass graves to produce evidence for war crimes trials
- Provide understanding about how materials degrade or decompose over time and in specific conditions



Forensic Anthropology

- Forensic Anthropology - A sub discipline of anthropology that deals with the analysis of human remains for the medicolegal purpose of establishing identity
- Involves applying detailed knowledge of the development, morphology, and variation of the human body as an aid to establishing, confirming, or indeed refuting personal identification
- Services primarily offered in investigations of the dead and certain investigations of the living

Investigations of the Dead

- Investigations resulting from homicide, unexplained natural deaths, accidents, and mass fatalities
- Noncriminal events resulting in multiple deaths, e.g., arising from natural catastrophes
- War crimes investigations and genocide

Investigations in the living

- Age assessments for the purposes of judicial accountability, immigration, or asylum status

Functional roles

- Establish, confirm / refute **identification**
- Advise on **manner of death** particularly in cases of skeletal trauma
- To assess **taphonomic modification** of human remains in the burial environment

Stages of identification in anthropology

- Is it Human / Non-Human Bone
- Minimum number of individuals present
- Sex determination
- Age determination
- Stature
- Ancestry / Ethnic identity
- Markers of personal identity

Identification traits

Primary traits

- Biological sex
- Skeletal / developmental age
- Racial affiliation (ancestry)

Secondary traits

- Body modifications
- Evidence of surgical interventions (scars, prosthetics)
- Evidence of trauma
- Chronic diseases that may leave characteristic lesions on surviving tissue

Forensic Age estimation

Forensic Sex determination

Extensive & Needs to be covered as a separate topic



Forensic Odontology

“Forensic odontology is a branch of forensic medicine and, in the interests of justice, deals with the proper examination, handling and presentation of dental evidence in a court of law.”

(BAFO)

Functional Roles of Forensic Odontology



Human Identification



Disaster Victim Identification



Age Estimation



Bitemark Analysis



Civil Litigation



Cheiloscopy & Rugoscopy



Dental Profiling

Forensic human identification - Application of forensic science to identify people

Context & significance of forensic human identification

The Living

- Identity fraud & theft
- Criminal cases
- Missing persons

The Dead

- Missing persons
- Human remains

Identification of the Living

Biometric Identity cards

- Aadhar card
- Passport
- Driving License
- PAN card
- Voter ID card

Scientific basis

- Fingerprints
- DNA
- Retinal Scans

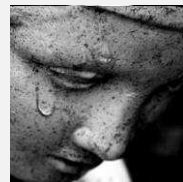
Identification of the Dead



Core of Humanitarian forensics



**Establishing Identity of The Deceased
– Extension of Human rights to the
Deceased (UN)**



**Aid Psychological closure to those
alive - Rights of the next of kin to
know the fate of their relatives and
To mourn**

Teeth

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graph TD; A[Teeth] --> B[Mineralized tissues]; A --> C[Resistant to High temperatures]; A --> D[Source for DNA];
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Mineralized
tissues

Resistant to High
temperatures

Source for
DNA

Dental identification

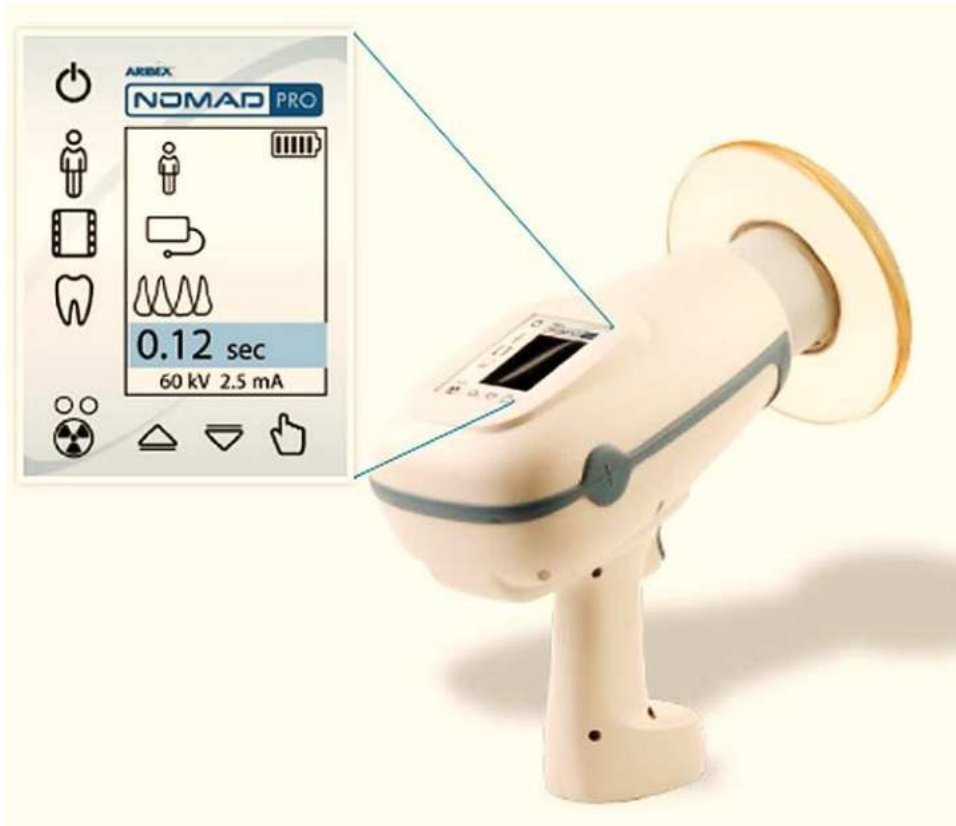
Dental Autopsy – post mortem dental record



Site of discovery:		Date:	
Location of remains:		Body no.:	
Cause of death:		Post. No.:	
		Sex:	
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12		12	
13		13	
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Dental radiographs



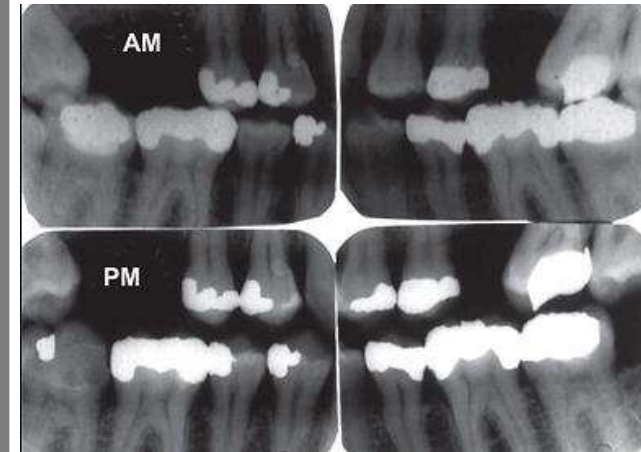
Ante Mortem dental records



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FACIAL	[Diagram of upper teeth with red markings on teeth 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16]															
LINGUAL	[Diagram of lower teeth with red markings on teeth 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16]															
TOOTH MOBILITY -	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TOOTH VITALITY -	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
															NV	NV

	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
INGUINAL	[Diagram of lower teeth with red markings on teeth 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17]															
FACIAL	[Diagram of upper teeth with red markings on teeth 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17]															
TOOTH MOBILITY -	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
TOOTH VITALITY -	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
															NV	NV

--- Indicates missing tooth
 NV Non-vital
 ☹ Defective crown
 ● Caries or defective restorations



Process of identification

Post-mortem records + Ante-mortem records

Comparison to match & establish identity

HIGH PROFILE CASES

Forensic odontology as prime evidence in identification



Adolf Hitler, 1945



Saddam Hussein, 2003

Dental Identification in Mass Disasters

Vienna opera house fire, 1849

First recorded use of dentitions in
body identifications associated
with mass disaster.



Paris fire - Bazar de la Charité, 1897





It is rarely possible to identify a victim of a major disaster by visual recognition; fingerprints, dental records or DNA samples are often required for a conclusive identification.



[Who we are](#) [Crimes](#) [How we work](#) [Our part](#)

Disaster Victim Identification (DVI)

— Setting the standard

In 1984, INTERPOL produced the first Guide to Disaster Victim Identification. The guide is updated every five years and is the unique globally accepted standard for DVI protocols.

Disaster Victim
Identification (DVI)

[Home](#) > [How we work](#) > [Forensics](#) >
Disaster Victim Identification (DVI)



Interpol

Primary Identifiers

Fingerprints

Dental

DNA

Secondary Identifiers

Personal
Effects

Personal
Data

Medical
Findings

Asian Tsunami (2004) - 79% cases identified by odontology



Grenfell Tower fire – London, UK (2017) - 67% of the positive identifications were by odontology



Expert Witness in Court

- Civil Cases – Age Estimation
- Criminal Cases – Bitemark Analysis

Dental Age estimation



Laws for Age related issues



सत्यमेव जयते

Child Labour Act, 1986

The Majority Act, 1875

National Policy on Child Labour, 1987

The Child Marriage Restraint Act, 1929

Right to Education Act, 2009

Juvenile Justice Act, 2015

International Laws dealing with age

UN Convention on the
Rights of the Child
1989 (CRC)

International Labour Organization
conventions(ILO), 1973 on the
Minimum Age for Admission to
Employment of 1973

Asylum Seekers



Basis for dental age estimation

1. Tooth development
2. Tooth eruption
3. Age changes

Bite Mark Analysis

Bite Marks

- **Bitemark – a pattern created by teeth contacting a surface**
- **On human skin – classified as patterned injury**
- **Body / Objects in the crime scene**
- **Can be seen on the Victim / Suspect**
- **Exculpatory / Inculpatory evidence in criminal proceedings**

King William, the Conqueror, 1066 AD

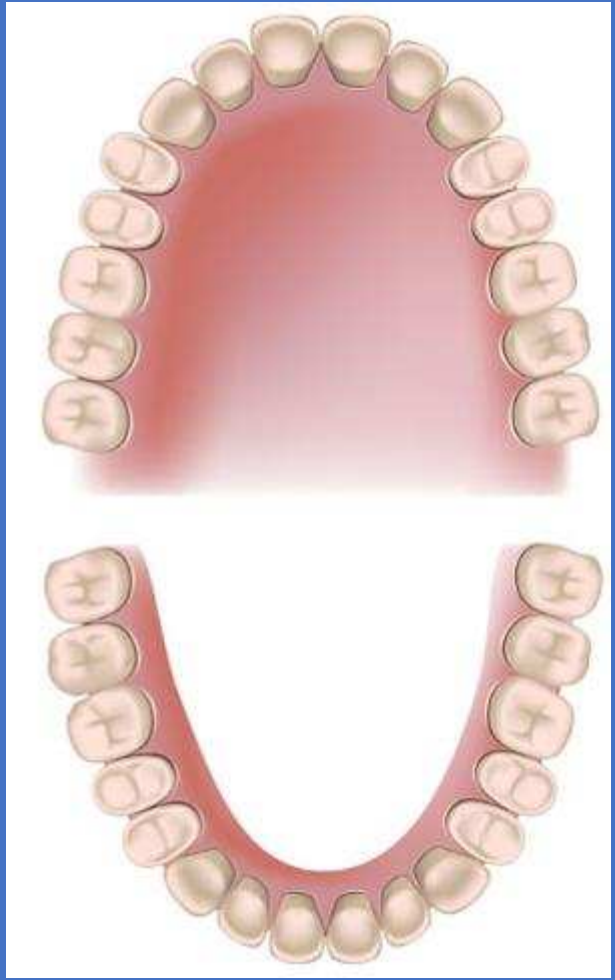
- 1st use of bite marks for identification.
- Habit of securing his mail with sealing wax imprinted with his bite.
- His anterior teeth were misaligned, thus allowing verification of authenticity of his documents.

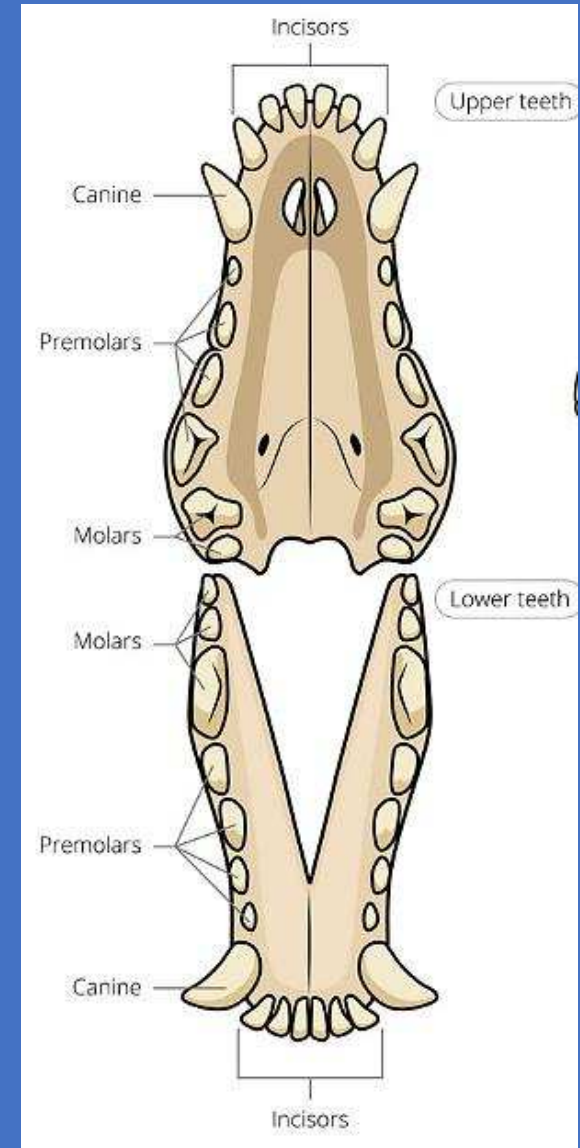


Recognizing Bite Marks

- Is the injury a bitemark ????
- If yes, was it caused by human teeth / animal teeth ???
- If human, adult teeth or juvenile teeth ??
- Is the injury of sufficient quality for further examination & testing ?

If your answer is YES to these questions, then Analysis continues...





Steps in Bitemark cases

- 1. Recognition of Bitemarks**
- 2. Evidence Collection**
- 3. Bitemark Analysis**
- 4. Collecting & preserving dental information from potential biters**
- 5. Comparing potential biter and bitemark evidence**
- 6. Report Writing**

1. Recognizing Bite Marks

- Semicircular to ovoid outline forms comprising of two arc-shaped components representing the two dental arches, with markings of individual teeth present within the arched outlines.



Partial
Bite mark



Avulsive
Bite mark



Multiple
bite marks

2. Evidence collection – Legal Paperwork

- Maintain chain of custody
- Written request from police, law enforcement agency, child protective services or an attorney- prior to investigative procedures

2. Evidence collection– Saliva swab

- Saliva Swabs for Salivary Trace evidence
- Double Swab technique
- Salivary amylase – confirms it to be a bite mark
- DNA from saliva / epithelial cells



Also test clothing overlaying bite marks sites for salivary traces



Photography

1. Initial photograph without washing / swabbing

*Scale should be placed on the
same plane as the bitemark &
photographed with the plane
of the camera sensor parallel
to the bitemark & the scale*



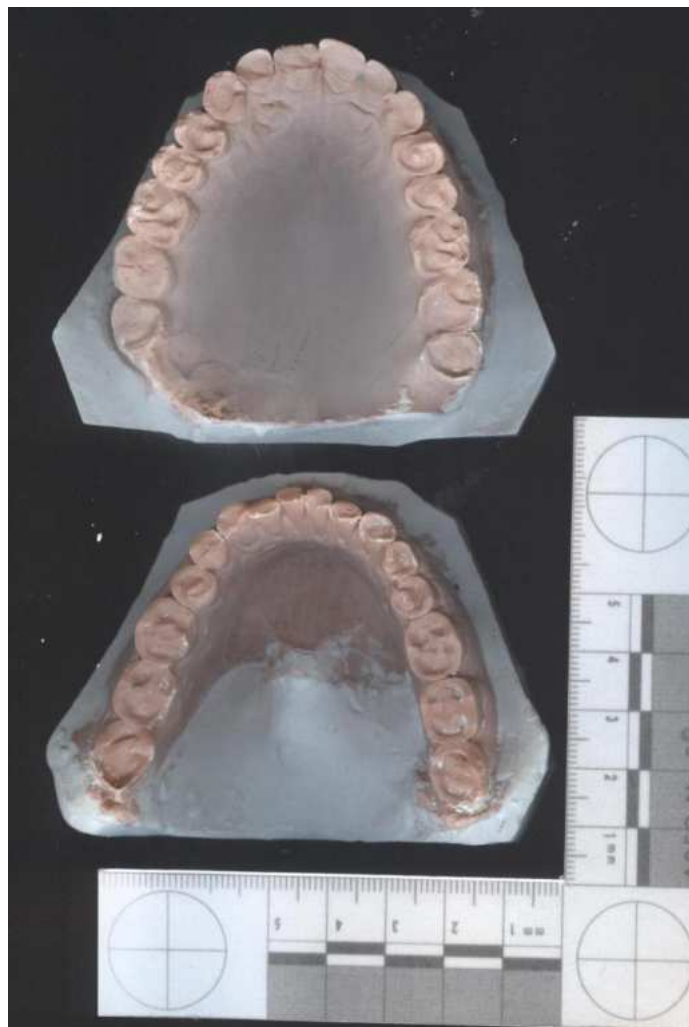
2. Orientation photograph must include anatomical landmarks



3. Close-up Working photograph – attention to detail & standardized technique are necessary

2. Data collection from suspect(s)

- *Obtain consent*
- *Dental examination & Dental Charting*
- *Photographs*
- *Impressions & Casts*



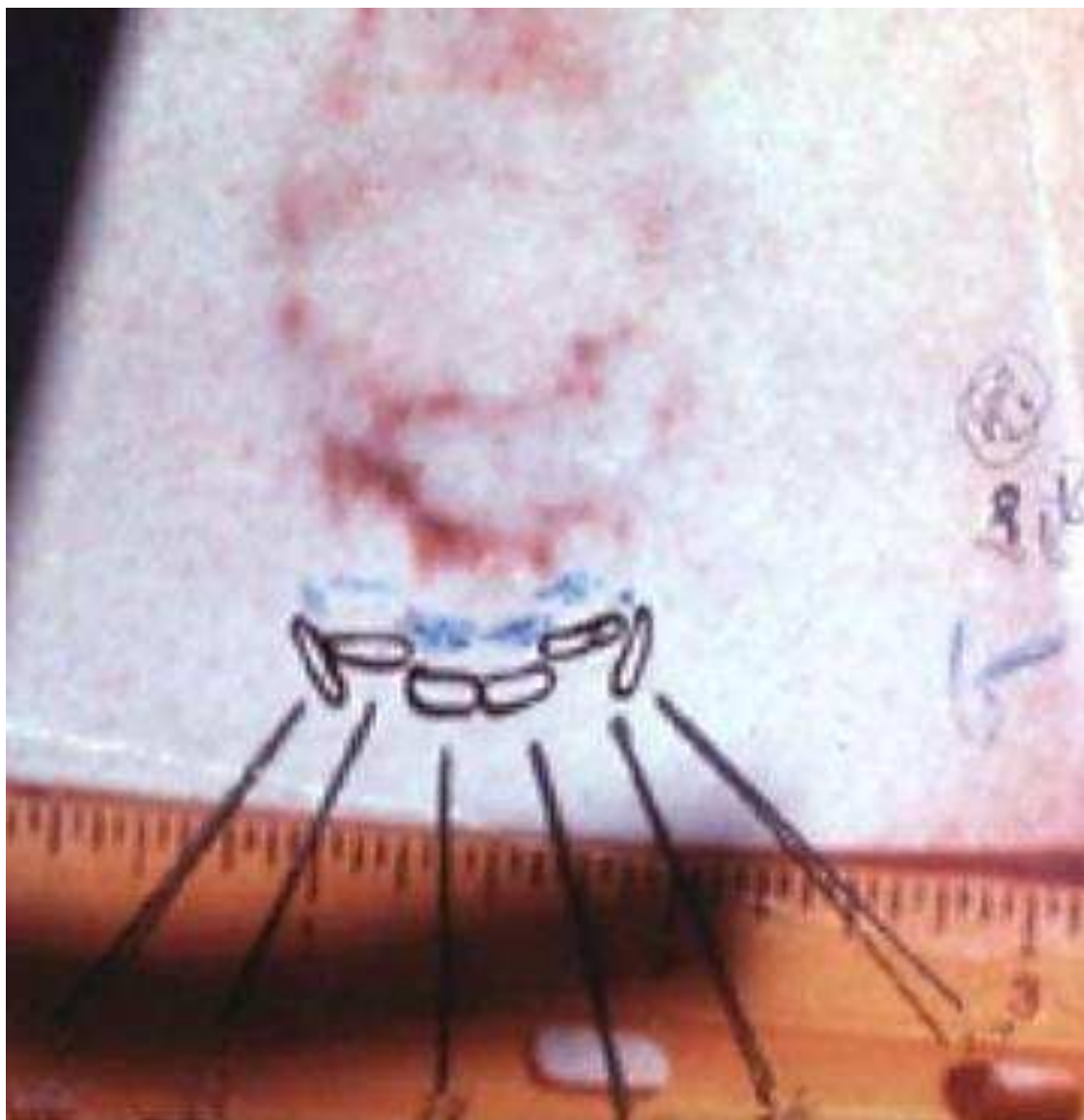
High profile cases

Forensic odontology as prime evidence in bitemark analysis



Ted Bundy, 1978
American serial killer
Bitemark evidence
admitted in court

Ted Bundy, 1978





Civil Litigation – Dental Jurisprudence

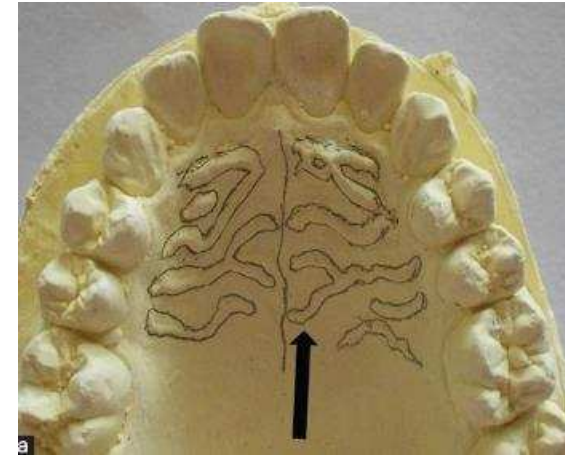
- **Malpractice(Iatrogenesis)**
- **Negligence**
- **Dental fraud**

Cheiloscopy – Lip Prints

- Lip print – unique & characteristic patterns formed by the wrinkles & grooves of the vermillion zone of the lip
- Cheiloscopy – Study of Lip prints
- Uniqueness in individuals ???
- Can serve as adjunct evidence.



Rugoscopy



The study of patterns of the grooves and ridges (rugae) of the palate to identify individual patterns

Dental profiling

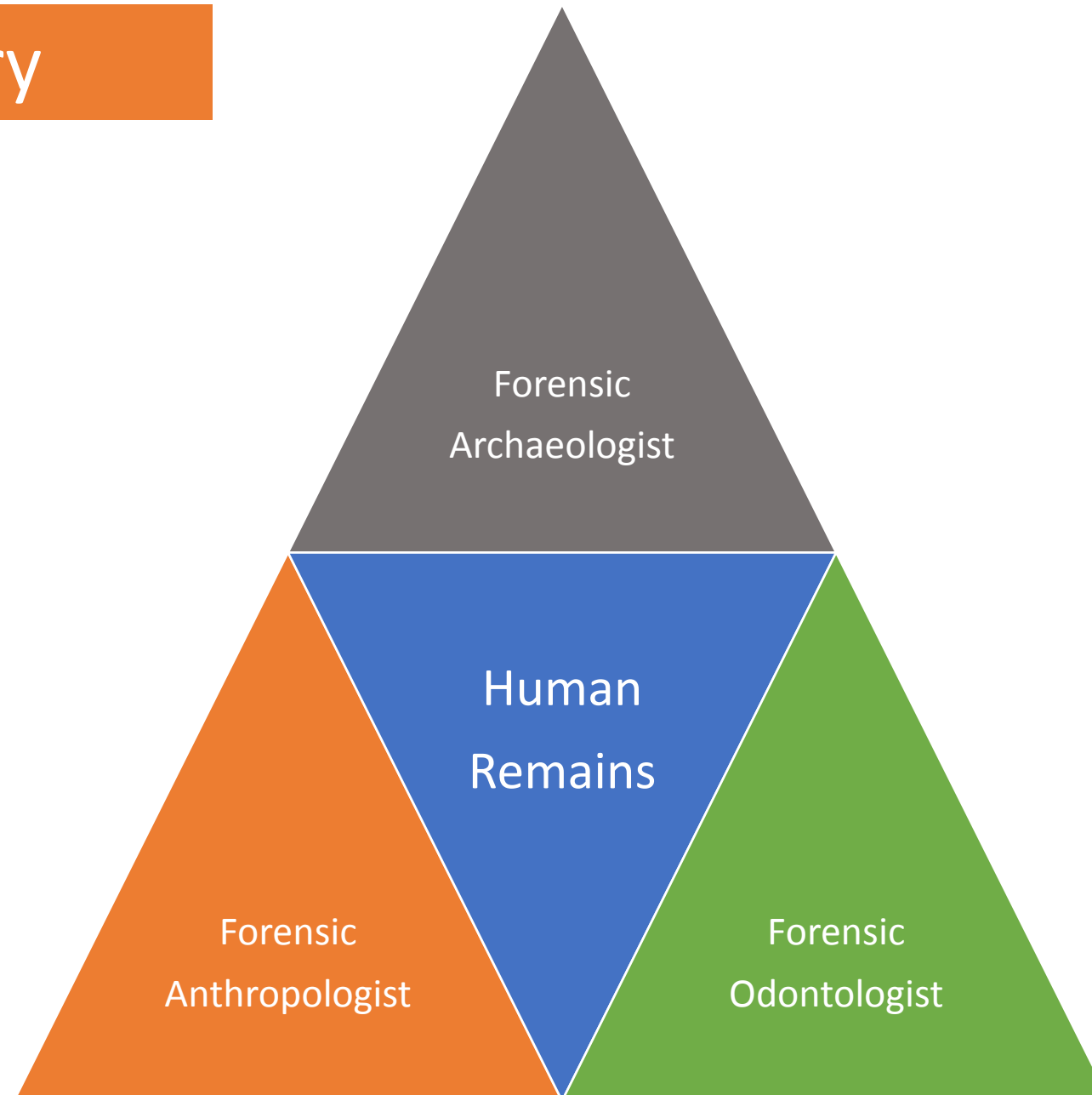
Caucasians: Carabelli's cusp



Mongolians: Shovel-shaped upper central incisors



Summary



Professional Organizations

- American Association of Forensic Sciences (AAFS) US
- Council for the Registration of Forensic Practitioners (CRFP)
- Forensic Science Society (FSS) in the UK
- Indian Anthropological Association
- Indian Anthropological Society
- Indian National Confederation & Academy of Anthropologists (INCAA)
- Indian Association of Forensic odontology



Dr. Ashith Acharya

Background: On 29 August 2010, a number of skulls were found when a drainage in the village of Annigeri near Hubli-Dharwad in North-western Karnataka was being desilted. Further excavation over the following days around the area revealed 400 to 600 such specimens (Fig. 1). Few clues were available about where the skulls came from and numerous theories were proposed—some believed that they belonged to soldiers killed in wars of yore, while others thought they were the remains of a genocide, still others hypothesized that they

In May 2011 the Office of the Deputy Commissioner, Dharwad, and the Directorate of Archaeology and Museum of Karnataka made a formal request to the Department of Forensic Odontology at SDM College of Dental Science & Hospital in Dharwad for assistance in estimating the age, assessing sex, and determining if there were signs of trauma on the skeletal samples. Owing to protected status accorded to the samples, it was necessary to visit the site some 60 km away for examination.

The examination and analysis: On 2 June 2011, two dentists from the college—Dr. Ashith Acharya of Forensic Odontology and Dr. Subendra Prabhu of Oral Pathology—visited the site for an examination of the remains. The samples were to be examined by them under observation of the Curator of the Government Museum of Gadag, who also travelled to the Annigeri site. Soon after arrival at the site, it was obvious that examining the 400 to 600 skeletal specimens was not possible owing to the partial burial of most of the skulls and their fragile nature (Fig. 1), which could easily damage them if further excavated. Hence a

several weeks and submitted to the Deputy Commissioner of Dharwad with copies to the Directorate of Archaeology and Museum, Mysore) on 26 July 2011.

The Conclusion: The 10-page report concluded that, “of the 31 specimens examined for assessment of sex, age-at-death and signs/patterns of injury, thirteen (13) are most likely to be male, nine (9) most likely to be female, and nine (9) are of indeterminate or inconclusive sex, with respect to age-at-death, twenty (20) specimens are in the age range of approximately 40–50 years (Fig. 2), two belong to an age range of 6–8 years (Fig. 4) while age-at-death could not be ascertained to nine (9). In relation to signs/patterns of injury, sixteen (16) show signs of injury attributable to blunt force trauma, while six (6) show signs of injury that may be caused by a sharp object. Overall, the sample reflects a heterogeneous population of children and adults, and of males and females, with signs of blunt and sharp force injury. It should, however, be recognized that conclusions concerning age and sex herein are limited by the purely visual/macroscopic nature of assessment of teeth and bones. This was used to verbal request by the district authorities to ensure that the specimens are unaltered and preserved in their present condition, more unequivocal results may be



Fig. 1 A skull excavated from the drainage in Annigeri, Karnataka. The specimen is fragile and needs to be handled with care.

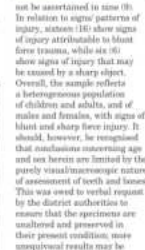


Fig. 2 A skull excavated from the drainage in Annigeri, Karnataka. The specimen is fragile and needs to be handled with care.

obtained through the application of histological techniques which assess the tissues at a molecular level.”

The report: Carbon dating analysis done in a laboratory in the United States of America revealed that the remains were likely to be 180 years old. The conclusion by the dentists that the remains comprised a heterogeneous mix of males and females, and children and adults helped dispel certain theories and contributed to the authorities’ conclusion that the skeletal specimens were most likely of victims of a famine from 1792 to 1796, as was also revealed by the questionnaire of the Directorate of Archaeology and Museum of Karnataka. In fact, the Archaeology Department acknowledged that the conclusion was arrived at based on the carbon dating analysis and the report submitted by the Department of Forensic Odontology in SDM Dental College, Dharwad—just one of the many examples and applications of teeth in solving age-old and present-day mysteries.

References:

- http://www.newindianexpress.com/states/karnataka/article522201.ece
- http://www.thehindu.com/india-paper/india-to-karnataka-to-be-fore-expert-in-to-unravel-annigeri-skulls-mystery/article256978.ece

Thank you for your patient hearing

For further queries contact
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