

Firearms & Toolmarks

Firearms & Toolmarks

The Firearms and Toolmark Section conducts examinations related to:

- Firearms and Ammunition
 - Detection of Gunshot Residue
 - Wound Examination
 - Range Determination
 - Toolmark Identification
 - Serial Number Restoration
 - Physical Match
-
- The forensic scientists attend crime scenes to assist in determining projectile trajectories, and autopsies to assist in determining direction and range of shots.

Firearms & Toolmarks

- The Firearms and Toolmark Sections are located at the following Forensic Laboratories:
 - Vancouver (RCMP)
 - Vancouver (Vancouver Police Service)
 - Regina (RCMP)
 - Toronto (Ontario Solicitor General)
 - Montreal (Quebec Department of Public Safety)
 - Halifax (RCMP)

Firearms & Toolmarks

- **The types of evidence examined include:**
 - Firearms, Ammunition and Ammunition Components
 - Toolmark damage on a variety of materials including wire, cable, tires, bone, wood, paint, etc.
 - Physical Match of broken or separated items including wire, tail light lenses, animal hide, bomb components, etc.
 - Residue of firearm discharge and shot gun patterns on clothing, skin or other target material
 - Gunshot residue sample kits from hands and faces
 - Unusual barreled weapons, silencers, unknown devices and firearms related items

Firearms & Toolmarks

Laboratory Services Provided

Firearms Related Examinations:

1. **Fired bullet(s), cartridge case(s) or unfired ammunition with a suspect firearm.**
 - Determine if the exhibit bullet was fired from the suspect firearm.
 - Determine if the exhibit cartridge case was fired in the suspect firearm.
 - Determine if the unfired cartridge was functioned in or through the action of the suspect firearm.

Firearms & Toolmarks

Laboratory Services Provided

Firearms Related Examinations :

2. **Fired bullet(s), cartridge case(s) or unfired ammunition without suspect firearm**
 - Determine the probable make, model and type of firearm involved.
 - Determine whether one or more firearms are involved from one or more occurrences.

3. **Unfired Cartridges with / without suspect firearm**
 - Determine make, type or legal classification of cartridges.

Firearms & Toolmarks

Laboratory Services Provided

Firearms Related Examinations:

4. Shotgun Wads and Shot Pellets

- Determine the shot size and composition (ie. Lead, copper coated steel) and/or the gauge and manufacturer of the wad components

5. Mechanical Assessment and Legal Classification

- Determine if an exhibit firearm is operating normally and safely and to determine the Legal classification as defined within the Criminal Code.

Firearms & Toolmarks

Laboratory Services Provided

Firearms Related Examinations:

6. Ammunition Velocity

- Determine the velocity produced by a firearm and ammunition combination.

7. Range Determination

- Determine the distance of the firearm muzzle from the target, at the time of discharge, by examining patterns of gunshot residue and projectile impact damage.

Firearms & Toolmarks Laboratory Services Provided

Firearms Related Examinations:

8. Gunshot Residue (GSR)

- Examination of GSR Kits used to sample suspect's hands, face or clothing for residue.

9. Physical Match

- Comparison of items to determine whether they are pieces of a single object which were severed or broken, or were in tight contact with each other.

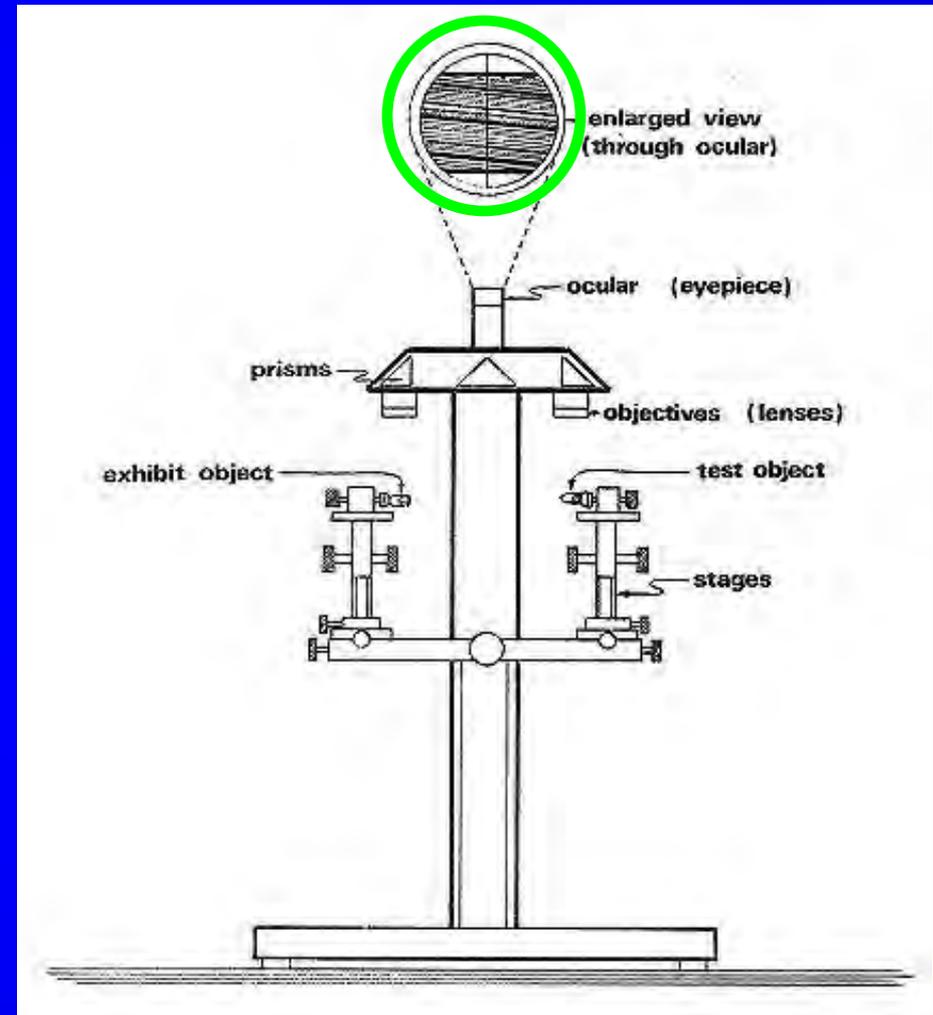
Firearms & Toolmarks

The Comparison Microscope

The questioned exhibit and known test are compared on a two stage microscope.

A **split screen** seen through the ocular shows the comparison.

Agreement of characteristics can be observed.



Firearm Identification

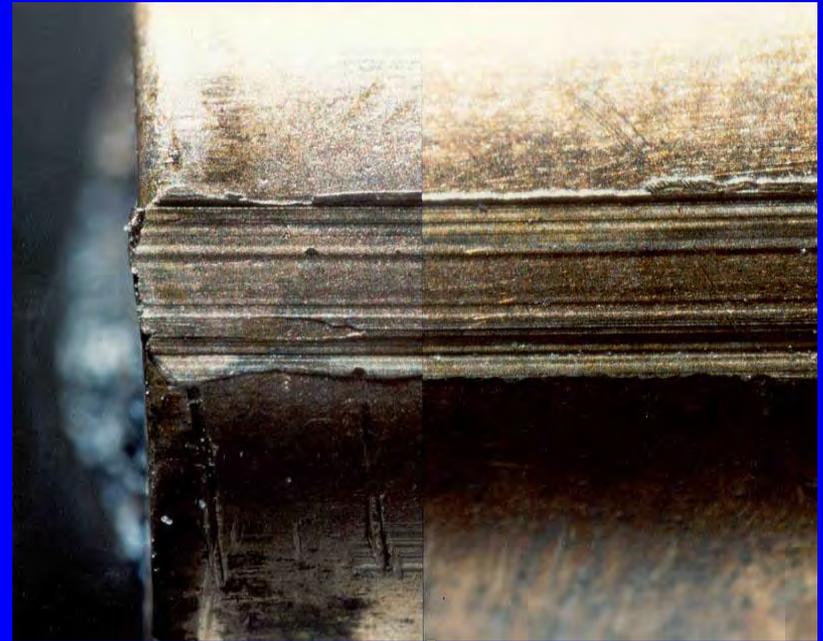


- A comparison microscope is used for bullet comparison and cartridge case comparisons

Firearms & Toolmarks

The Comparison

- Bullets and other toolmark exhibits are compared.
- Sufficient agreement allows POSITIVE identification.
- Firearm related evidence is only part of Toolmark Examination.



Bullet from
suspect firearm
fired in the lab

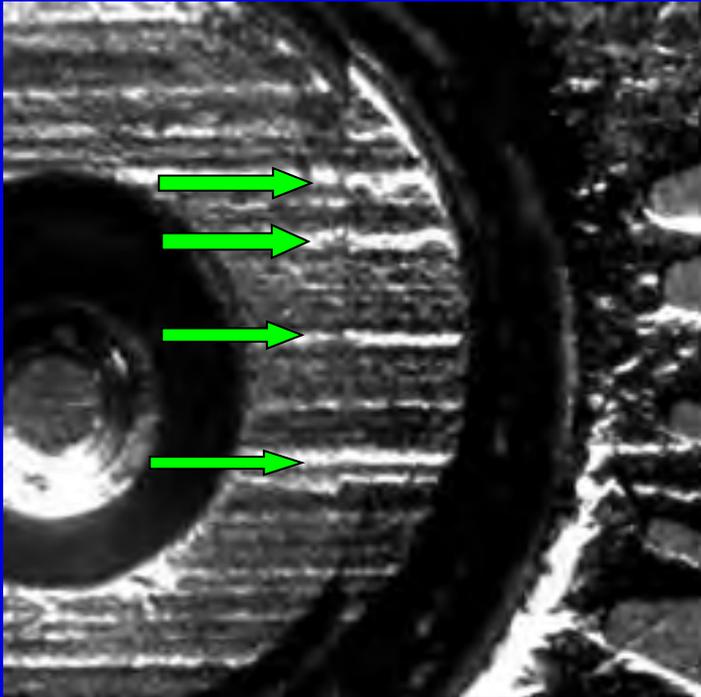
Bullet from
crime scene

PROJECTILES

- Fired bullets and bullet fragments may be matched back to a specific firearm
- Fired slugs in theory may be matched back to a rifled slug barrel.
- Fired shot cannot be matched back to a specific firearm.



Firearm Identification



- If an agreement in pertinent accidental features exists between two cartridge cases that are being compared then it can be concluded that both cartridge cases were fired in the same firearm.

Firearm Discharge Residue



Gunshot Residue:

Submicroscopic particles of gunshot residue may be deposited on the shooter's hands, face or clothing.

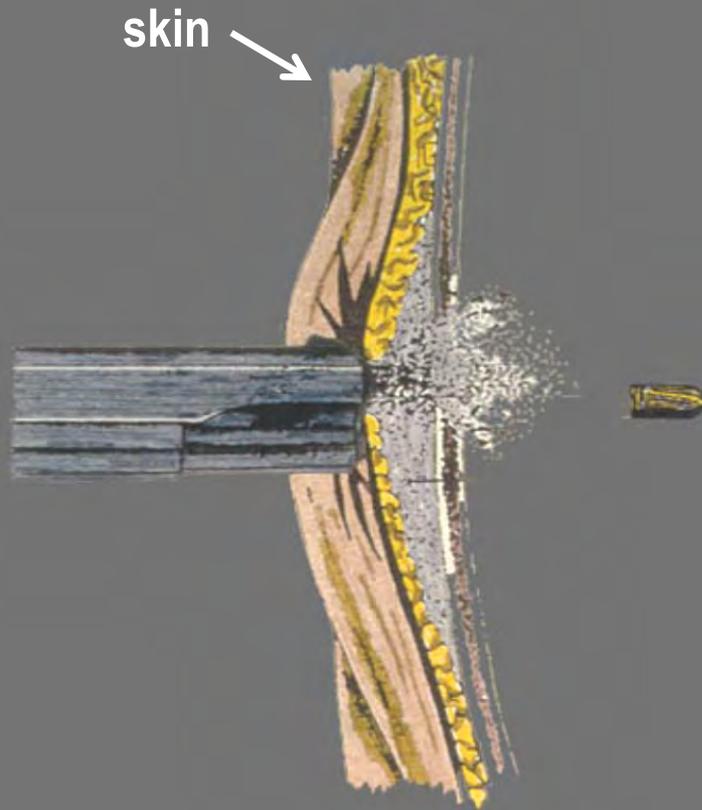
Range Determination:

Gases, smoke and residues of burned or unburned powder, metallic fragments, wax or grease are ejected along with the projectiles when a firearm is discharged.

Firearm Discharge Residue

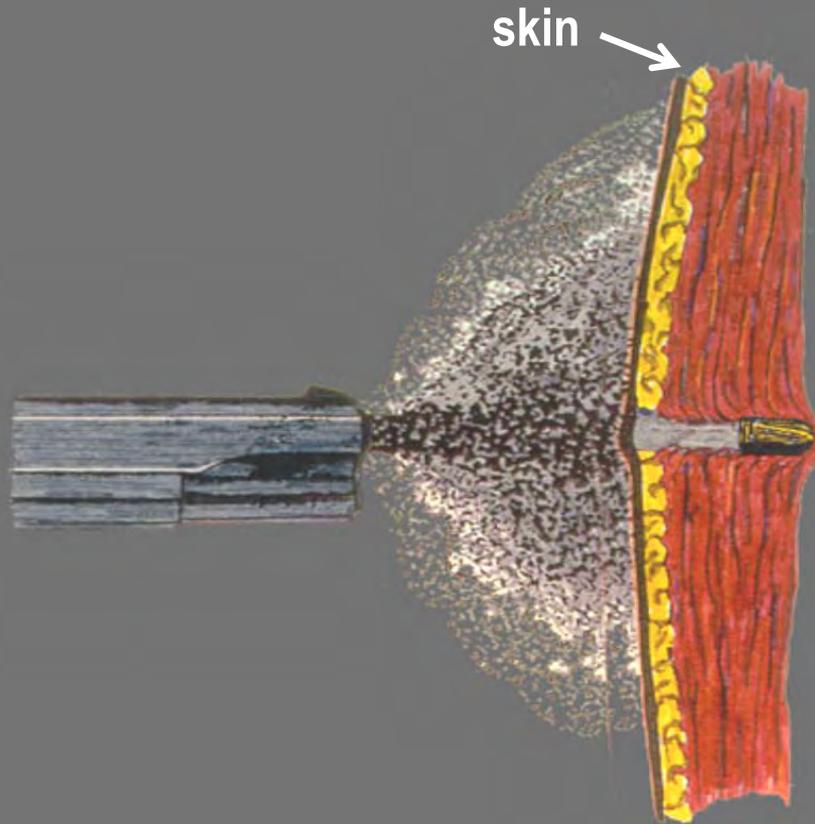
- The examination for residue, in or around wounds, produced by the firearm discharge.
- The determination of the distance of the firearm muzzle from the target, from observed patterns.

Wounds & Range Determination



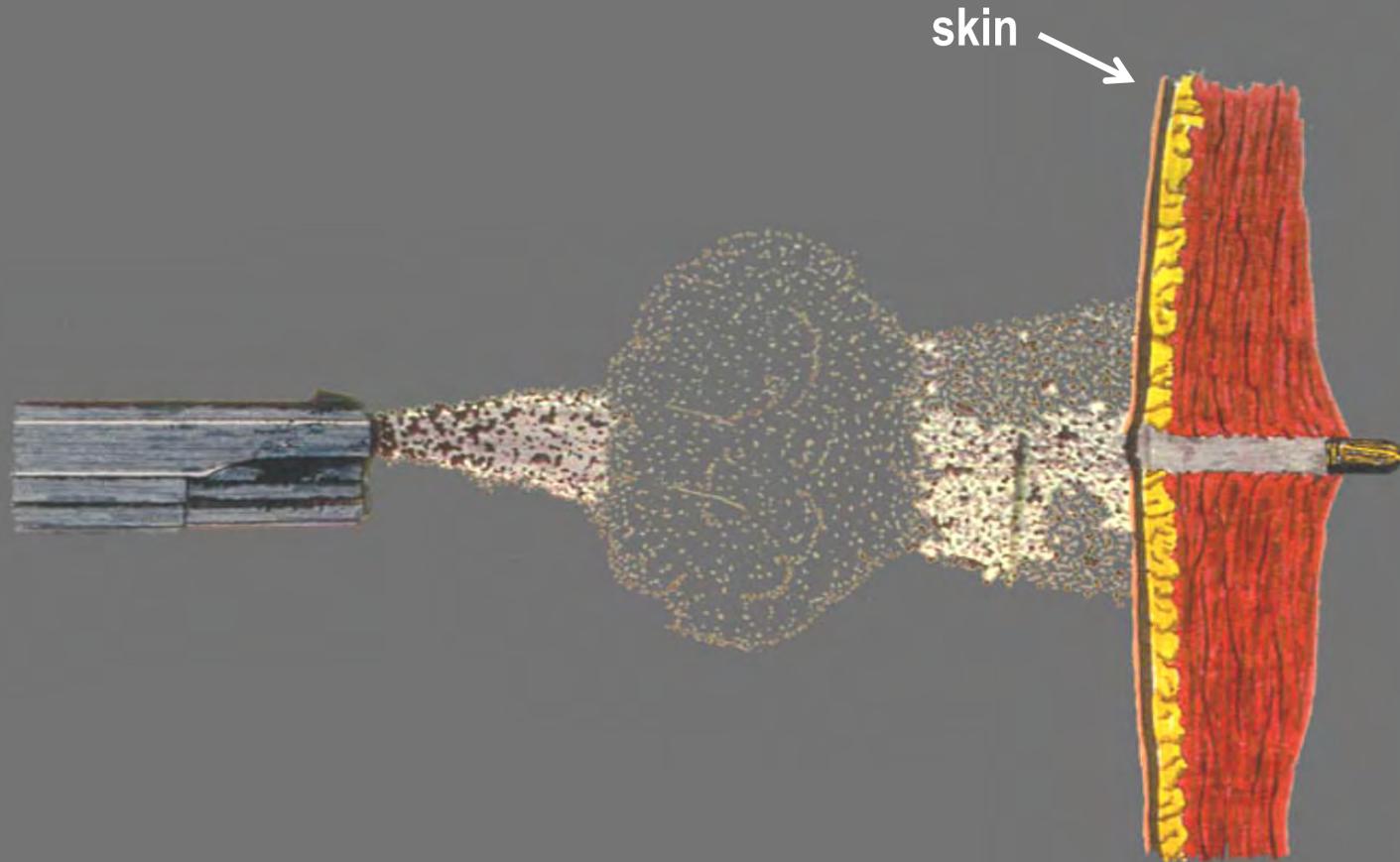
On contact, particles of residue follows bullet through the opening in the skin.

Wounds & Range Determination



At close range, most of residue particles are projected on to the skin.

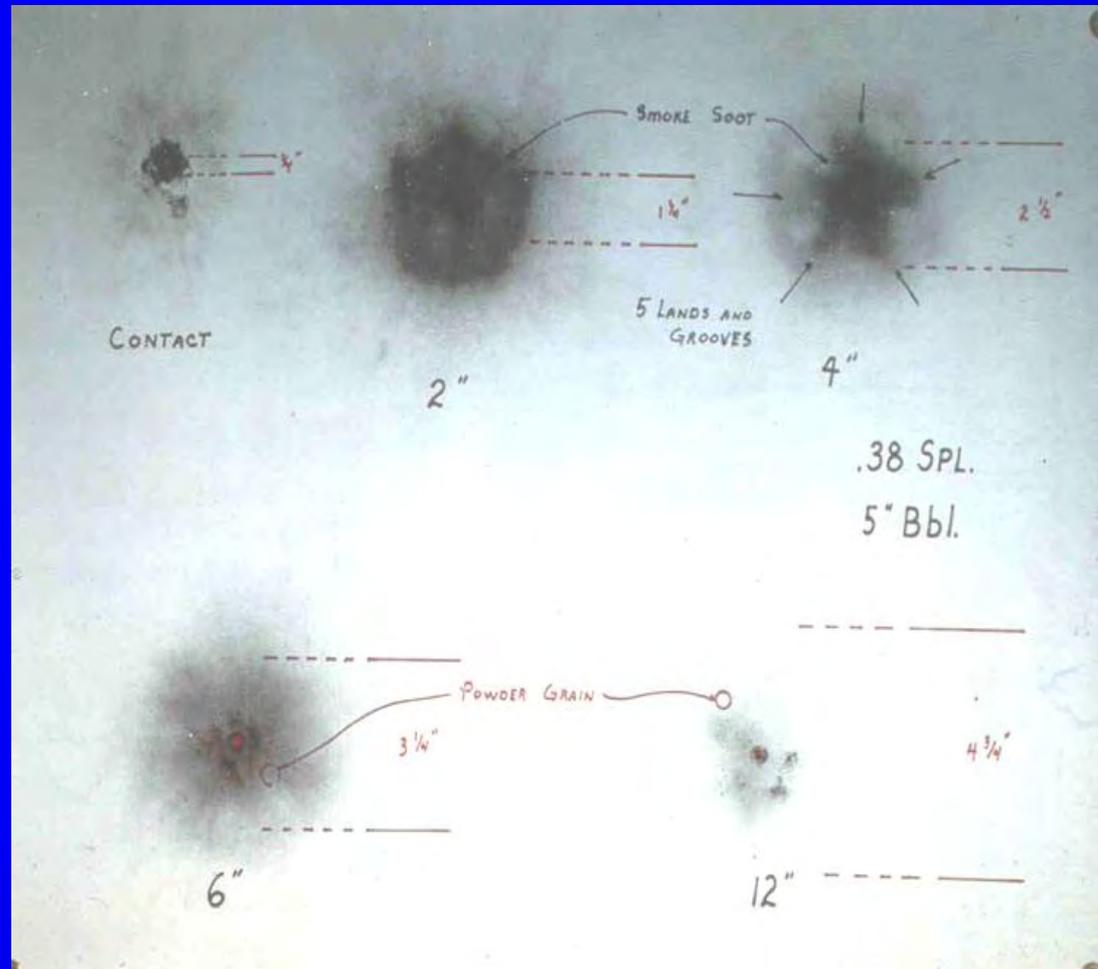
Wounds & Range Determination



At mid-range, fine particles of residue dissipate before getting to target.

Wounds & Range Determination

The firearm discharge residue patterns are small or concentrated if the muzzle is close and the pattern **increases in size** and **decreases in density** with increasing distance between the muzzle and the target.



Range Determination Shotgun



- A contact wound from a 12 gauge shotgun to the neck of the victim. Scorched edges of entrance wound, no individual pellet holes, and gas tearing around the ear.

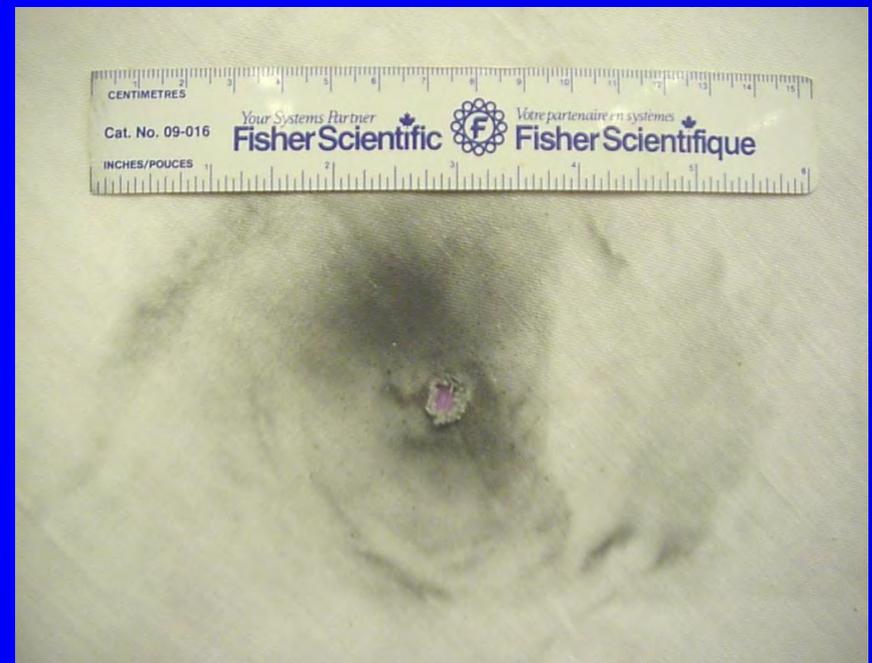
Range Determination Shotguns



- In cases where there is a pellet pattern to work with the range is determined by using the suspect firearm and ammunition, and duplicating the pattern. (12 gauge, full choke barrel at 20 feet.)

Range Determination Rifle / Handgun

- Determination by :
- a visible GSR pattern
- a non-visible pattern visualized using specialized chemical spot tests
- gas damage to tissue or fabric
- GSR in wound tract



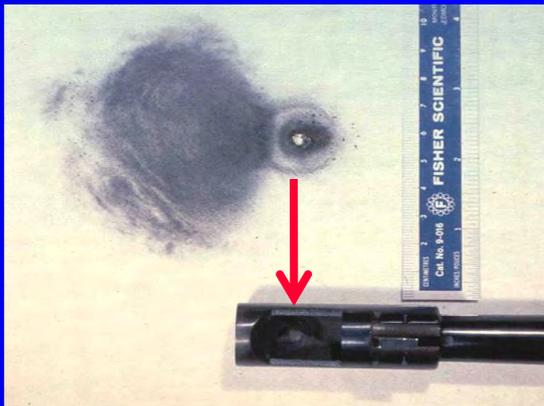
Range Determination



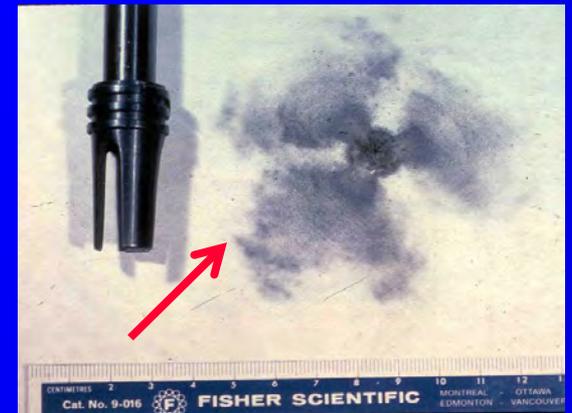
- 38 special revolver
- two shots to head
- one contact
- one near contact

Wounds & Range Determination

- Some patterns will illustrate the configuration of the firearms muzzle and can be used to determine the make or type of firearm.



Muzzle at the end of gun leaves a specific gunshot residue pattern.



Wounds & Range Determination

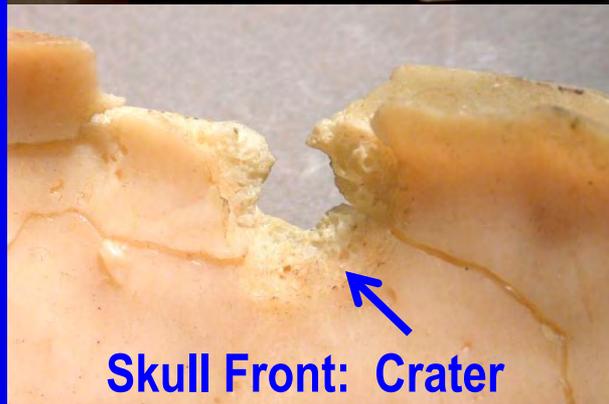
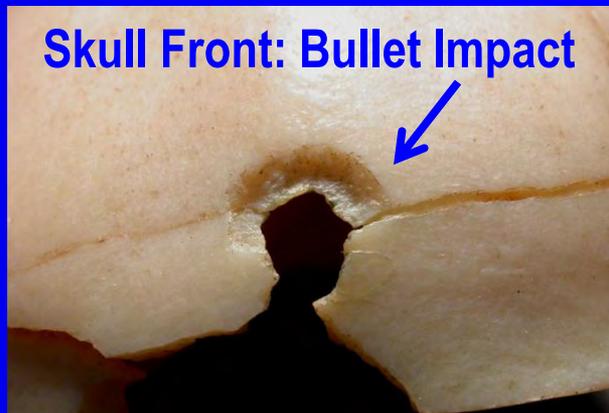
Chemical Test for Residue on Tissue

- Area is sprayed with a chemical which reacts with lead therefore identifying the presence of gunshot residue.



Wounds & Range Determination

The “Cratering Effect” caused by bullet entry / exit shows the direction from which the ammunition was fired.



AMMUNITION COMPONENTS



- There is an almost endless variety of fired and unfired ammunition components that may be collected at crime scenes or autopsies. Identification of these components may often aid in shooting investigations.

Ammunition

Shotgun cartridges may contain:

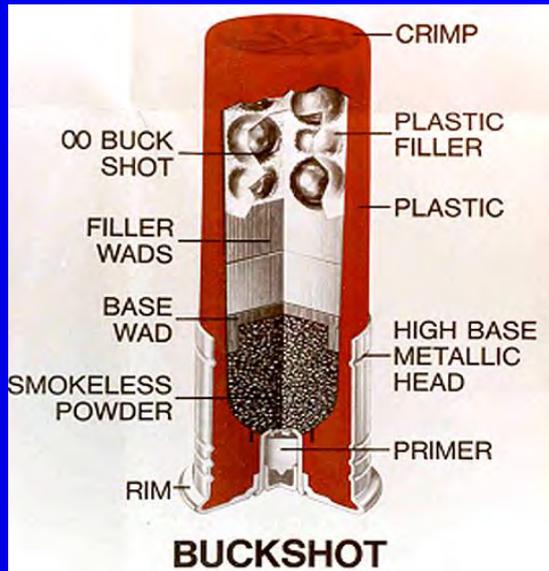
- Lead, copper, steel, rubber or plastic pellets
- Plastic, paper or fibre wads
- Tiny arrows or flechettes
- Gun Powder or plastic shot buffer



Firearm Discharge Residue

Ammunition vs Wounds

Remnants of projectiles on a target or in a wound depend on the bullet design or cartridge components.



Ammunition

Projectiles can include:

- Plastic, nylon or aluminium bullet tips
- Lead, copper, steel or brass fragments

Bullet tips →

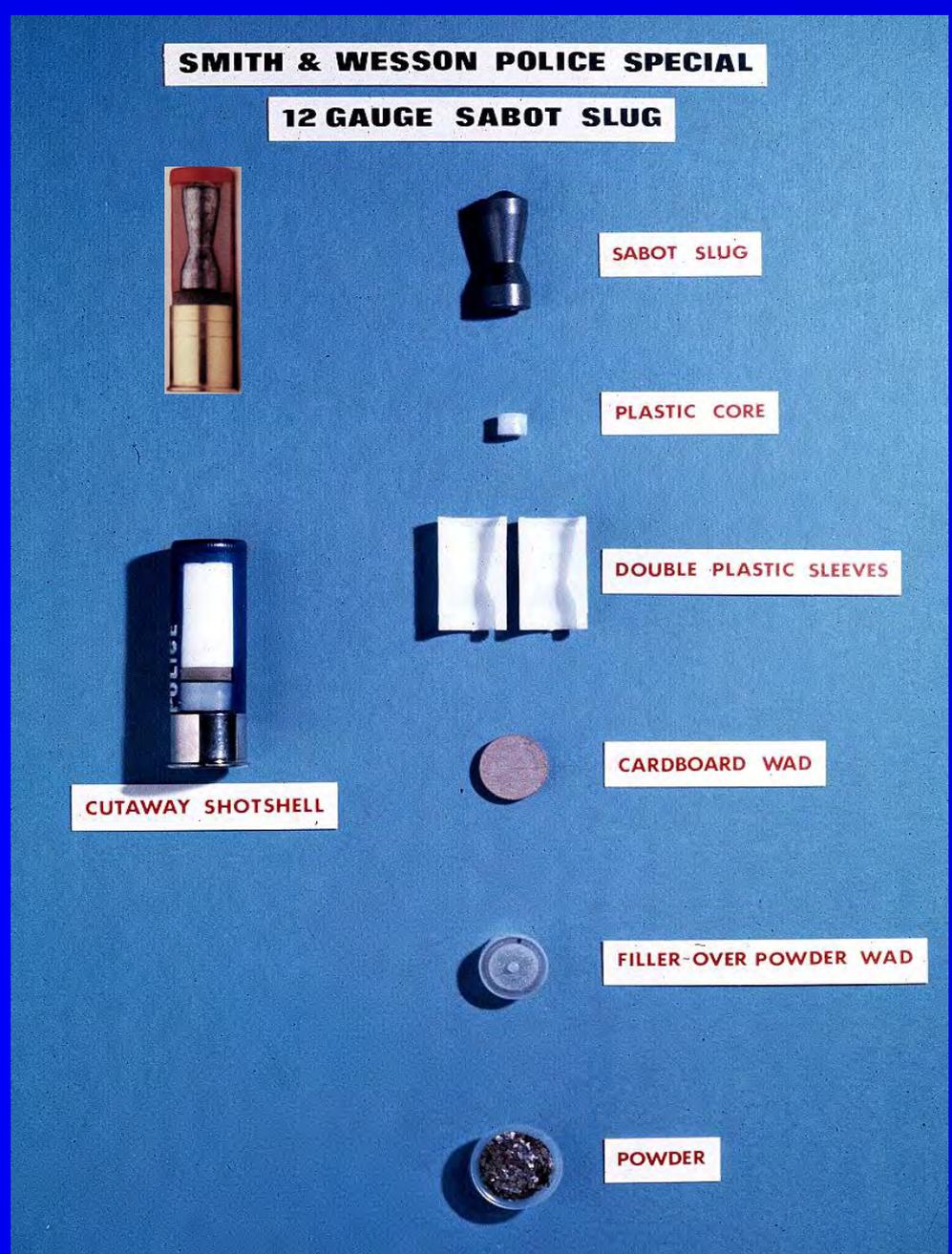
Fragments →



Ammunition

Projectiles can include:

- Plastic sabots
- The unusual - from exploding and frangible bullets, or the Glaser safety slug.
- Gun Powder particles adhering to the base



Expended Cartridge Cases & Shotshells

- if no firearm is recovered they may be used to identify the probable make and type of firearm used in the offense.



Gunshot Residue (G.S.R.)

Gunshot Residue Examinations:

- The examination of samples taken from the hands, face, or clothing of a shooting suspect can often provide corroborative evidence linking the suspect to the discharge of a firearm.
- The examination of a gunshot residue kit is very time consuming.
- Only those kits which may provide evidence that cannot be determined by other means will be examined.
- The need for analysis and the priority of each kit must be determined by the forensic examiner and investigator and will depend on the circumstances surrounding the occurrence.

Gunshot Residue

- Gunshot Residue can indicate if a person was in the vicinity of a firearm discharge or exposed to GSR.
- Normally, there is no evidential value in taking gunshot residue samples from the hands of a shooting victim.
- However, in those rare instances where some unusual factors may exist, obtain the gunshot residue sample; it can be easily discarded later.

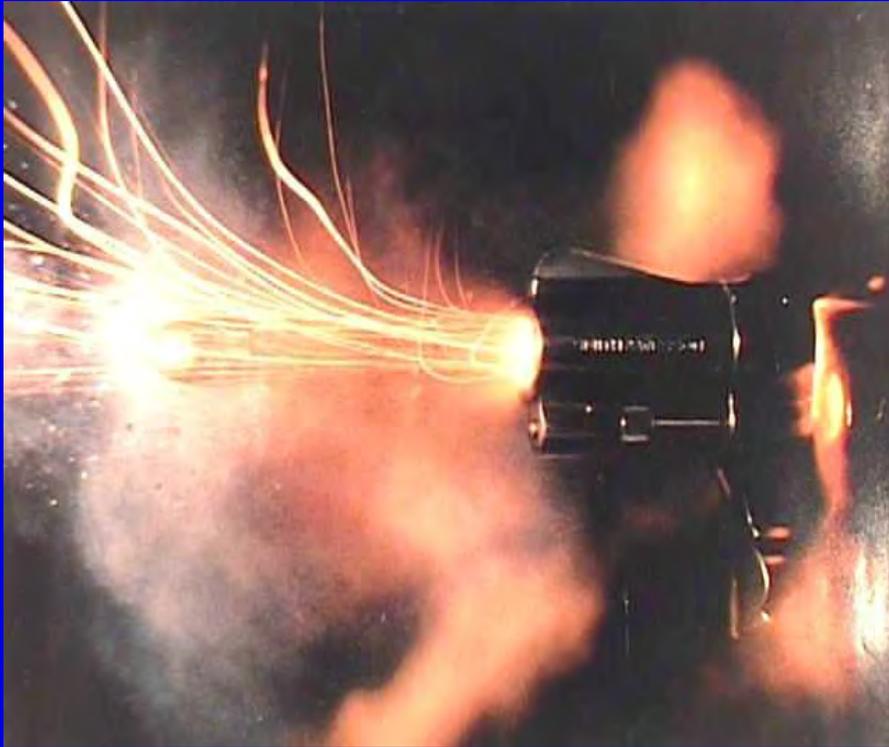
Gunshot Residue Kit

A Gunshot Residue Kit contains:

- Instructions
- A pair of rubber gloves
- Labels
- Two sample vials containing an adhesive-coated stub mounted on the face of its rubber stopper.



GUNSHOT RESIDUE ANALYSIS



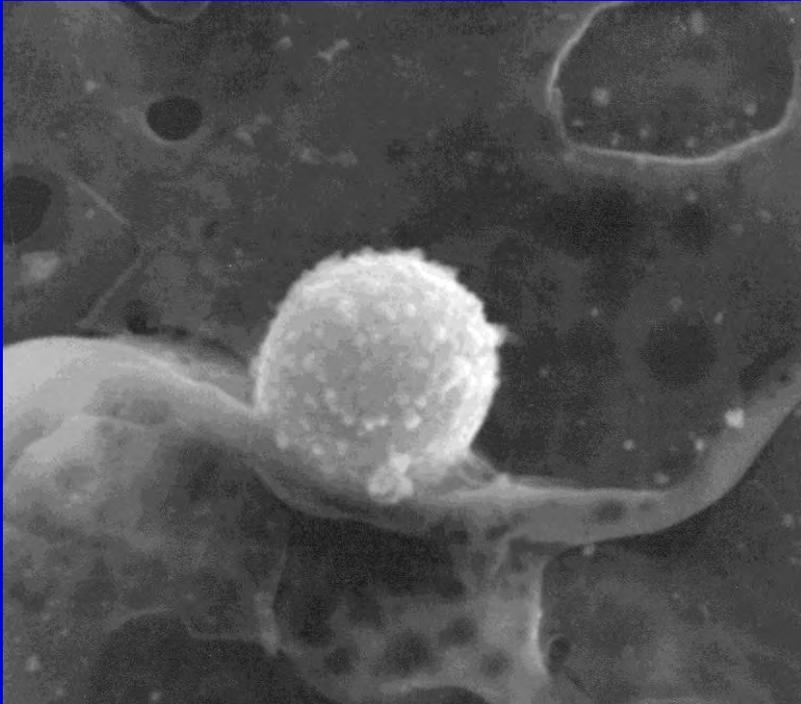
- When a firearm is discharged the majority of GSR travels downrange, away from the shooter, however a relatively small amount of GSR may curl back and be deposited on the shooters hands, face, or clothing.

GSR Analysis

- The particles of interest in this type of analysis originate within the primer, not the gunpowder, of a cartridge. The particles are formed when the cartridge is discharged.



GSR Analysis



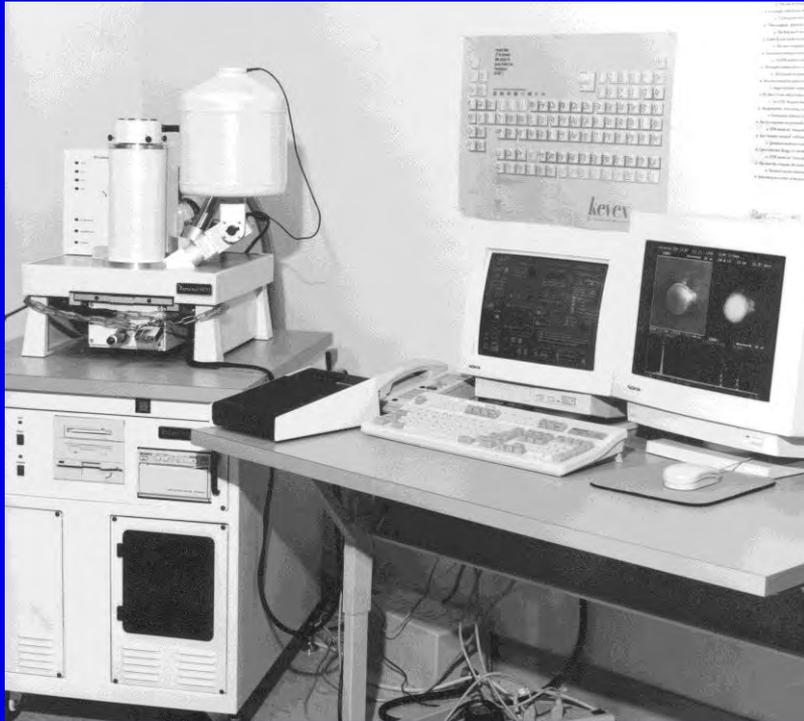
- The GSR particles make up only a small percentage of the gas cloud or “muzzle blast” produced. These particles are submicroscopic and invisible to the naked eye.

GSR Analysis

- Samples collected from the hands and face of shooting suspects, or from their clothing, may be analyzed for the presence of GSR particles.



GSR Analysis



- Samples are analysed using Scanning Electron Microscope Energy Dispersive X-ray (SEM/EDX) technique.

GSR Analysis

- If particles characteristic of GSR are detected on an individual it simply means that person was exposed to a source of these types of particles. It may have been through the discharge of a firearms cartridge or it may have been through other means.

GSR Analysis

- A positive result does not necessarily mean an individual discharged a firearm.
- Bystanders or shooting victims may be more likely to have residue deposited on them than the shooter
- Typically no evidentiary value in submitting samples from shooting victims

Toolmarks

Toolmarks are areas of damage produced when two surfaces come in contact.

- The softer surface receives the majority of the damage and becomes the toolmark.
- The harder surface is the tool.

Firearms & Toolmarks

Laboratory Services Provided

Toolmark Related Examinations:

- Examination of toolmark damage on surfaces such as doors, locks, window mouldings, safes, etc. to determine whether a particular tool was used to make the impression on the exhibit.

Toolmark Examinations

Forensic Significance

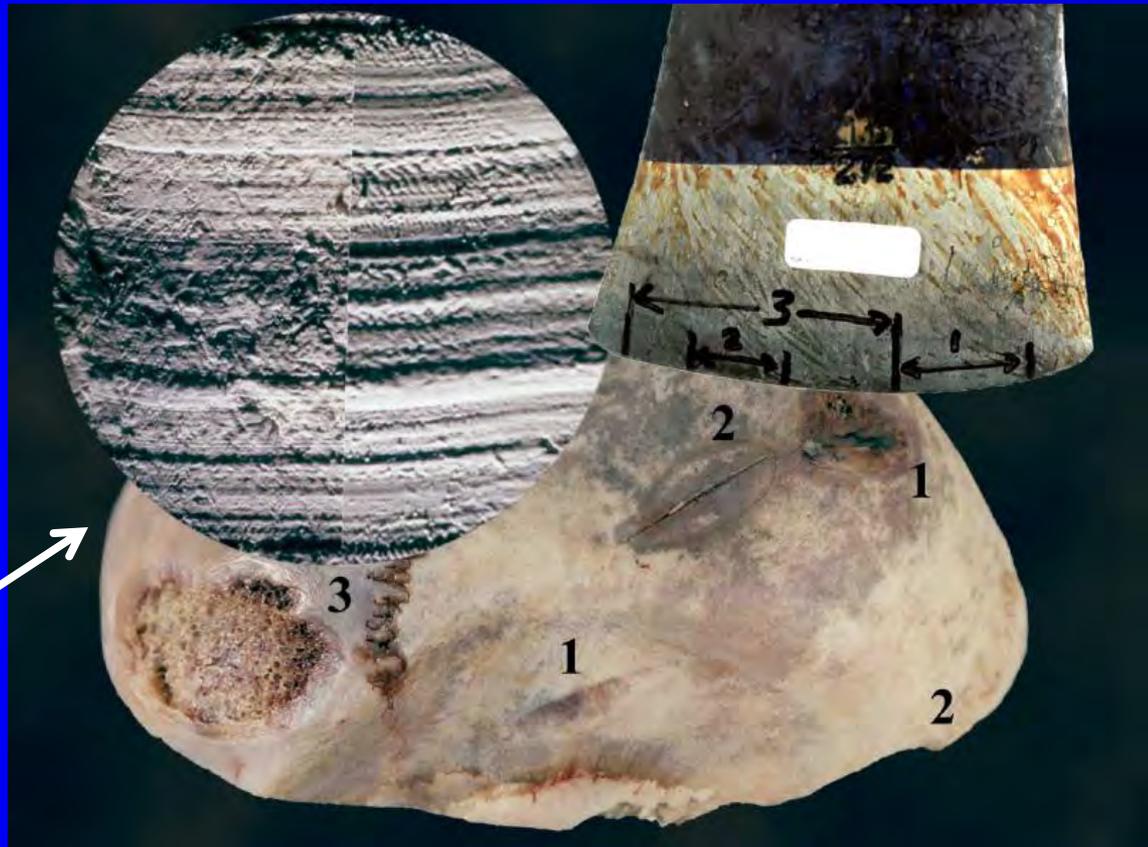
- Examinations may identify the type of tool which produced impressions, and may positively identify it as the source of the tool mark found on the exhibit.
- Examinations of impressions left on motor vehicles involved in a hit-and-run incident may positively identify one vehicle to another, pedestrian or object to a vehicle.
- When an impression is made by a tool on another surface, there may be a transfer of material (ie. paint, metal, wood, soil). The ERU at the laboratory will recover this for examination.

Toolmarks

Examples of toolmark damage are:

- Bullet and fired cartridge case comparison to firearms
- Scrapes across a door frame or on a safe door made by a screwdriver or pry-bar
- Cuts made by bolt cutters on a padlock, chain or fence wire
- Mould marks made on illicitly manufactured drugs (pill ballistics)
- Damage resulting from a vehicle collision
- Knife cuts in automobile tires, bone or cartilage
- Tooth marks of locking grip pliers on locks or doorknobs

Toolmark Examination Example



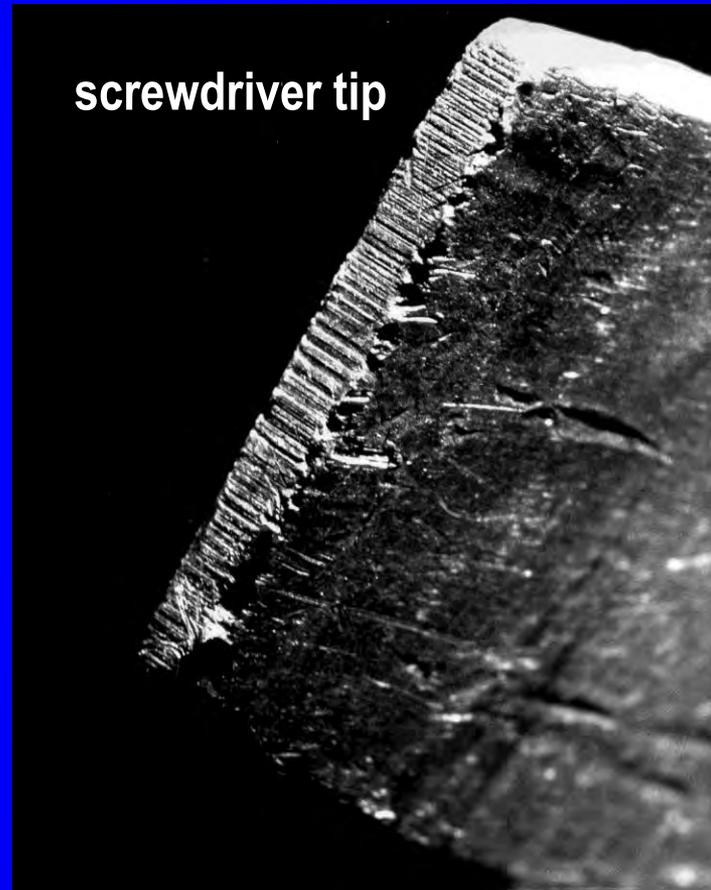
Under the microscope, the suspect axe blade characteristics match those of the chop marks on the skull.

Cuts & Punctures Examination Example

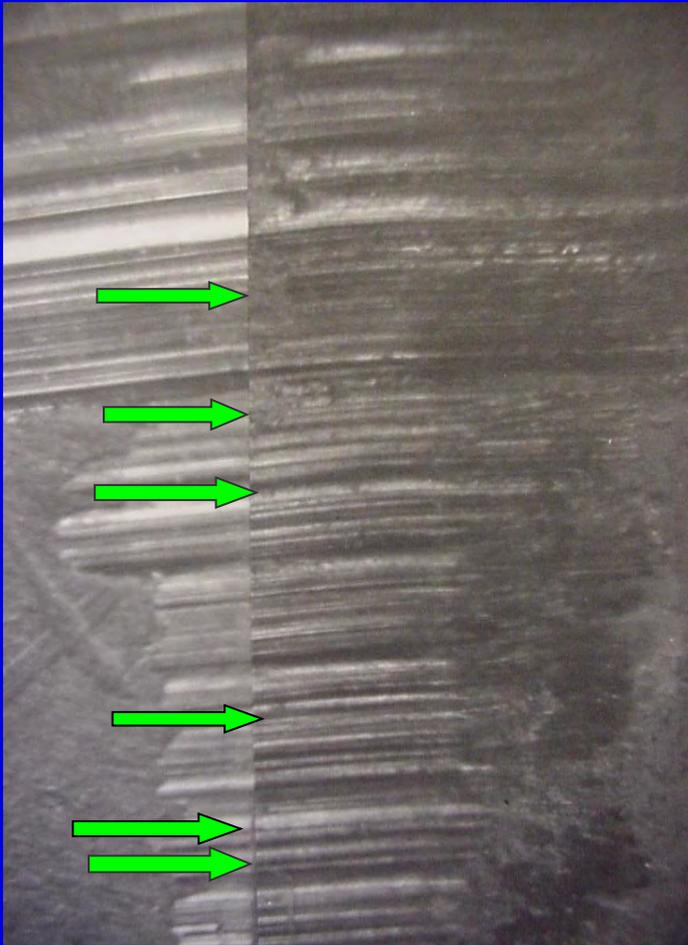
The suspect tool's characteristics are compared to the toolmarks made from the puncture on the exhibit tire.



Toolmark Identification



Toolmark Identification



- Tests are made using the suspect tool, and directly compared to the evidence toolmark using the comparison microscope.

Toolmarks in Tissue



- Victim discovered in a machine shed
- Death due to multiple blows with a weapon such as a hatchet or axe.

Toolmark in Tissue



- Examination at the autopsy showed the evidence of multiple strikes.
- Bone tissue samples were collected from selected areas of several of the strikes.

Toolmarks in Tissue



- A wooden handled hatchet was recovered from the trunk of the suspect vehicle.
- Tests were made in suitable medium and compared to toolmarks present in the bone. It was determined that the hatchet was the murder weapon.

Toolmarks in Tissue

- A badly decomposed body of an adult female was discovered in a shallow grave
- Pathologist suspected the cause of death to be a gunshot wound to the head
- The surface skull and exposed cross sections of the bone were examined for the presence of toolmarks.



Toolmarks in Tissue



- Toolmarks were noted on the skull surface where glancing blows from some type of tool contacted the skull. A cross sectional view of in the area thought to be the bullet entrance wound showed striated toolmarks .

Toolmarks in Tissue



- The examiner determined that a tool such as a wrecking bar was used on the victim.
- When confronted with this new evidence the common law spouse admitted to the crime.
- The murder weapon was not recovered.

Serial Number Restoration

Serial numbers and any other significant markings on firearms are examined and restored for identification.

Serial Number Restoration Process:

- Exhibit is sanded and polished
- Chemicals are applied
- Number or markings revealed



Physical Match Examination

Physical match examinations are conducted on items that have been:

- physically broken
- severed
- in contact by adhesion
- in tight physical contact
- separated, but have surface defects that continue across the line of separation

Physical Match Examination Examples



Physical Match Examination Examples



Paint Chip

Mirror Housing
(suspect truck)

Mirror Mount
(scene)



Tail Light Lens
Fractures

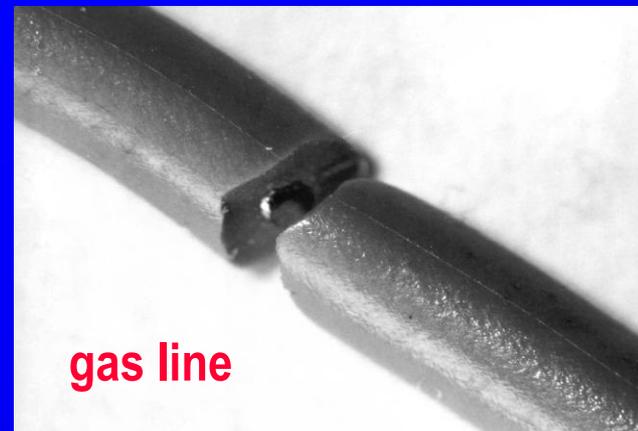
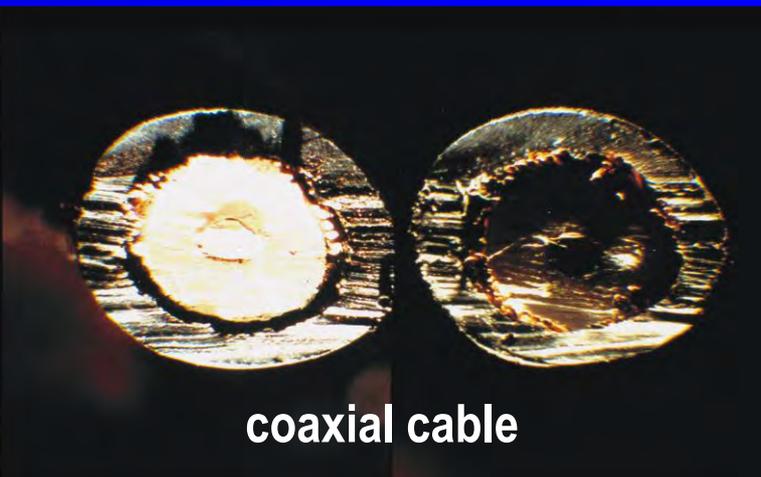
Physical Match Examination Examples

electrical lamp cord



gas line

coaxial cable



gas line

Physical Match Examination Example



▶ Physical matching involving the reconstruction of a fragmented object



Death- Medical Definition

- the cessation of life. In lower multicellular organisms, death is a gradual process at the cellular level, because tissues vary in their ability to withstand deprivation of oxygen; in higher organisms, a cessation of integrated tissue and organ functions; **in humans, manifested by the loss of heartbeat, by the absence of spontaneous breathing, and by cerebral death**

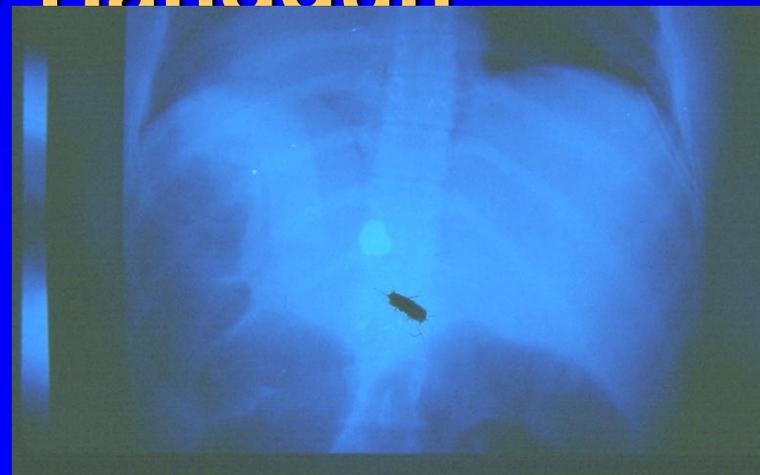
Firearms Capable of Causing Death

-that is capable of causing serious bodily injury or death to a person....
- Numerous cited cases of death with common centre fire and rim fire firearm/ ammunition combinations.

Handguns



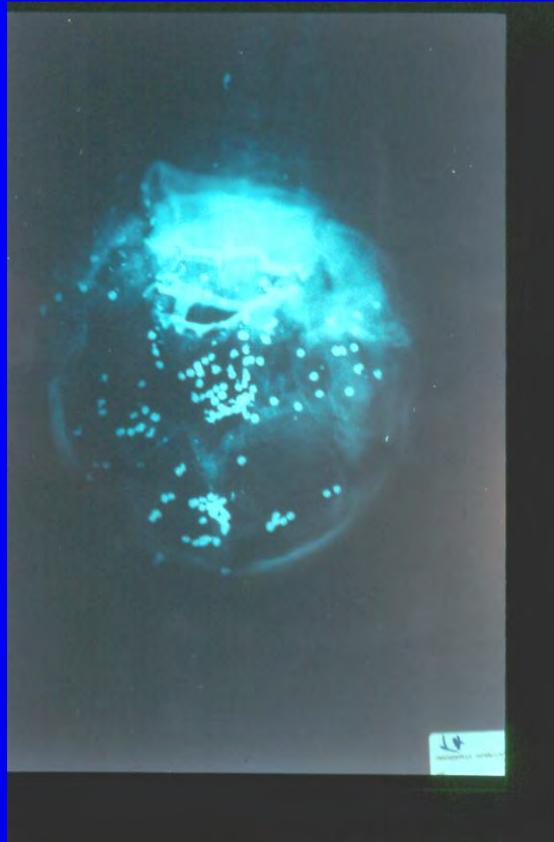
Death by Handgun



Long Arms



Death by Long Arm



Shotgun

Firearms Capable of Causing Serious Bodily Injury

(no Canadian statutory definition)

SERIOUS BODILY INJURY - Bodily injury that involves a substantial risk of death, unconsciousness, extreme physical pain, protracted and obvious disfigurement, or protracted loss or impairment of the function of a bodily member, organ, or mental faculty. 18 USC

Firearms Typically Not Capable of Causing Death

BB and pellet guns

Paintball markers

Soft air guns

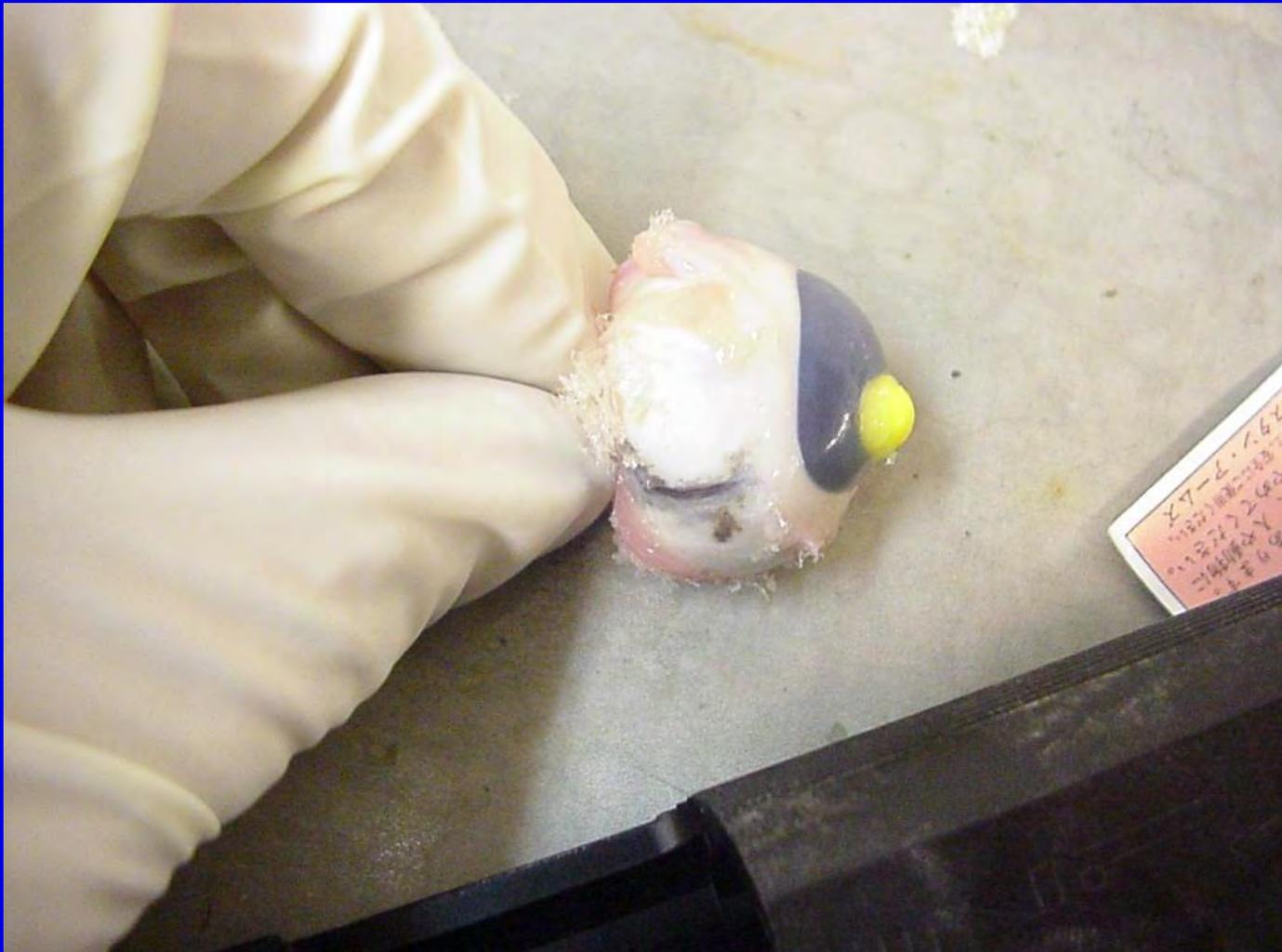
Less-lethal firearms (exclusively)

Flare and Gas guns

Soft Air (Airsoft)



Eyeball Penetration Test



Paintball Guns



Replica Paintball Firearms



RAP4 AK47

1 to 1 scale design

full metal body construction

casing ejection after each shot

velocity 350 fps

effective range 40 yards

new METS technology

safe/semi/full auto

25 rounds detachable magazine



Blunt Force Eye Trauma

