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AMERICAN COLLEGE OF EMERGENCY PHYSICIANS

SCIENTIFIC ASSEMBLY
1999

Clinical Forensic Medicine: How it Applies to Your Practice

Clinical forensic medicine has many important applications to the practice of emergency medicine. Emergency physicians should be familiar with some of the practical aspects, including forensic photography, evaluation of gunshot wounds and ballistics, and injury pattern interpretation. Domestic violence and abuse patients are most often evaluated in the emergency department. Learn techniques to effectively evaluate these patients.

- Define clinical forensic medicine and its role for emergency physicians.
- Describe the forensic evaluations of gunshot wounds and ballistics.
- Describe effective evidence gathering and photography in the emergency department.
- Learn practical clinical forensic medicine techniques for practicing emergency physicians.
- Describe pattern injuries associated with victims of domestic violence.

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FACULTY

William S Smock, MD, FACEP

Assistant Professor and Director, Clinical Forensic Medicine Training Program, Department of Emergency Medicine, University of Louisville School of Medicine, Louisville, Kentucky

What Emergency Physicians Should Know about Clinical Forensic Medicine

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William S. Smock, M.D.
Assistant Professor
Department of Emergency Medicine
University of Louisville School of Medicine
Louisville, Kentucky 40292
bsmock@pol.net

Clinical Forensic Medicine

Introduction:

Clinical forensic medicine is the application of forensic medical knowledge and techniques to patients in a clinical setting. Most of the patients with forensic needs are victims of assault, abuse and trauma who present to the emergency physician for care and treatment.

Historically, the emergency physician has been trained to primarily treat injuries without consideration of the associated forensic issues. As a consequence, emergency physicians may misinterpret wounds, not recognize the victims of abuse and domestic violence, and fail to appropriately document the nature of injuries in the medical record. During the provision of patient care, critical evidence can be lost, discarded or inadvertently washed away. Such evidence can be of critical significance when criminal or civil proceedings arise.

History:

For more than 200 years, physicians in Europe and Great Britain have performed forensic examinations on living patients. The physician is variously referred to as a police surgeon, forensic physician, forensic medical examiner, or a forensic medical officer. Clinical forensic medicine programs are also well established in Asia, Latin America and Australia. The Metropolitan Police Force in London employs 20 full time medical officers who perform forensic evaluations on prisoners and victims of physical and sexual assault. These physicians provide clinical forensic medical services to 11 police stations in Central and east London.

The coroner, medical examiner or combined coroner/medical examiner systems in the United States are responsible for the investigation of unnatural and suspicious deaths, but are not traditionally concerned with forensic issues on living patients. In the U.S., there is no physician or specialty responsible for addressing the forensic needs of those patients who survive their trauma. The only forensic policy statements for training guidelines from specialty societies in emergency medicine are related to the collection or evidence in cases of sexual assault.

In July, 1991, the Department of Emergency Medicine at the University of Louisville and the Kentucky Medical Examiner's Office initiated the first clinical forensic medicine training program in the United States. This program incorporated clinical forensic training into the emergency medicine residency training program and established a one-year fellowship in clinical forensic medicine.

Clinical forensic medicine is the application of forensic medical techniques to living patients. In the emergency department these techniques include the evaluation and documentation of traumatic injuries and the collection of evidentiary material for possible medicolegal presentation. Formal residency level training in clinical forensic medicine was nonexistent in the United States prior to 1991.

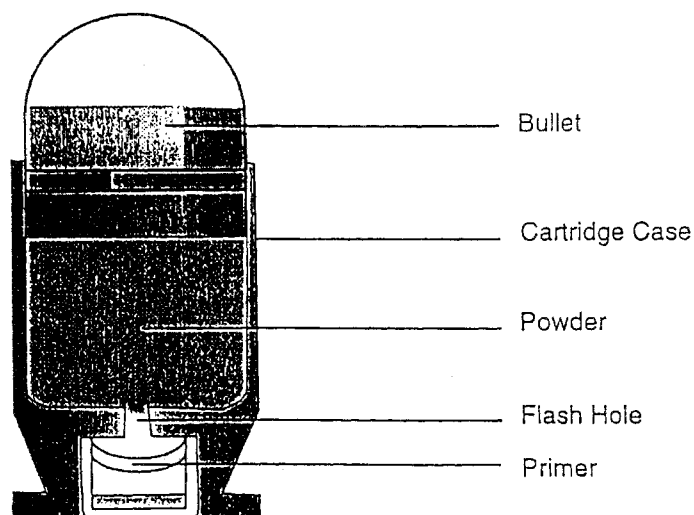## Forensic Aspects of Penetrating Trauma:

Emergency department personnel are challenged not only by the medical consequences associated with penetrating trauma but may be equally challenged by the medico legal sequelae as well. Besides rendering lifesaving treatment to the victim of a gunshot or stab wound, a physician, nurse or paramedic may be called upon, by either the prosecution or defense, to render "factual" or "expert" testimony. The rendering of such testimony, without an appropriate forensic examination or adequate forensic training, may deny the criminal justice system a suspect, and more importantly — the patient access to short-lived evidence that may assist in the determination of a suspected assailant's innocence or guilt.

Handguns:

A handgun is defined as a firearm that is held and fired with one hand. There are four general types of handguns, including: *single-shot, derringers, revolvers* and *auto-loading pistols.* The revolver is the most common handgun in the U.S. but the auto-loading pistol has experienced recent popularity. *Subguns* or *submachine guns* fire pistol ammunition in fully-automatic manner. Handguns far-and-away account for the majority of gunshot wounds which present to the emergency departments in the U.S.
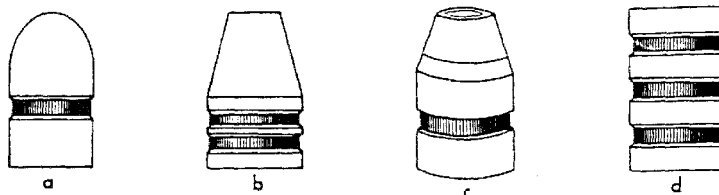
Handgun Ammunition:

- The "cartridge" is composed of several structural elements:

- Primer:

small explosive charge in base of cartridge
- Cartridge Case: metal, usually brass or aluminum
- Gunpowder (Smokeless): nitrocellulose base with various shapes: ball, flattened ball, flake, (cylindrical in rifle).
- Bullet:
- metal projectile; primarily lead or steel with various shapes. May be covered with a thin layer or jacket of metal or copper.) Full metal jacket, hollow-point, wadcutter, or aluminum semi-wadcutter.

Lead bullets. a. Round nose. b. Semiwadcutter. c. Hollow-point. d. Wad-cutter.
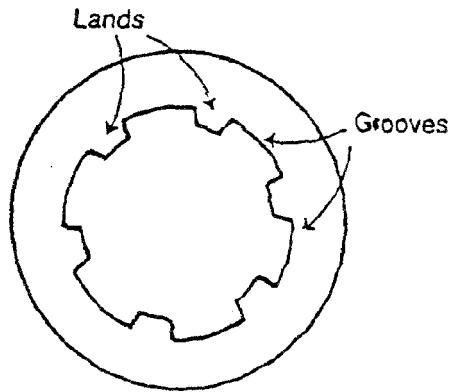
Caliber:

The size of a handgun is commonly described by the diameter of the cartridge it fires. This diameter or caliber is expressed in millimeters or 100th's of an inch: i.e. 9 mm, 10 mm, .22 (22 caliber), .25 (25 caliber), .32 (32 caliber), .38 (38 caliber), or .45 (45 caliber).

Caliber and Ammunition (in) and (mm)	Bullet WGT. (in grains)	Bullet Type	Muzzle Velocity (ft/sec)	Energy (ft/lbs)
.22 Short (.224in/5.59mm)	27	HP	1164	81
.22 Long (.224in/5.59mm)	29	RN	1180	90
.22 Long Rifle (.224in/5.59mm)	36	HP	1280	135
.22 Magnum (.224in/5.59mm)	40	HP	1910	324
.25 Automatic (.251in/6.38mm)	50	FMJ	760	64
.32 Automatic (.312in/7.92mm)	60	HP	970	125
.32 Automatic (.312in/7.92mm)	71	FMJ	905	129
.380 Automatic (.355in/9.02mm)	95	FMJ	955	190
.38 Special (.357 in/9.07mm)	125	JHP	945	248
.38 Special (.357 in/9.07mm)	158	RN	755	200
.357 Magnum (.357in/9.07mm)	125	JHP	1450	583
.357 Magnum (.357in/9.07mm)	158	SWC	1235	535
9mm Automatic(.355in/9.02mm)	115	FMJ	1475	555
9mm Automatic(.355in/9.02mm)	147	JHP	1000	326
.40 Automatic (.400in/10.16mm)	165	JHP	1150	485
.41 Magnum (.410in/10.41mm)	210	JHP	1300	790
.44 Magnum (.4295in/11mm)	240	JHP	1180	741
.44 Magnum (.4295in/11mm)	240	SWC	1350	971
.45 Automatic (.4515in/11.47mm)	255	RN	860	420

HP=Hollow Point
RN=Lead Round Nose
JHP=Jacketed Hollow Point
FMJ=Full Metal Jacket
SWC=Semi-Wad Cutter
Sierra Bullets, Sedalia, MO

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Forensic Evidence from the Gun and Cartridge:

During the manufacture of a handgun, a rifling tool cuts a series of spiral grooves in the length of the barrel. The elevated surfaces between the grooves are called "lands." The lands are in contact with the bullet as it travels down the length of the barrel. The spiraling of the lands imparts a spin to the bullet, giving it gyroscopic stability. Contact between the bullet and the lands will also impart unique microscopic lines on the bullet of the jacket, which can be used to identify the weapon from which it was discharged.

Di Maio, VJ. Gunshot Wounds, New York, Elsevier Science Publishing, Co. 1985.

Cartridge Case:

The cartridge case is also invaluable to the forensic firearms examiner when identifying or excluding a weapon that may have been fired. The microscopic marks on the cartridge case result from contact with the firing pin, the break lock and the magazine of semi-automatic weapons, the extracter and ejector mechanism. The bullets, jackets and cartridge case should not be handled in a manner that would destroy these microscopic marks.
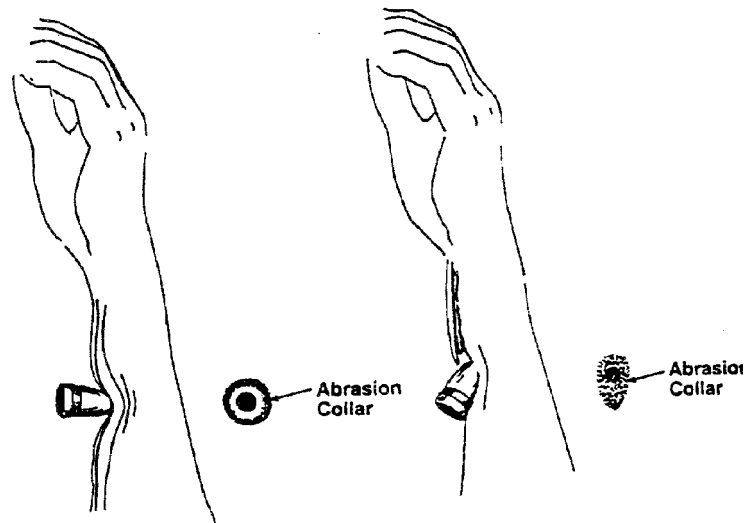
Entrance Wounds:

Gunshot wounds of entrance can be divided into four general categories, depending on the range-of-fire: *contact; near-contact* or *close-range; intermediate* or *medium range;* and *indeterminate* or *distant range.* Range-of-fire is the distance from the muzzle to the victim. When describing wounds in the various categories, specific forensic terms should be used. Some are unique to their classification.

The size of the entrance wound bears no relationship to the caliber of the bullet that inflicted it. Entrance wounds over elastic tissue will contract around the tissue defect and have a diameter much less than the caliber of the bullet.

Distant Range or Indeterminate Range:

The distant or long-range wound is inflicted from a range sufficiently far that only the bullet makes contact with the skin. There is no tattooing or deposition or soot associated with distant entrance wounds. As the bullet penetrates the skin, the skin is indented, resulting in the creation of an "**abrasion collar**." This collar is an abraded area of tissue that surrounds an entrance wound. It is the result of fraction between the bullet and the epithelium. The width of the abrasion collar will vary with the angle of impact. The vast majority of entrance wounds will have an abrasion collar. Entrance wounds on the palms and soles are exceptions, usually appearing slit-like.
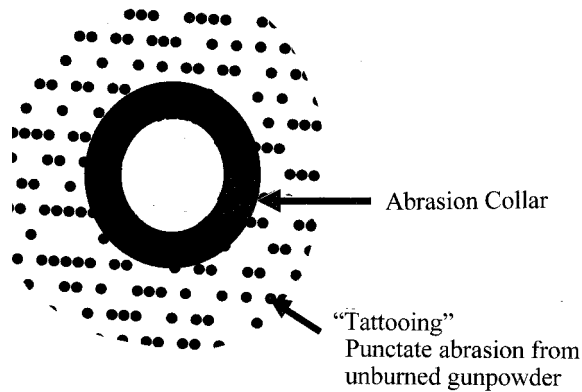

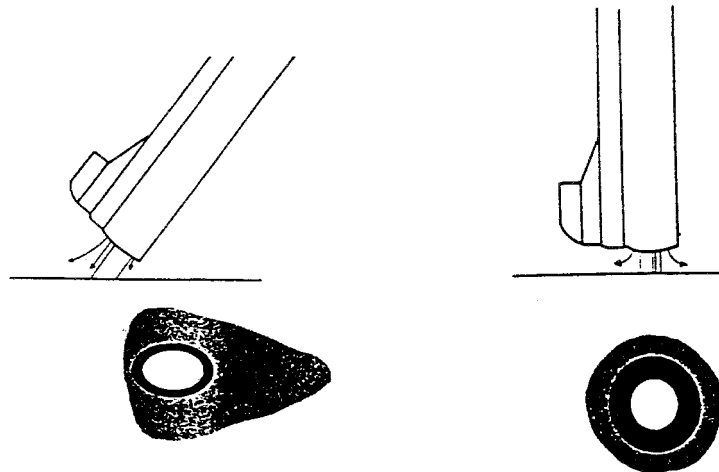## Intermediate   Range:

Tattooing is pathognomonic for an intermediate range gunshot wound and presents as punctate abrasions from contact with partially burned or unburned grains of gunpowder. Tattooing cannot be wiped away. Clothing and hair, as intermediate objects, may prevent the gunpowder grams from making contact with the skin. It is rare for tattooing to occur on the palms of the hands and the soles of the feet, due to the thickness of the epithelium, but it has been reported.

Tattooing has been reported with distances as close as one cm and as far away as four feet. The density of the abrasions and the associated pattern will depend on the length of the barrel, muzzle to skin distance, type of gunpowder (ball, flattened ball, or flake), the presence of intermediate objects, and the caliber of the weapon. Spherical powder will travel farther and have greater penetration than flattened ball or flake powder.

Abrasion Collar

"Tattooing"
Punctate abrasion from
unburned gunpowder

Close Range/Near Contact Wounds:

Close-range is defined as the maximum range at which soot is deposited on the wound or clothing. Close-range usually describes a muzzle-to-target distance of less than six inches. On rare occasions, however, soot has been noted on victims as far away as twelve inches from the offending weapon. Beyond six inches the soot usually falls away and does not reach the target. The concentration of the soot will vary inversely with the muzzle to target distance and will be influenced by the type of gunpowder and ammunition used, the barrel length, and the caliber and type of weapon.

Di Maio, VJ. Gunshot Wounds, New York, Elsevier Science
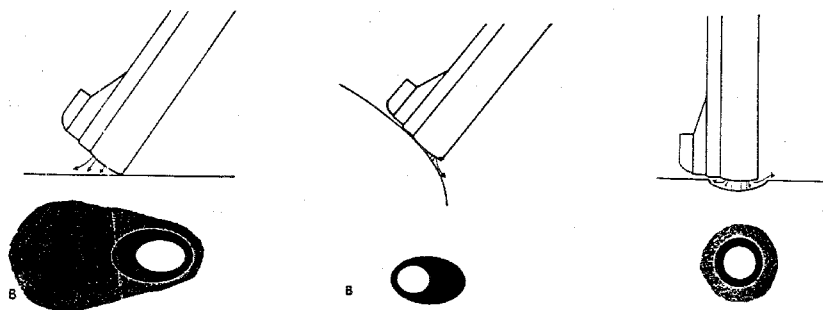Publishing Co., 1985.

Contact Wounds:

In contact wounds, the barrel or muzzle is in actual contact with the skin or clothing. Contact wounds can be subdivided into tight contact, where the muzzle is pushed hard against the skin, and loose contact, where the muzzle is incompletely or loosely held against the skin or

clothing. Wounds sustained from a tight contact with the barrel can vary in appearance from a small hole with seared blackened edges (from the discharge of hot gases and an actual flame, to a gaping stellate wound from the expansion of the skin from the gases.) The large stellate wounds are often misinterpreted as exit wounds based solely upon their size and without adequate examination of the wound.
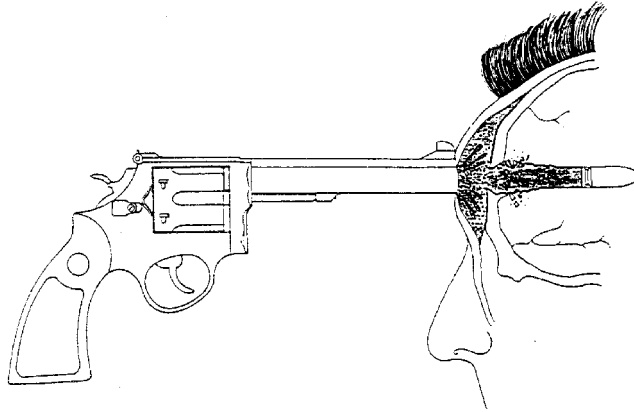
In a tight contact wound, all material — the bullet, the gases, the soot, the incompletely burned pieces of gunpowder and metal fragments — is driven into the wound. If the wound is over thin or bony tissue, the hot gases will cause the skin to expand to such an extent that the skin stretches and tears. The tears generally have a triangular shape with the base of the triangle overlying the entrance wound. Larger tears are generally associated with ammunition of .32 caliber or greater, or magnum loads.

Stellate tears are not pathognomonic for contact wounds. Tangential wounds, ricochet or tumbling bullets and some exit wounds may also be stellate in appearance. One way to distinguish these from a tight contact wound is the absence of soot and powder within the wound. In some tight contact wounds, expanding skin is forced back against the muzzle of the gun. When this occurs a characteristic pattern contusion is left behind called a "**muzzle contusion**." Patterns like these are helpful in determining what type of weapon, revolver or semi-automatic, was used to inflict the wound and should be documented prior to wound debridement or surgery.

When a gun's muzzle or barrel is in incomplete or loose contact, or is angled relative to the skin, the soot and gunpowder residues will be present within the wound and surrounding the wound. The angle between the muzzle and the skin will determine the soot pattern. A perpendicular loose or near-contact wound results on searing of the skin and deposition of soot surrounding the wound. A tangential loose or near contact wound produces an elongated searing and soot deposit surrounding the wound.

Di Maio, V.J. Gunshot Wounds, New York, Elsevier Science
Publishing Co., 1985.

Exit Wounds:

The determination at entrance versus exit wounds should be based upon the physical characteristics and physical evidence associated with the wound and never upon the size of the wound. Exit wounds are the result of a bullet pushing and stretching the skin from inside/out. The skin edges are generally everted with sharp but irregular margins. Abrasion collars and soot are not associated with exit wounds and tattooing is never seen at an exit wound site. On rare occasions soot may also be present at an atypical exit wound site. If a contact entrance wound is located close to its associated exit wound, soot can be propelled through the short wound track and appear faintly on the exit wound surface.

Exit wounds will assume a variety of shapes and configurations and are <u>not</u> consistently larger than their corresponding entrance wounds. The exit wound's size is determined primarily by the amount of energy possessed by the bullet as it exits the skin and by the bullet's size and configuration. A bullet's configuration will change from its usual nose-first attitude upon entering the skin, to a tumbling and yawing one after contact with tissue. A bullet with sufficient energy that exits the skin in a sideways configuration, or one that has increased its surface are by mushrooming, may have an exit wound larger than its entrance wound. The transference of energy to underlying bone may also result in an exit wound being larger "then an entrance wound".
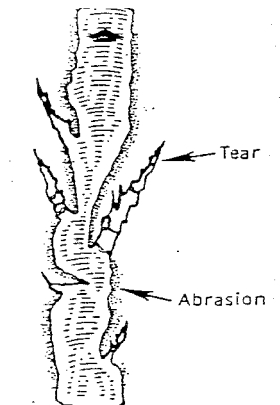
Shored Exit Wounds:

A shored exit wound is a wound that has an associated false abrasion collar. If the skin is pressed against or supported by a firm object or surface at the moment the bullet exits, the skin can be compressed between the exiting bullet and the support surface. Examples of supporting structures include: belts, floors, walls, doors, chairs, and mattresses.

Graze Wounds:

Graze wounds are considered atypical wounds and result from tangential contact with a passing bullet. Directionality of the bullet can be determined from a close examination of the

wound. The bullet produces a trough with formation of skin tags on the lateral wound margins. The base of these skin tags point toward the weapon and away from the direction of bullet travel.

Forensic Evidence from the Clothing and Patient:

Emergency physicians in the evaluation and treatment of patients who are victims of assault or trauma may have the opportunity to recognize, preserve, and collect short-lived evidence.

Bullet Wipe:

Soot residue, soft lead, and lubricant may leave a gray rim or streak on clothing overlying an entrance wound. This gray discoloration may also be found around the abrasion collar but is usually more prominent on clothing.

Intermediate Objects:

The presence of an object between a particular wound and the muzzle may prevent the deposition of soot, powder tattooing and other residues on the skin. Clothing is the most common intermediate object and must be preserved if a range-of-fire is to be determined. The victim's clothing may yield information about the range-of-fire and help distinguish entrance from exit wounds. Gunpowder residues and soot will deposit on clothing as they do on skin. Some of the residue will be invisible to the naked eye but can be visualized utilizing standard forensic laboratory staining techniques. When articles of clothing are removed from a wounded patient, it is helpful if each piece is placed in a separate paper bag to avoid the cross contamination of evidence.

Intermediary objects may be sufficiently substantial to distort or fragment a bullet, thereby distorting an entry wound. The bullet may also carry splinters or fragments of the intermediate object toward or into the wound. Such evidence should be preserved and collected from the wound.

A gunshot residue test (GSR) or firearms residue test (FART) may determine if a victim
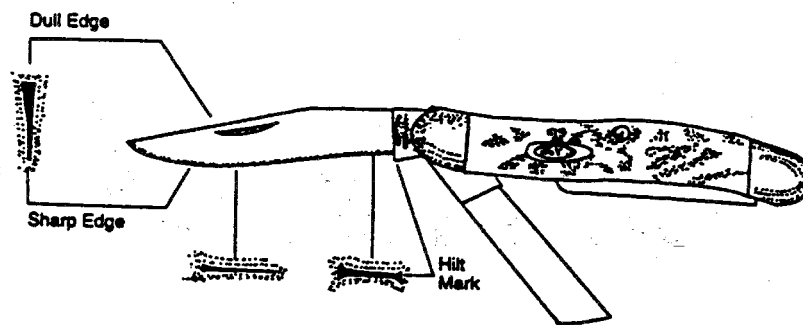
or suspect has fired a weapon. The GSR test checks f the presence of invisible residues from the primer: barium nitrate, antimony sulfide and lead peroxide. There are two methods of checking for residue: a) The palms and the dorsum of the hands are swabbed with a 5% nitric acid solution and analyzed using atomic absorption spectrophotometry or b) tape or an adhesive disk is placed on the hands and removed for examination under a scanning electron microscope.

Intermediary objects may be sufficiently substantial to distort or fragment a bullet, thereby distorting an entry wound. The bullet may also carry splinters or fragments of the intermediate object toward or into the wound.

Sharp Force Pattern Injuries:

There are two types of sharp force injuries, incised or stabbed. The incised wound is longer than it is deep. The stab wound is defined as a puncture wound that is deeper than it is wide. The wound margins of sharp force injuries are clean and lack the abraded edges of injuries resulting from blunt forces.

Forensic information can be gathered during the examination of a stab wound. Some of the characteristics of a knife blade, single-edged or double-edged, can be determined from visual inspection. Additional characteristics, such as serrated versus sharp, can be determined if the blade was drawn across the skin during its insertion or withdrawal. Serrated blades do not always leave these characteristic marks.

Self-Inflicted Sharp Force Injuries:

When a patient presents with multiple incised wounds, the emergency physician must carefully evaluate that patient for a history of depression or psychiatric disorder. The vast majority of patients who present with multiple incised wounds have inflicted the wounds themselves. Examples include wounds to wrists, chest and face.
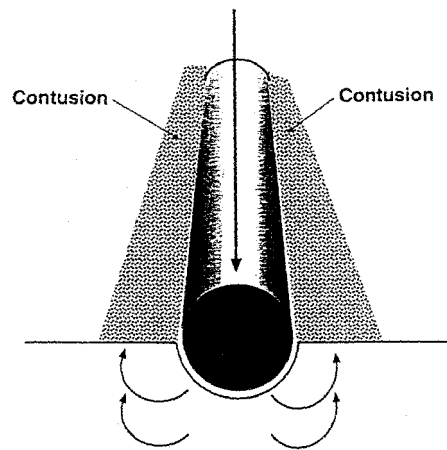
Blunt Force Pattern Injuries:

Every *"weapon"* [hand, belt, pipe wrench, hot iron, electrical cord, or baseball bat] leaves a mark, design or pattern stamped or imprinted upon or just below the epithelium. The epithelial

imprints of these weapons are called pattern injuries, which are consistently reproducible. These injuries can be categorized into three major classifications according to their source: blunt force, sharp force and thermal.

The most common blunt force injury is the contusion. The other manifestations of blunt force trauma to the skin are the abrasion and the laceration. A weapon with a unique shape or configuration may stamp a mirror image of itself on the skin.

The *pattern contusion* is a common injury that helps identify the causative weapon. A blow from a linear object leaves a contusion that is characterized by a set of parallel lines separated by an area of central clearing. The blood underlying the striking object is forcibly displaced to the sides, which accounts for the pattern's appearance.

Pattern Injuries the **Emergency**
Physician Should be Able to Recognize:
Injuries caused by impact with linear objects
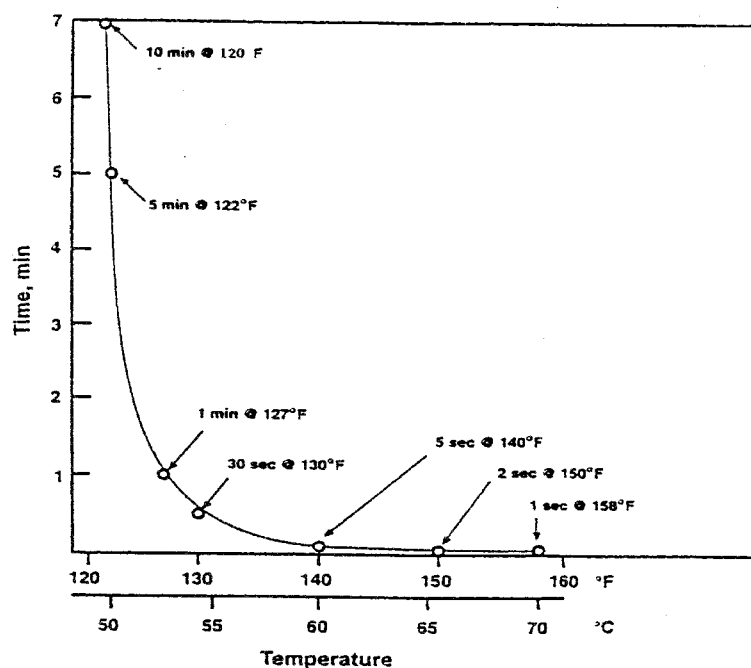   - Hand
          - Slap marks
          - Fingertip contusions
          - Grab marks
          - Choke holds
          - fingernail abrasions
        - Other objects
          - Baseball bat
          - Tire tool
          - 2 x 4
          - Belt
          - Shoe
          - Comb
        - Bite Marks

Thermal Pattern Injuries:

A thermal pattern injury is a common form of abuse or assault, especially in children and the elderly. The detailed history of the incident should include the position of the patient relative to the thermal source. This will help determine whether the injury was inflicted or accidental.

Pattern thermal injuries commonly encountered in the emergency department include: *flat iron burns, curling iron burns, immersion burns, and splash burns.* Immersion or dipping burns are characterized by a sharp or clear line of demarcation between burned and unburned tissue. In contrast, splash burns are characterized by an irregular or undulating line or by isolated areas of thermal injury, usually round or oval in shape, caused by droplets of hot liquid. The severity of the thermal or scald injury depends upon the length of the time the skin is in contact with the offending force and the temperature of the force itself. Tap or faucet water causes full-thickness thermal damage in one second at 158°F/70°C , and 180 seconds at 120°F/48.9°C. Law enforcement agents routinely measure the household's or institution's water temperature in any investigation involving a scald injury of a child, developmentally delayed or elderly patient.

Vehicle Trauma:

The law enforcement officials charged with investigating an incident involving serious injuries from a motor vehicle or pedestrian collision may benefit from information regarding injury patterns and the collection of trace evidence from the victim. This information can help determine an occupant's position or role as driver or passenger, or identify a suspected vehicle involved in a hit-and-run pedestrian collision. In addition, a pedestrian's position when struck in the roadway, standing or lying, may be determined. The emergency physician may be involved

in subsequent legal proceedings that arise in both the civil and criminal courts. The courts will benefit from the careful documentation of injuries, injury patterns and the recognition and preservation of trace
evidence. (See paper, *The Forensic Pathologist and the Determination of Driver Versus Passenger in Motor Vehicle Collisions*.)

The Bible of Clinical Forensic Medicine
Spitz WU: **Medicolegal Investigation of Death,** Springfield, Il, 1993, Charles C. Thomas (3rd ed).

Best book on the forensic evaluation of gunshot wounds:
DiMaio VJM: **Gunshot Wounds**, CRC Press, 1985.

Clinical Forensic Medicine

1. Busuttil A, Smock WS: Training in clinical forensic medicine in Kentucky. *Police Surgeon* 26, 1990.

2. Carmona R, Prince K: Trauma and forensic medicine. *J Trauma* 29(9):1222, 1989.

3. Eckert WG et al: Clinical forensic medicine. *Am J Forensic Med Path* 7(3):182, 1986.

4. Eckert W: Forensic sciences — the clinical or living aspects. *Inform* 16:3, 1983.

5. Goldsmith MF: U.S. Forensic pathologists on a new case: examination of living patients.

   JAMA 256(13):1685, 1986.

6. McLay WDS: Clinical Forensic Medicine, London, 1990, Pinter.

7. Payne-James JJ, Dean PJ: Assault and injury in clinical forensic medical practice. *Med Sci Law* 34(3):202, 1994.

8. Smialek JE: Forensic medicine in the emergency department. *Emerg Med Clin N Am* 1(3):1685, 1983.

9. Smock WS, Ross CS, Hamilton FM: Clinical forensic medicine: How ED physicians can help with the sleuthing. *Emergency Legal Briefings* 5(1):1, 1994.

10. Smock WS, Nichols GR, Fuller PM: Development and implementation of the first clinical forensic medicine training program. *J Forensic Sciences* 38(4):835, 1993.

11. Smock WS: Development of a clinical forensic medicine curriculum for emergency physicians in the USA. *J Clin Forensic Sciences Med* 1(1):27, 1994.

Gunshot Wounds

1.   Breo DL: JFK's death — the plain truth from the MD's who did the autopsy. *JAMA* 267(20):2794, 1992.

2.   Collins KA, Lantz PE: Interpretation of fatal, multiple, and exiting gunshot wounds by trauma specialists. *J Forensic Sciences* 39(1):94, 1994.

3.   DeMuth WE: Ballistic characteristics of "Magnum" sidearm bullets. *J Trauma* 14:227, 1974.

4.   DiMaio VJM: Gunshot Wounds, CRC Press, 1985.

5.   DiMaio VJM, Spitz WU: Variations in wounding due to unusual firearms and recently available ammunition. *J Forensic Sciences* 17:377-386, 1982.

6.   Dixon DS: Characteristics of shored exit wounds. *J Forensic Sciences* 26(4):691, 1981.

7.   Dixon DS: Determination of direction of fire from graze gunshot wounds. *Forensic Sciences* 25(2):272, 1980.

8.   Dixon DS: Determination of direction of fire from graze gunshot wounds of internal organs. *J Forensic Sciences* 29(1):331, 1984.

9.   Donoghue ER et al: Atypical gunshot wounds of entrance: an empirical study. *J Forensic Sciences* 29(2):379, 1984.

10.   Fackler ML, Riddick L: Clinician's inadequate descriptions of gunshot wounds obstruct justice — clinical journals refuse to expose the problem. Proceedings of the American Academy of Forensic Sciences, Vol. II: 150, Colorado Springs, 1996, McCormick-Armstrong.

11.   Fackler ML: Wound ballistics: a review of common misconceptions. *JAMA* 259(18):2730, 1988.

12.   Fatteh A: Medicolegal investigation of gunshot wounds, Philadelphia, 1976, J.B. Lippincott.

13.   Godley DR, Smith TK: Some medicolegal aspects of gunshot wounds. *J Trauma* 17(11):866, 1977.

14.   Le Garde LA: Gunshot injuries, (2nd ed. revised), Mt. Ida, Arkansas, 1991, Lancer Militaria.

15.   Randall T: Clinicians' forensic interpretations of fatal gunshot wounds often miss the mark. *JAMA* 269(16):2058, 1993.

16.   Sellier KG, Kneubuehl BP: Wound ballistics and the scientific background, Amsterdam, 1994, Elsevier.

Domestic Violence

1.   Abbott J et al: Domestic violence against women: incidence and prevalence in an emergency department population. *JAMA* 273(22):1763, 1995.

2.   Appleton W, Renton W: The battered women syndrome. *Ann Emerg Med* 9(2):84, 1980.

3.   Campbell JC et al: Battered women's experiences in the emergency department. *J Emerg Nurs* 20(4):280, 1994.

4.   Centers for Disease Control and Prevention. Education about adult domestic violence in U.S. and Canadian medical schools, 1987-88. *MMWR Morb Mortal Wkly Rep* 38:17:1989.

5.   Chambliss LR, Bay RC, Jones RF: Domestic violence: Educational imperative? *Am J Obstet Gynecol* 172(3):1035, 1995.

6.   Council on Ethical and Judicial Affairs, American Medical Association: Physicians and domestic violence, ethical considerations. *JAMA* 267(23):3190, 1992.

7.   Council on Scientific Affairs, American Medical Asosciation: Violence against women, Relevance for medical practitioners. *JAMA* 267(23):3184, 1992.

8.   Delahunta EA: Hidden trauma: The most missed diagnosis of domestic violence. *Am J Emerg Med* 13(1):74, 1995.

9.   Goldberg WG, Tomlanovich MC: Domestic violence victims in the emergency department. *JAMA* 251 (24):3259, 1984.

10.   Goldberg W, Carey Al: Domestic violence victims in the emergency setting. *Top Emerg Med*
3:65, 1982.

11.   Gremillion DH, Evins G: Why don't doctors identify and refer victims of domestic violence? *NC Med J* 55(9):428, 1994.

12.   Grunfeld AF et al: Detecting domestic violence against women in the emergency department: A nursing triage model. *J Emerge Nubs* 20(4):271, 1994.

13.   Isaac NE, Sanchez UL: Emergency department response to battered women in Massachusetts. *Ann Emerg Med* 23(4):85, 1994.

14.   McLeer SV, Anwar RA: The role of the emergency physician in the prevention of domestic violence. *Ann Emerg Med* 16:1155, 1987.

15.
        Morrison LJ: The battering syndrome: A poor record of detection in the emergency department . *J Emerge Med* 6:521, 1988.

16. Randall T: Domestic violence intervention calls for more than treating injuries. *JAMA* 254:939, 1990.

17. Rounsaville B, Weissman MM: Battered women: A medical problem requiring detection.

   Intl J Psychiatry Med 8(2):191, 1977-1978.

18. Stark E, Flitcraft A, Frazier W: Medicine and patriarchal violence: The social construction of a `private' event. *Int J Health Serv* 9:461, 1979.

19. Tilden VP, Shepherd P: Increasing the rate of identification of battered women in an emergency department: Use of a nursing protocol. *Res Nurs Health* 10:209, 1987.

20. Tilden VP: Response of the health care delivery system to battered women. *Issues Ment Health Nurs* 10 (3-4):309, 1989.

Motor Vehicle Trauma

1. Blackbourne BD: "Injury-vehicle correlations in the investigation of motor vehicle accidents. In Wecht CH ed, <u>Legal Medicine Annual 1980</u>, New York, Appleton-Century-Crofts, 1980.

2. Smock WS et al: The forensic pathologist and the determination of driver versus passenger in motor vehicle collisions. *Am J Forensic Med Path* 10(2):105, 1989.
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