FORENSIC ODONTOLOGY
Forensic Odontology

- The application of dental principles to legal issues

- Applications:
  - Individual Identification
  - Mass Disaster Identification
  - Bite mark analysis
  - Dental Malpractice
History

- **66 A.D.: Lolliia Paulina’s body identified through teeth:** Roman Emperor Claudius had his mistress, Lolliia Paulina, beheaded and then demanded to examine the teeth on the body to ensure the right woman had been put to death. He knew she had a discolored front tooth.
Casualty ID in Revolutionary War: Paul Revere (blacksmith and dentist) was able to identify Dr. Joseph Warren, the man who sent him on his famous ride, because he had made him a partial out of silver wire and pieces of hippo tusk.
In United States courts, dental evidence was first presented in court in 1849 when the incinerated remains of George Parkman were identified by Nathan Cooley Keep through a partial denture he had made for this patient. He proved identity by fitting the prosthesis onto the cast that had been used in its manufacture. The evidence led to the conviction and execution of J.W. Webster for the murder.

Nathan Cooley Keep (1800-1875), first Dean of the Harvard School of Dental Medicine
Odontologist Training

Most are practicing dentists with many years of schooling:

- Undergraduate education
- Dental school
- Possible specialized training
- Admittance into professional groups
- May have further requirements for admittance
Odontology

The identity of a skull can usually be determined by comparing a person’s dental records.

Unusual features include:

- The number and types of teeth and fillings;
- The spacing of the teeth;
- Special dental work (bridges, false teeth, root canals)
Odontology and Identification

Teeth are often used for body identification because:

- They are the hardest substances in the body
- They are unique to the individual
- There is usually a good record of our teeth
- Crowns
- Fillings
- Root canal
- Bridge
- Extractions
Individuality of Teeth

- Many combinations of restorations
- Size/Orientation can vary greatly
- Variable numbers of teeth
- Variable root structure
General Teeth Information

- 32 adult, permanent teeth
- 20 baby or deciduous teeth
- Numbered from 1 to 32 starting from the upper right (1), to upper left, to lower left to lower right (32)
- Each tooth has 5 surfaces which helps to further individualized teeth
  - $M =$ mesial (front)
  - $D =$ distal (backside)
  - $O =$ occlusal (biting surface)
  - $F =$ facial (cheek side)
  - $L =$ lingual (tongue side)
Dentition

- 32 teeth
- 4 tooth types
  - Incisors
  - Canines
  - Premolars
  - Molars
- Orientation/Size
- Root Structure
Primary Teeth Timeline

### Upper Teeth
- Central incisor
- Lateral incisor
- Canine (cuspid)
- First molar
- Second molar

<table>
<thead>
<tr>
<th>Erupt</th>
<th>Shed</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-12 mos.</td>
<td>6-7 yrs.</td>
</tr>
<tr>
<td>9-13 mos.</td>
<td>7-8 yrs.</td>
</tr>
<tr>
<td>16-22 mos.</td>
<td>10-12 yrs.</td>
</tr>
<tr>
<td>13-19 mos.</td>
<td>9-11 yrs.</td>
</tr>
<tr>
<td>25-33 mos.</td>
<td>10-12 yrs.</td>
</tr>
</tbody>
</table>

### Lower Teeth
- Second molar
- First molar
- Canine (cuspid)
- Lateral incisor
- Central incisor

<table>
<thead>
<tr>
<th>Erupt</th>
<th>Shed</th>
</tr>
</thead>
<tbody>
<tr>
<td>23-31 mos.</td>
<td>10-12 yrs.</td>
</tr>
<tr>
<td>14-18 mos.</td>
<td>9-11 yrs.</td>
</tr>
<tr>
<td>17-23 mos.</td>
<td>9-12 yrs.</td>
</tr>
<tr>
<td>10-16 mos.</td>
<td>7-8 yrs.</td>
</tr>
<tr>
<td>6-10 mos.</td>
<td>6-7 yrs.</td>
</tr>
</tbody>
</table>
Age Determination

- 6 months
- 18 months
- 3 years
- 4 years
- 6 years
- 8 years
- 10 years
- 12 years
- 15 years
- 21 years
### Table 1 - Ages of Eruption for Deciduous and Permanent Dentition

<table>
<thead>
<tr>
<th>Tooth</th>
<th>Maxillary</th>
<th>Mandibular</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deciduous Dentition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>central incisor</td>
<td>7.5 mo.</td>
<td>6 mo.</td>
</tr>
<tr>
<td>lateral incisor</td>
<td>9 mo.</td>
<td>7 mo.</td>
</tr>
<tr>
<td>canine</td>
<td>18 mo.</td>
<td>16 mo.</td>
</tr>
<tr>
<td>first molar</td>
<td>14 mo.</td>
<td>12 mo.</td>
</tr>
<tr>
<td>second molar</td>
<td>24 mo.</td>
<td>20 mo.</td>
</tr>
<tr>
<td><strong>Permanent Dentition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>central incisor</td>
<td>7-8 yr</td>
<td>6-7 yr</td>
</tr>
<tr>
<td>lateral incisor</td>
<td>8-9 yr.</td>
<td>7-8 yr.</td>
</tr>
<tr>
<td>canine</td>
<td>11-12 yr.</td>
<td>9-10 yr.</td>
</tr>
<tr>
<td>first premolar</td>
<td>10-11 yr.</td>
<td>10-12 yr.</td>
</tr>
<tr>
<td>second premolar</td>
<td>10-12 yr.</td>
<td>11-12 yr.</td>
</tr>
<tr>
<td>first molar</td>
<td>6-7 yr.</td>
<td>6-7 yr.</td>
</tr>
<tr>
<td>second molar</td>
<td>12-13 yr.</td>
<td>11-13 yr.</td>
</tr>
<tr>
<td>third molar</td>
<td>17-21 yr.</td>
<td>17-21 yr.</td>
</tr>
</tbody>
</table>
In cases of unidentified remains, a postmortem description is generated.
Cases – 9/11

At ground zero, about 20% of the victims were identified using dental records.
Cases – Asian Tsunami

“Around mid-March, (of some 800+ identified bodies) 90% were identified by dental records ...”

A forensic expert examines a film of the teeth of a tsunami victim in Phuket of Thailand, on Jan. 11, 2005.
When bodies are burned, teeth and bones will be some of the last remaining body parts. These will be used for identification.

<table>
<thead>
<tr>
<th>BURNING RESULTS</th>
<th>F</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teeth are brittle</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>Teeth disintegrates.</td>
<td>900</td>
<td>480</td>
</tr>
<tr>
<td>Cremation</td>
<td>1800</td>
<td>980</td>
</tr>
<tr>
<td>Dental gold melts</td>
<td>2000</td>
<td>1100</td>
</tr>
<tr>
<td>Porcelain melts</td>
<td>2200</td>
<td>1200</td>
</tr>
<tr>
<td>Hot fire!!</td>
<td>2200</td>
<td>1200</td>
</tr>
</tbody>
</table>
Bite mark analysis

- Can be used to link a suspect to a crime
- Impressions left on food, skin or other items left at a scene
Impression Variation

- Each dentition can produce variable impressions
- Change based on pressure and surface of contact

Impressions from the same dentition
Analysis

- Bite marks are photographed with a scale
  - Bite marks on skin are taken over repeated intervals
- Casts of impression are taken
- Impression traced onto transparencies
- Casts of suspects teeth are taken
- Comparison between suspect cast and bite mark
Cases – Ted Bundy

- The most famous bite mark case

The bite mark was on the body of a victim

Transparent overlays superimposed

Wax bite exemplar
Computer Aided Forensic Odontology

- 3D Bite mark analysis
- Automatic dental code matching
- OdontoSearch
- Automatic dental identification system
Bite mark Analysis Using 3D Scans
-- DentalPrint

3D scans of dental casts are used to generate overlays using various pressure and deviation.
Bitemark Analysis Using 3D Scans
-- DentalPrint

The overlays are compared with the photograph.