Chapter 15

Firearms, Toolmarks, and Impressions

"Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed."

—Dwight D. Eisenhower (1890–1969), U.S. general and 34th president

Chapter 15

Firearms, Toolmarks, and Impressions

Firearms

Forensic analysis is vital to solve a crime that uses a gun.

> The vast majority of U.S. homicides involve guns. And they are more powerful than ever.
>
> *Lansing State Journal*, July 2007

In 2004, there were 12,000 homicides in the United States.

Types of Firearms

Handguns (pistols)

- Revolver
- Semiautomatic

Rifles

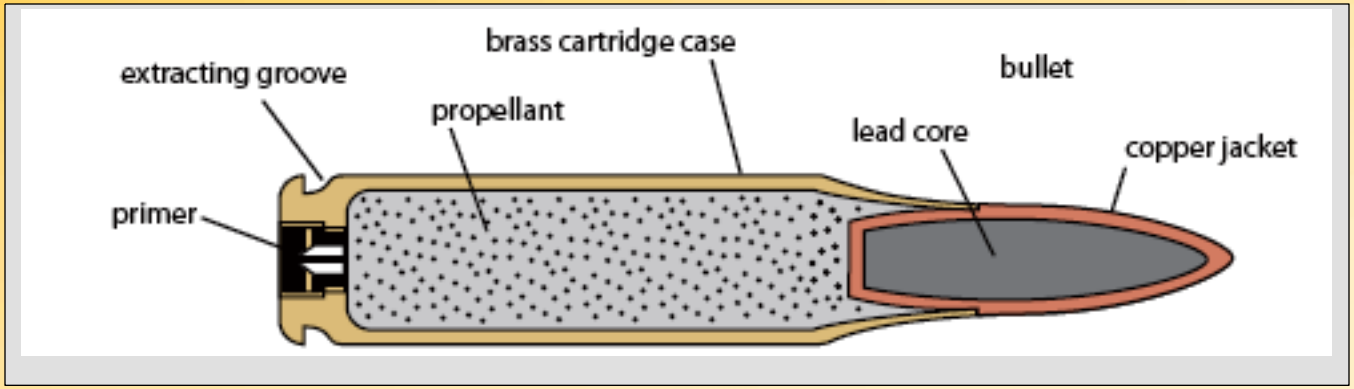
Shotguns

Air or BB guns

Ammunition

Components:

- Cartridge case
- Primer
- Propellant
- Projectile

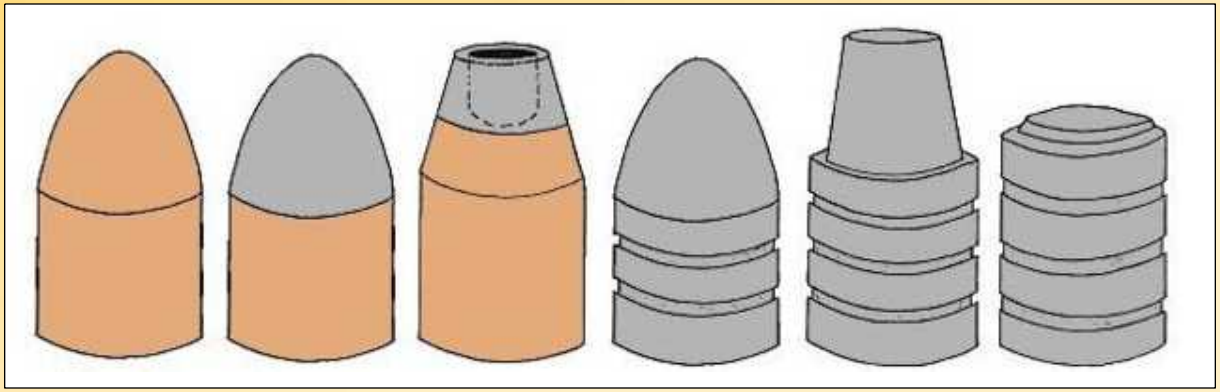


Bullets

Made of lead, sometimes jacketed with brass, copper, or steel

Bullet size—diameter (caliber or gauge)

Shapes



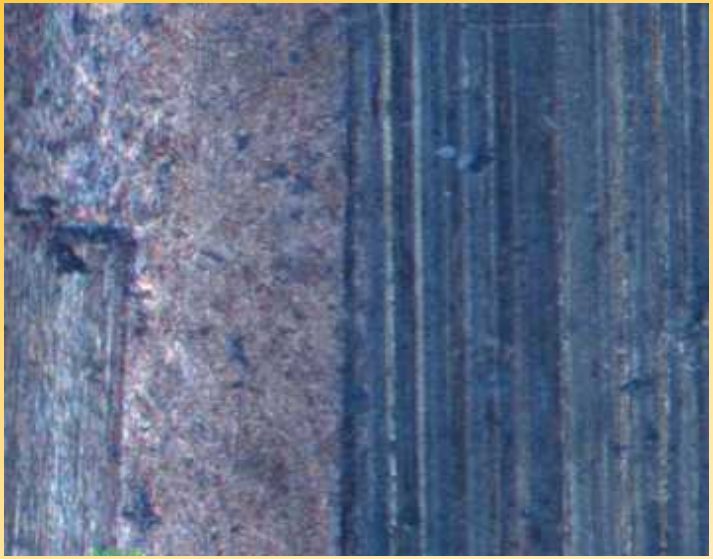
Rifling

The grooved spirals inside the barrel of a gun that produce lands and grooves on a bullet

Lands and grooves are class characteristics.

Striae

Scratches on a fired bullet, like a barcode,



that can serve as individual evidence, matching bullets or bullet to a firearm

Cartridge Case

Usually brass or nickel-clad brass

Head stamps


Rimfire and centerfire cartridges

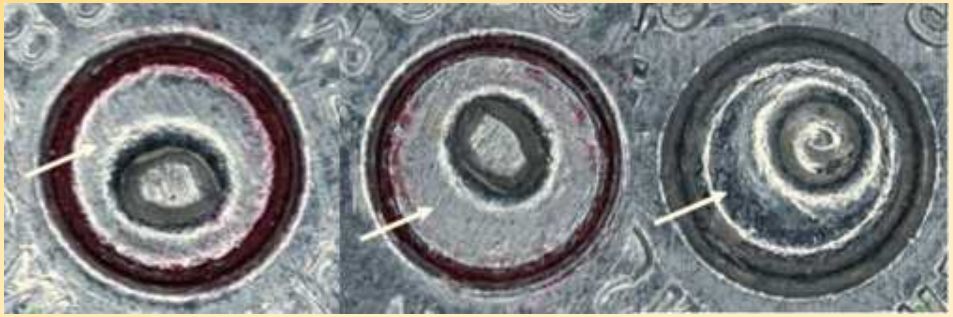
Class evidence

Cartridge Case, *continued*

Individual characteristics

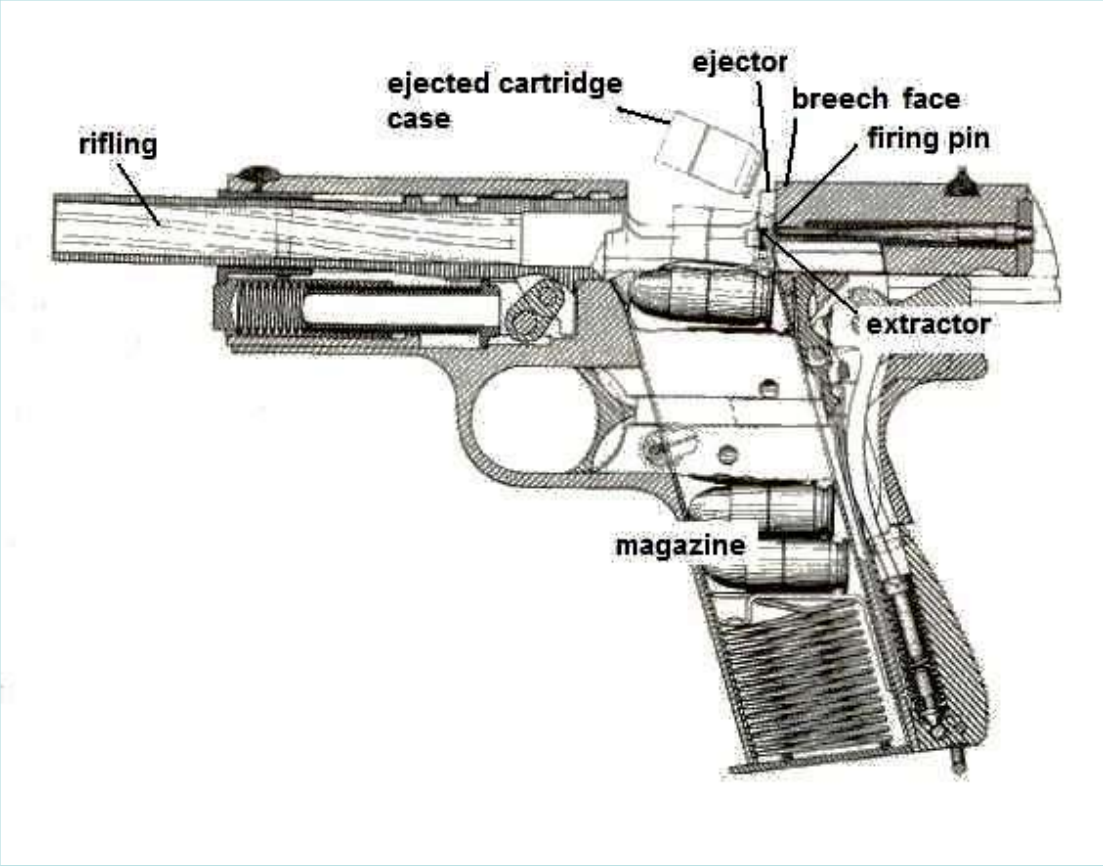
Extractor marks

Firing pin marks



Breech marks

Features of a Semiautomatic Handgun



Features of a Revolver Handgun

Parts of a Handgun
Handguns (revolvers and pistols) are short-barreled firearms sometimes used for hunting. Below are the parts of a double-action revolver and a semi-automatic pistol.

Firearms Evidence

Individual:

Striae
Firing pin marks
Breech marks
Extractor marks
Ejector marks
Chamber marks

Class:

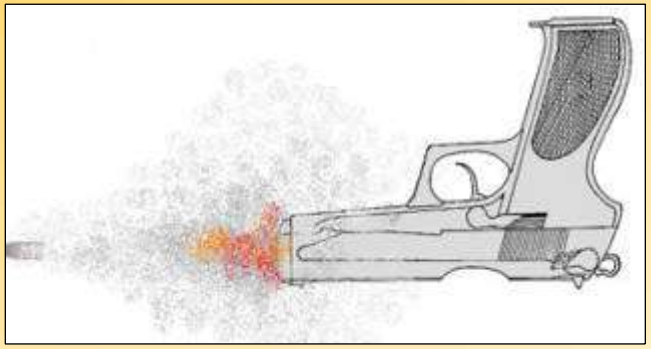
Bullet type
Bullet caliber
Bullet weight
Lands and grooves
Rifling
Cartridge case
Head stamp

Gunshot Residue (GSR)

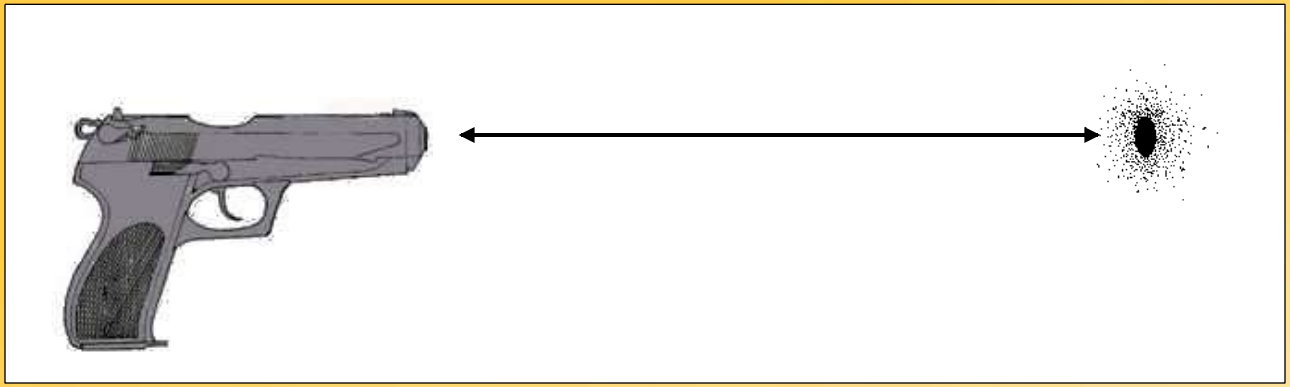
When a weapon is fired:

Primer and propellant particles blow back toward the shooter.

Combustion products (mostly NO_2^-), unburned propellant, and particles of lead follow the bullet, spreading out with distance.



Distance to Target



The Greiss test converts nitrites to an orange-red color.

Sodium rhodizonate reacts with traces of lead to make purple spots.

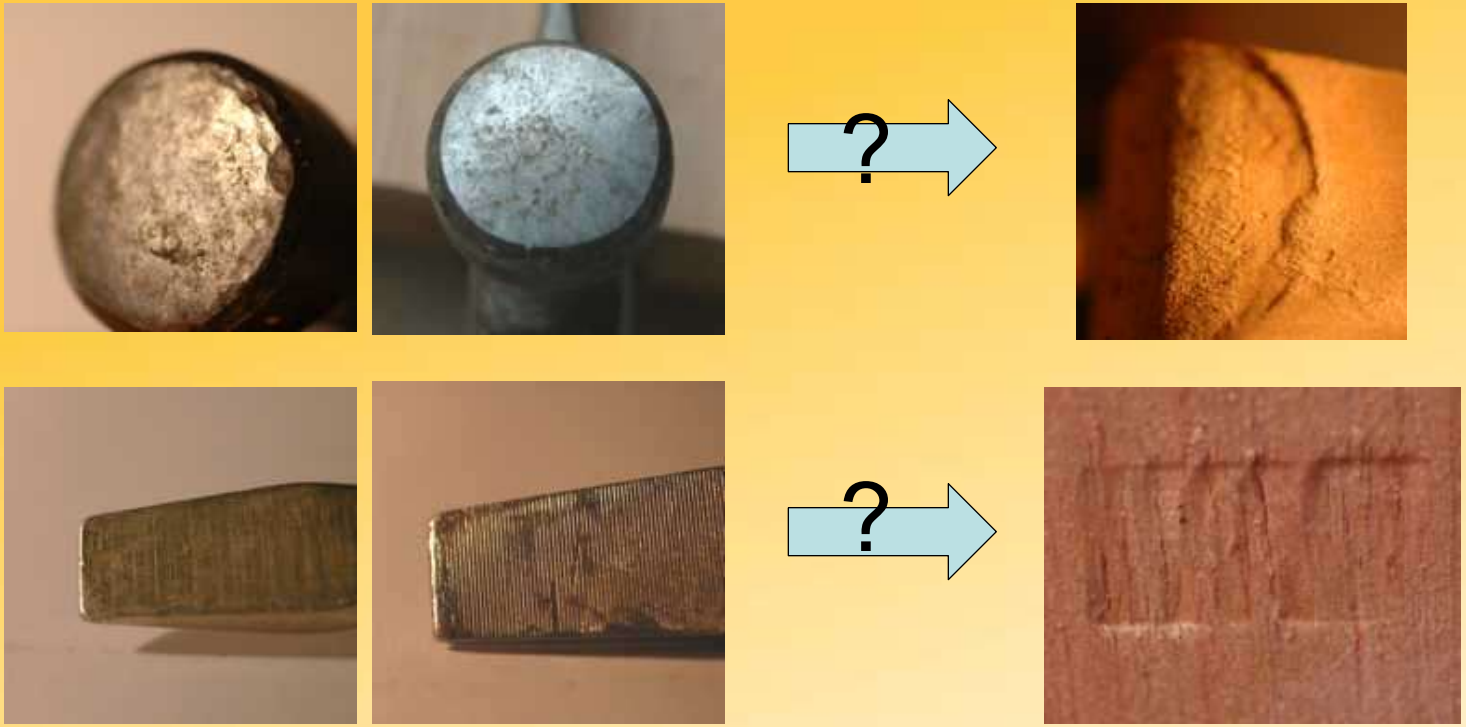
Toolmarks

Tools often used in burglaries may leave a mark.

Class characteristics: type, size, shape

Individual characteristics: features from wear and damage

Lab Activity: Matching Toolmarks

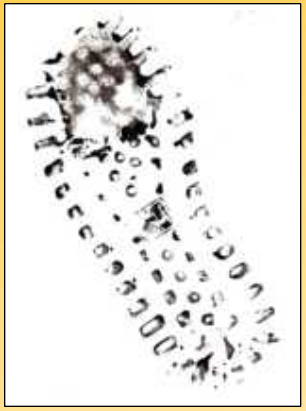


Photography and casting are important to match tool with mark.

Impressions

Shoeprints

Class characteristics— manufacturer, type, model, size



Individual characteristics— wear patterns, nicks, marks, occlusions (like pebbles or sticks)

Impressions, *continued*

Shoeprints

Captured by oblique-angle photography or chemical enhancement; also by casting in soil, or lifting.

Impressions, *continued*

Treated much the same as shoeprints

Tire Treads

Class characteristics involve design, size, type, and model.

Wear and damage cause defects that can lead to individualization.

Impressions, *continued*

Tire Treads

ARSON SUSPECTED IN CHURCH FIRES

Blazes reported in 2 counties; churches destroyed

Friday, February 3.2006;
It was old fashioned police work that led to the arrests. Investigators made casts of identical tire tracks at six churches, matching the pattern and size to a database of manufacturers. That narrowed the field to Toyota 4 Runners and similar SUV's, and agents then methodically interviewed everyone in the nearby counties who owned such a vehicle.

TreadMate is a database containing data on more than 5,000 vehicle tires and tread patterns.

Impressions, *continued*

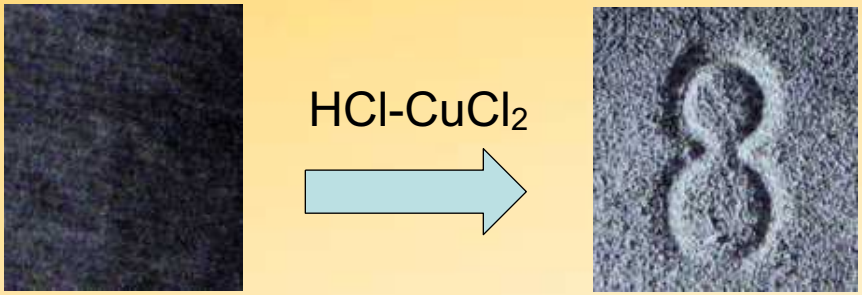
Serial Numbers

Restoration of serial numbers

Items of value may have ID numbers stamped into them.

Grinding is usually used to obliterate identification numbers.

To restore ID numbers on metal, an acid etching solution is employed.



History

Body Identification

Roman Emperor Claudius - wife wanted decapitated head of mistress

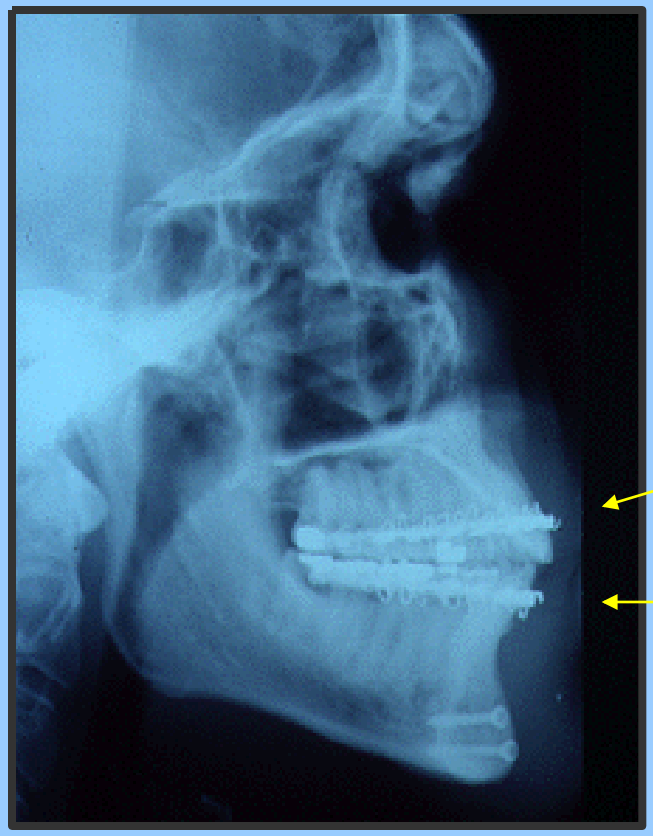
Paul Revere – dentures of soldier

Bite Mark Analysis

King William - bite in wax

Education:

Forensic Odontologists are dentists first.
D.D.S. or D.D.M. degree
Certification available from the American Board of Forensic Odontology



Anatomy of Oral Cavity:

Maxilla – upper jaw

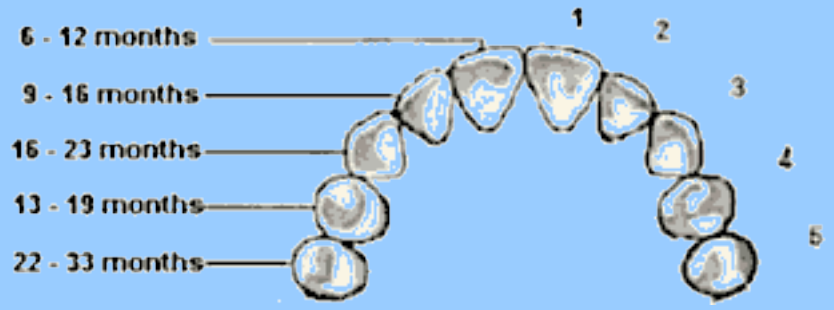
Mandible – lower jaw

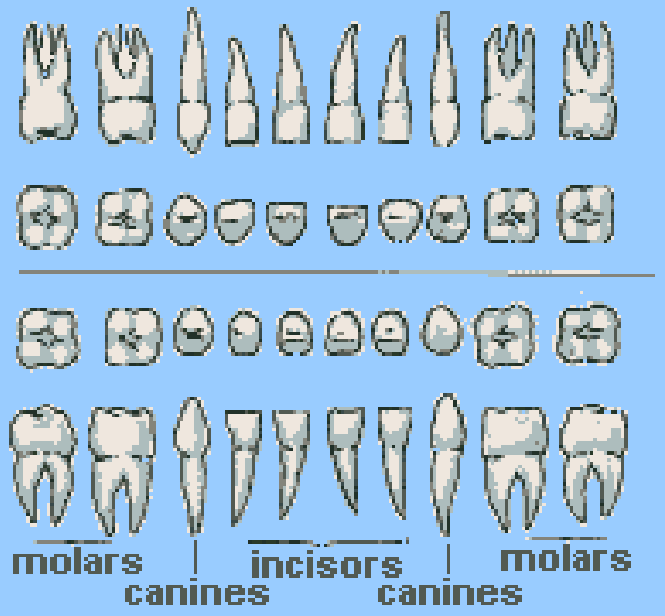
Anatomy of Oral Cavity

Primary dentition

Baby teeth or milk teeth

20 teeth



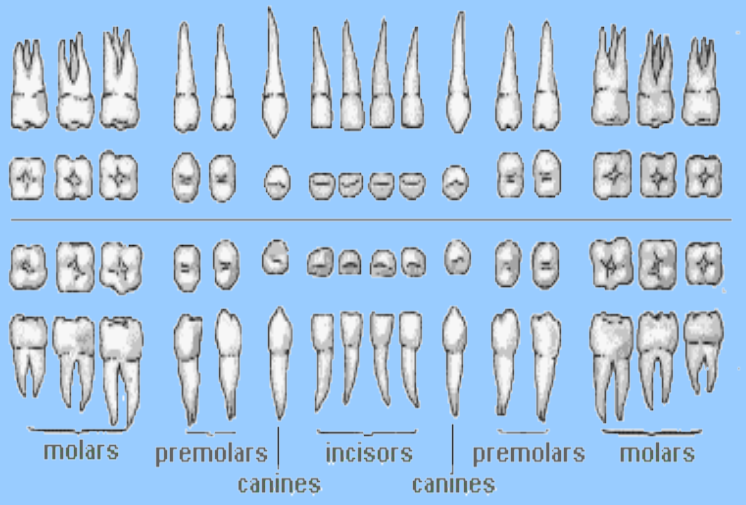


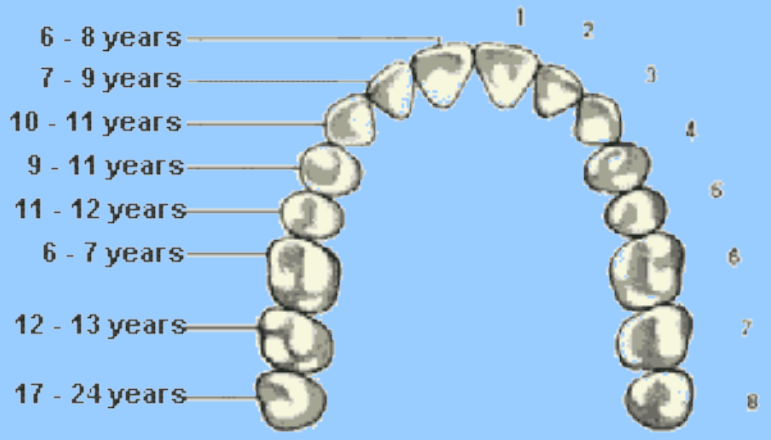
Anatomy of Oral Cavity

Permanent dentition

Start at 6-8 years old

32 teeth



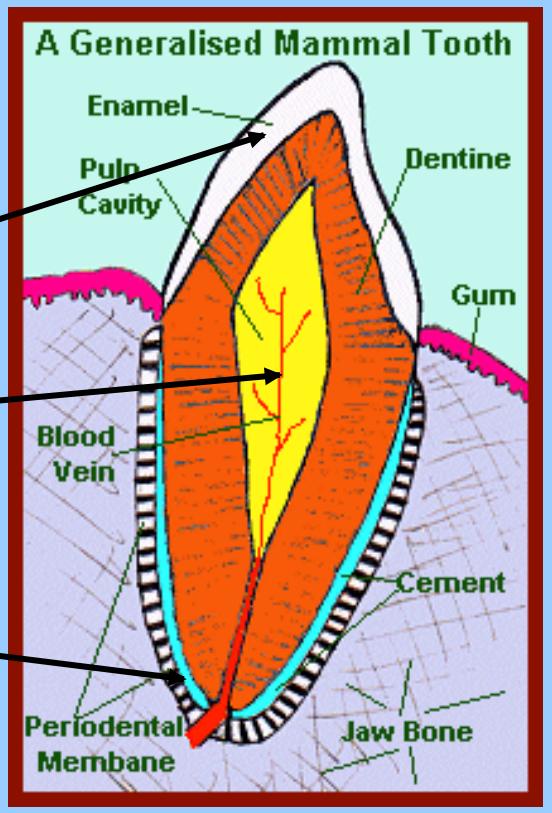


Anatomy of Tooth

Enamel

Contains DNA → Pulp

Cementum



Crown

Root

A body is identified by comparing **teeth and bone structures of the body** to the **dental records** of the suspected individual.

A body is identified in **3 steps**:

1. Postmortem examination of the body
2. Locating the antemortem dental records
3. Comparing the body to the dental records

Postmortem Examination:

May examination teeth while in the body (if body needed for funeral)

or

May remove jaw (using bone saw) and remove soft tissue using hydrogen peroxide.

Postmortem Examination

Each tooth or socket is examined individually and the following is recorded:

1. Presence/absence of tooth
2. Socket present or healed
   - § Healed socket = past removal
   - § Present socket = recent removal
3. Erupted vs. Unerupted
4. Filling or Crown Material

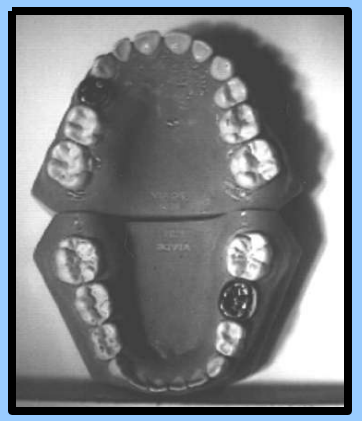
Postmortem Examination

Each tooth or socket is examined individually and the following is recorded:

Also record any diseases and the general anatomy.

Postmortem Examination

After examination of teeth, they should be **photographed** and **X-rays** should be taken.



Antemortem Records

If body is known, dental records can usually be recovered from his or her dentist.

If body is unknown, the examination results are submitted to a missing person registry.

Comparison

Postmortem exam compared to antemortem records.

A statement is made about each tooth:

Consistent

Different with explainable differences

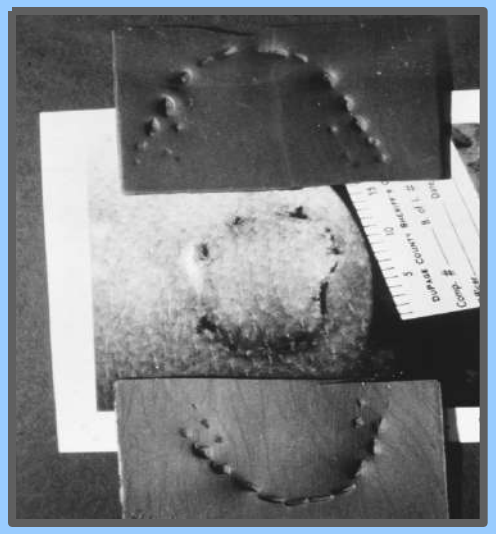
Different with no explanation

Identification in Mass Disasters:

Split into 4 teams. Run by Chief Forensic Dentist.

1. Recovery at disaster scene.
2. Postmortem exams at morgue.
3. Collect antemortem dental records.
4. Comparisons with computer software.

Characteristics of Bite Marks:



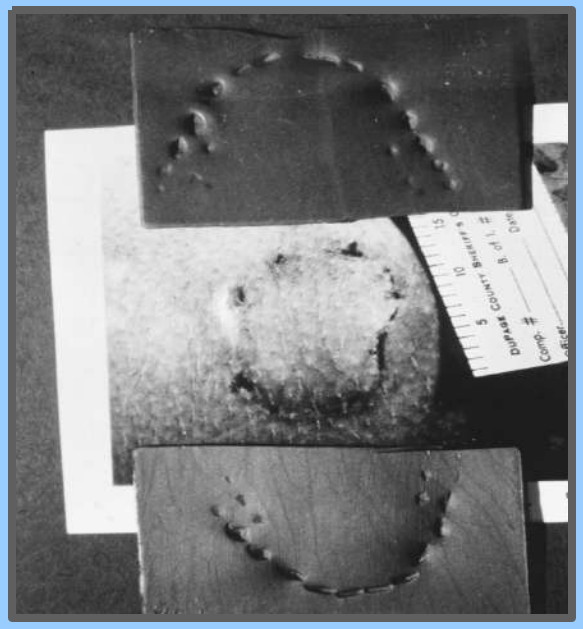
Usually shape of two half moons (upper/lower)

Usually composed of 6 upper / 6 lower teeth

Characteristics of Bite Marks:

Antemortem (diffuse bruise)
Perimortem (defined bruise)
Postmortem (no bruise)

Only persists 8 hours on living person



Collection of Bite Marks

1. Identify as potential bite mark
2. Collect 3 swabs
   - § ABO blood test, amylase detection
   - § DNA analysis
   - § Microorganism analysis
3. Photograph bite mark
4. Make an impression of bite mark

Comparison of Bite Marks:

1. Photographic overlay of suspect's teeth and bite mark.
2. Compare mold of suspect's teeth to bite mark or impression of bite mark.

Impressions, *continued*

Bite Marks

Result from assault or sexual attack, common in domestic violence

Individual evidence, if enough impressions

Bite marks were the prime evidence in the conviction of serial killer Ted Bundy.