

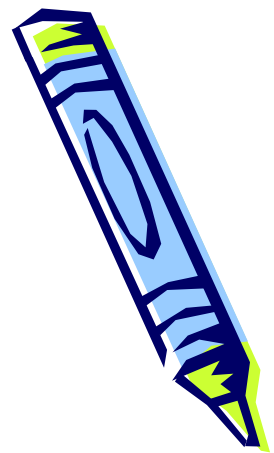
Firearm injuries



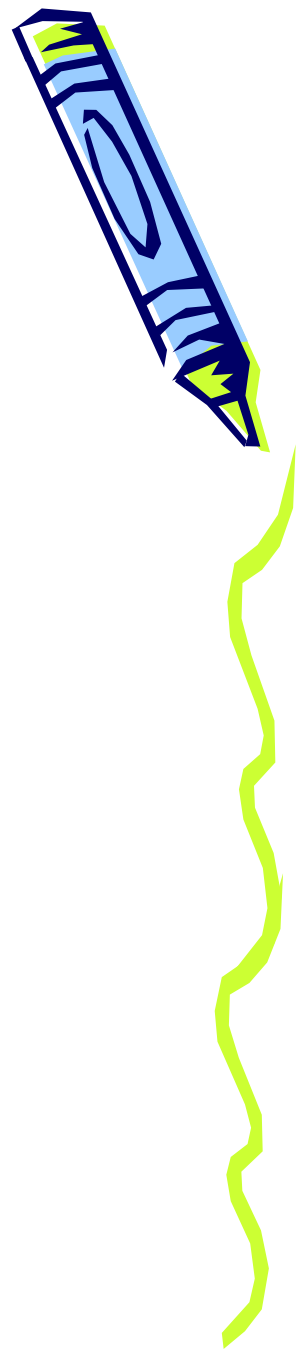
Asela Mendis

Objectives of this lecture are

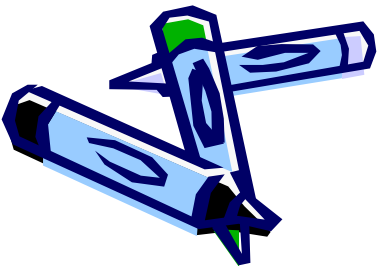
- *To give you a basic understanding about firearms,*
- *Different types of firearms and ammunition,*
- *Features of gunshot injuries as to determine the range and direction of fire.*
- *Entry and exit wounds – features and importance of them,*
- *Wound ballistics- mechanism of injury.*
- *Investigation of firearm death,*
- *Autopsy procedure.*
- *Report and opinion.*



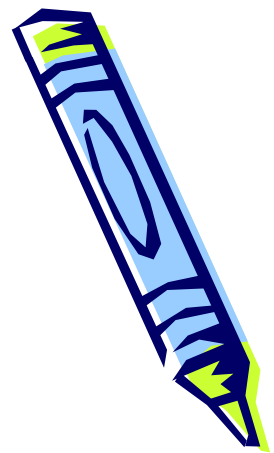
This lecture will cover the basics of following areas;



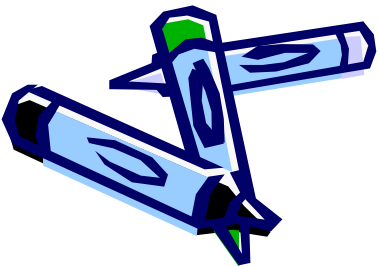
- *Firearms and ammunition,*
- *Ballistics – basics,*
- *Classification of gunshot wounds,*
- *Rifle firearm injuries and shotgun injuries,*
- *Investigation of death due to gunshot injuries,*
- *Special situations,*
- *Circumstances of firearm injuries,*
- *Reporting and opinion,*



What is a firearm:



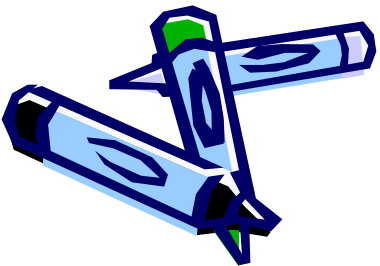
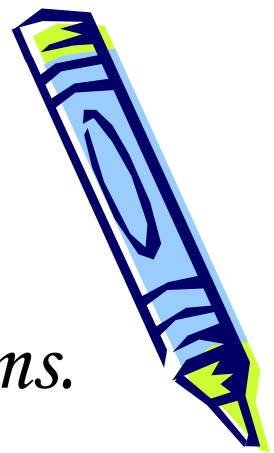
- *A gun is a mechanical device which expels a projectile.*
- *It is meant harm or kill someone.*
- *The term arm refers to a weapon that is hand held and can be transported by one person. Therefore a firearm is a gun intended to be used and supported by a single individual.*



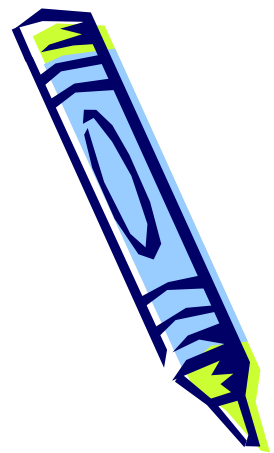
Firearms and ammunition

- *There are different ways of classifying firearms.*
 1. *Handguns & shoulder guns.*
 2. *Light & heavy artillery.*
 3. *Rifles and shotguns.*
 4. *Rifle weapons and smooth bore weapons.*

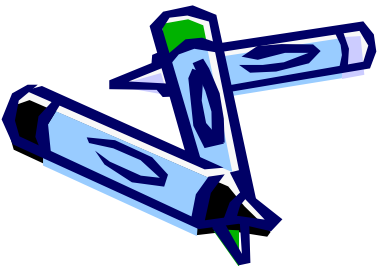
From these 3 & 4 are more appropriate for forensic purposes



Types of firearms:

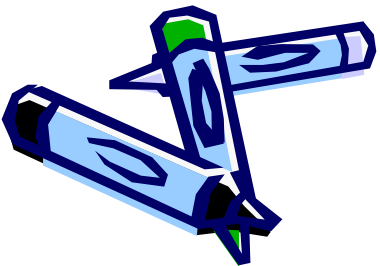
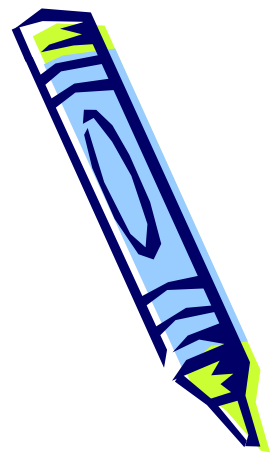


- *Small firearms & heavy artillery.*
- *Fully mechanical.*
- *Semiautomatic;*
 - *Automatically loaded but fires only once when the trigger is pulled. You have to release the trigger and pull once more to fire the next.*
- *Fully automatic;*
 - *continue to fire as long as the trigger is activated and ammunition is fed are fully automatic or machine guns.*

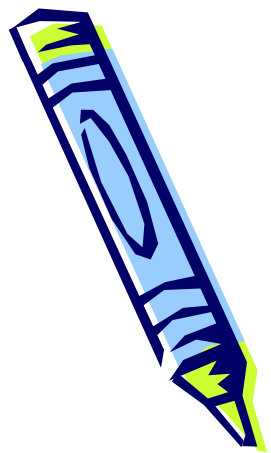
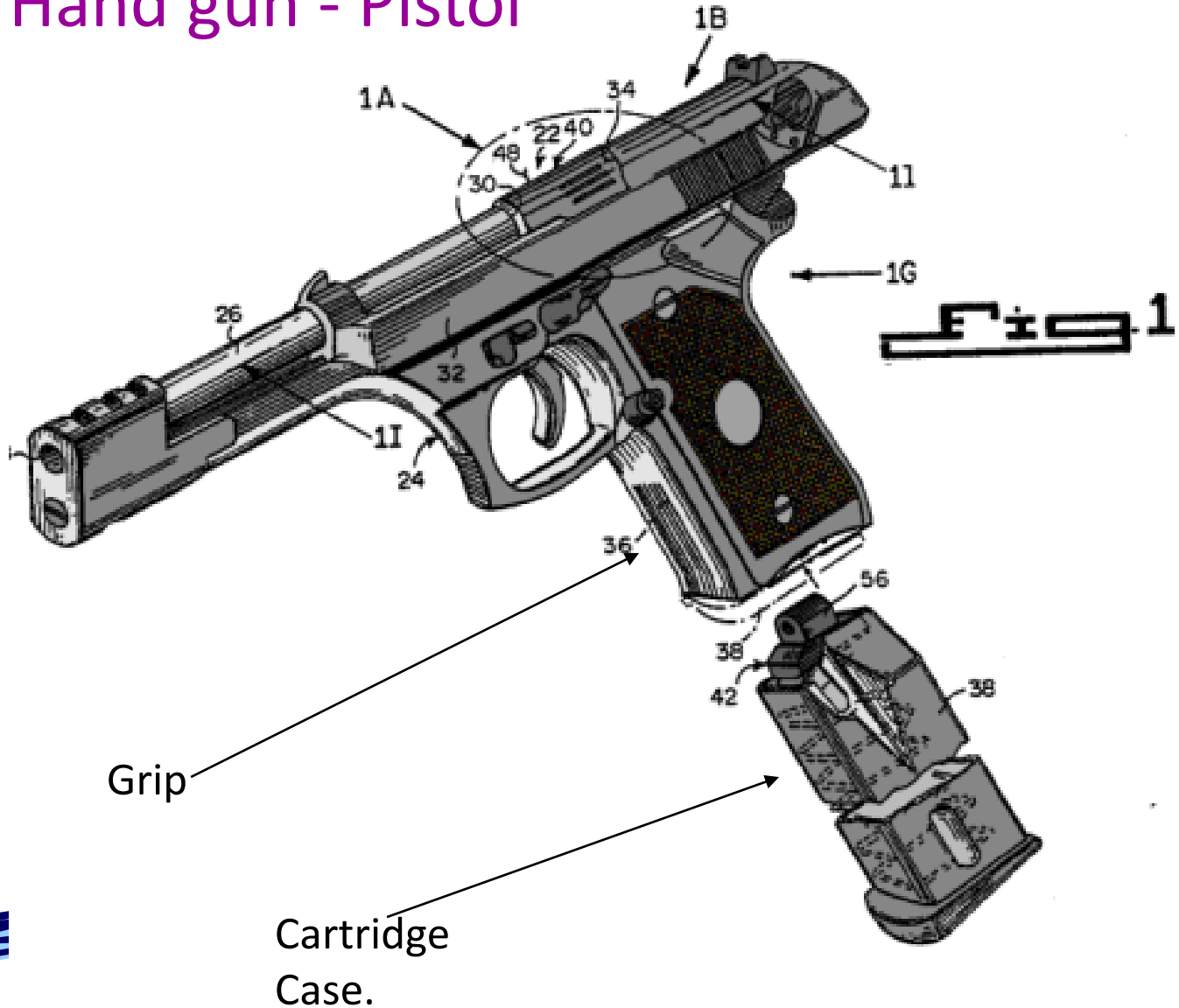


Hand guns – use only hand and fingers to load, aim and fire the weapon

Shoulder guns – use both hands and shoulder to operate the weapon.



Hand gun - Pistol



Hand gun - Revolver

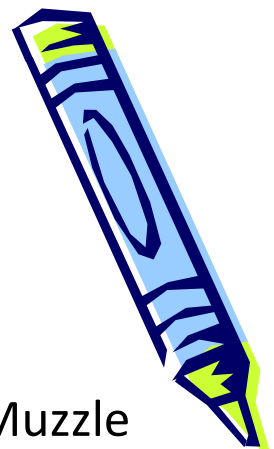
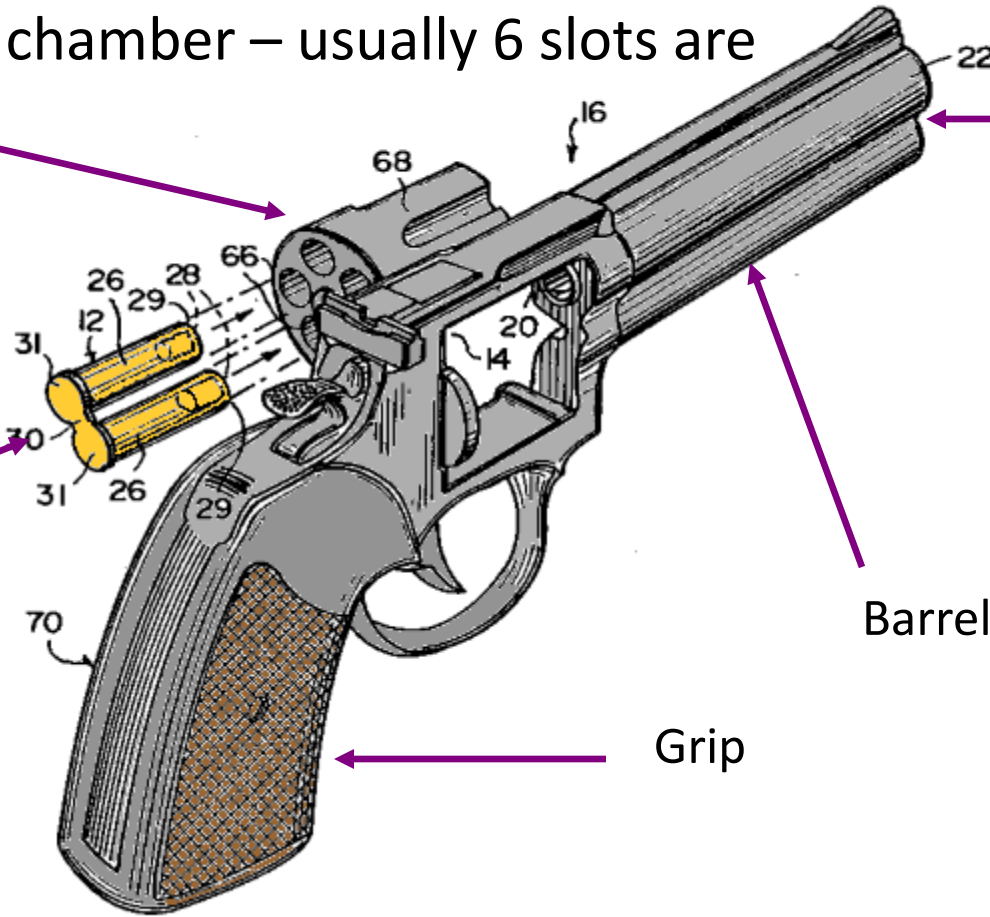
Revolving chamber – usually 6 slots are there

Muzzle

Cartridges

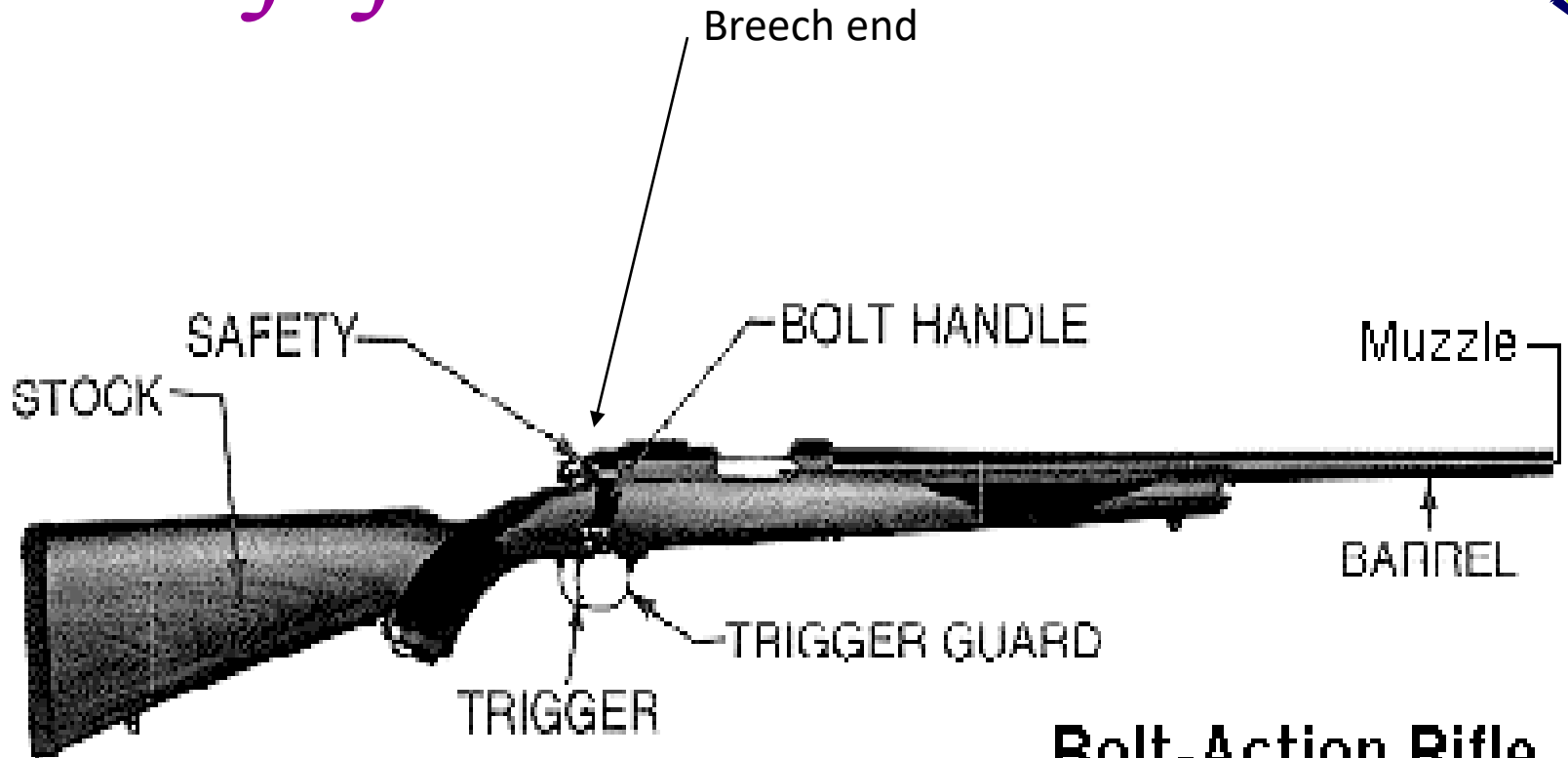
Barrel

Grip

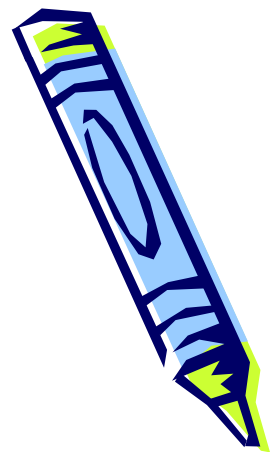


Shoulder Gun

Parts of a firearm

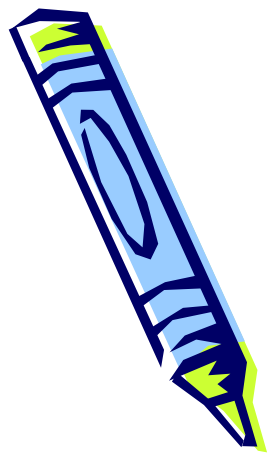
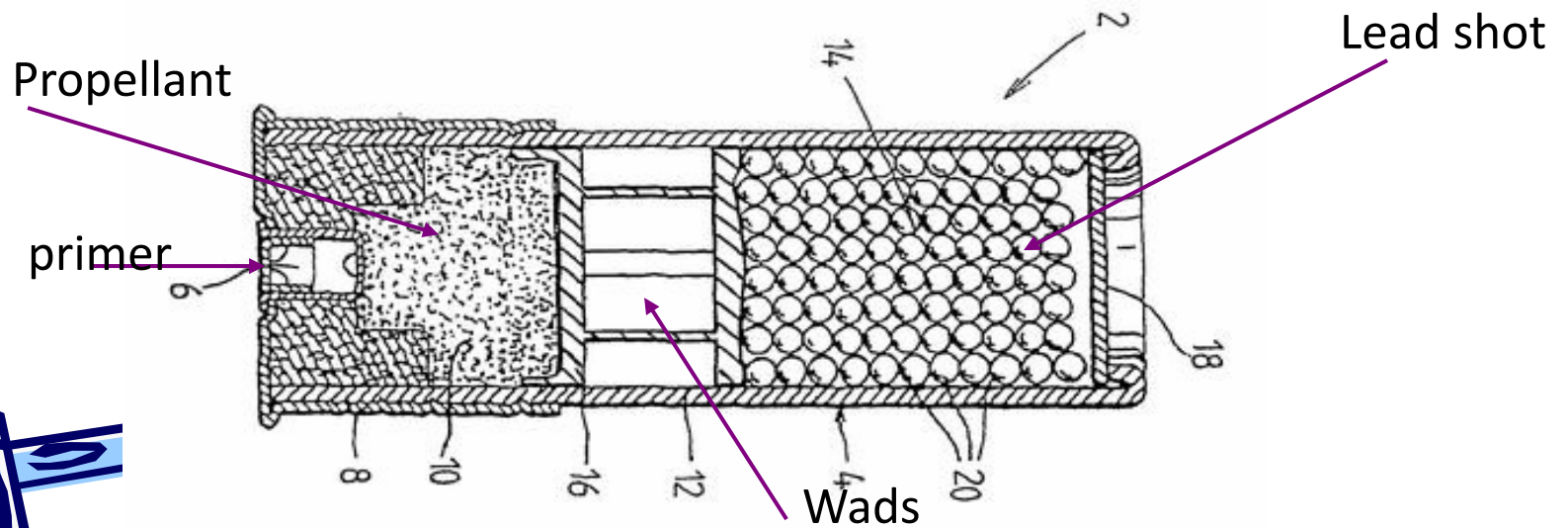


Bolt-Action Rifle

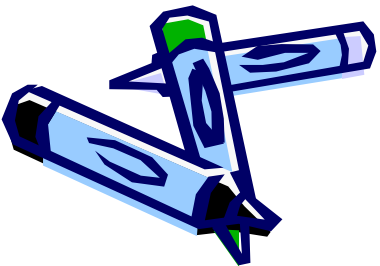


Smooth bore weapons

- *Inside of the barrel is smooth.*
- *Fire a cartridge which consists of propellant and a shot.*

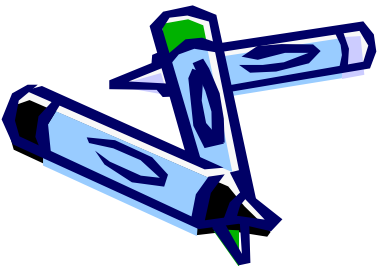


- *When the trigger is pulled hammer hits the primer cap,*
- *Which ignites the propellant,*
- *Explosive effect,*
- *Shot and wads are ejected.*

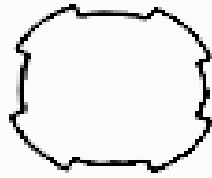


Rifle firearms;

- *Rifling inside the barrel – spiraling lands and grooves, right or left sided spirals.*
- *Size of the weapon is given by the term calibre.*
- *Calibre is the distance measured between two lands.*



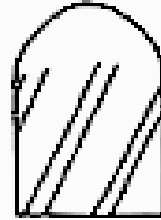
Calibre of a rifle firearm



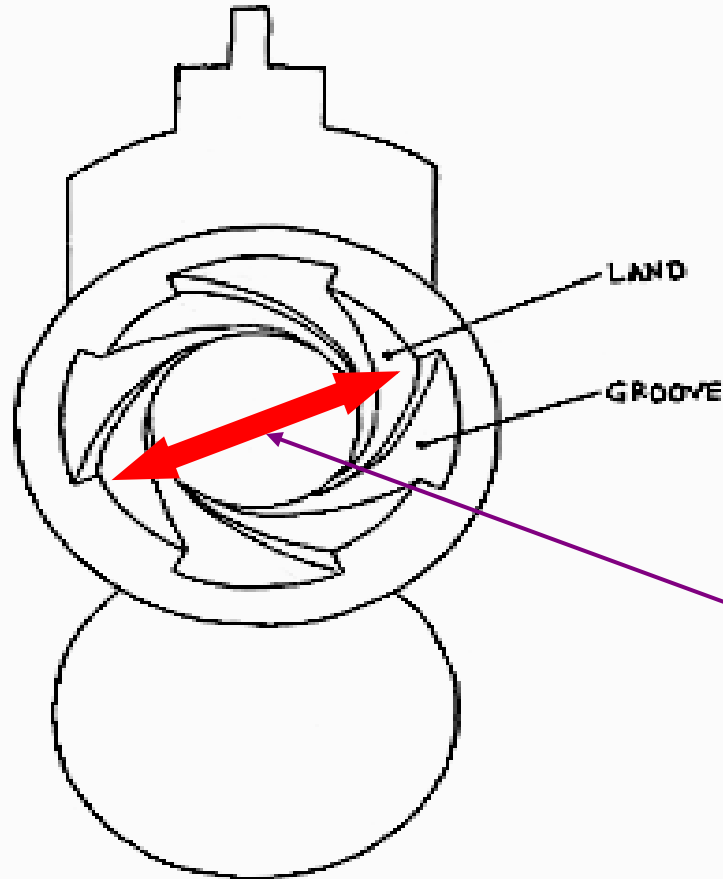
BASE OF BULLET



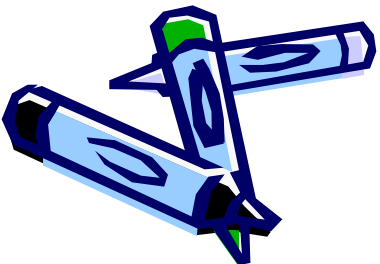
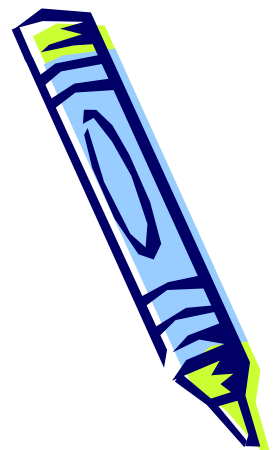
LEFT TWIST



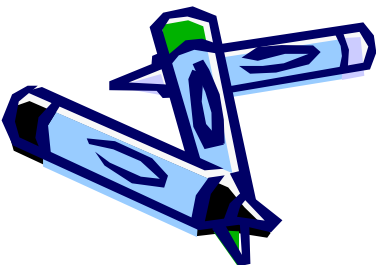
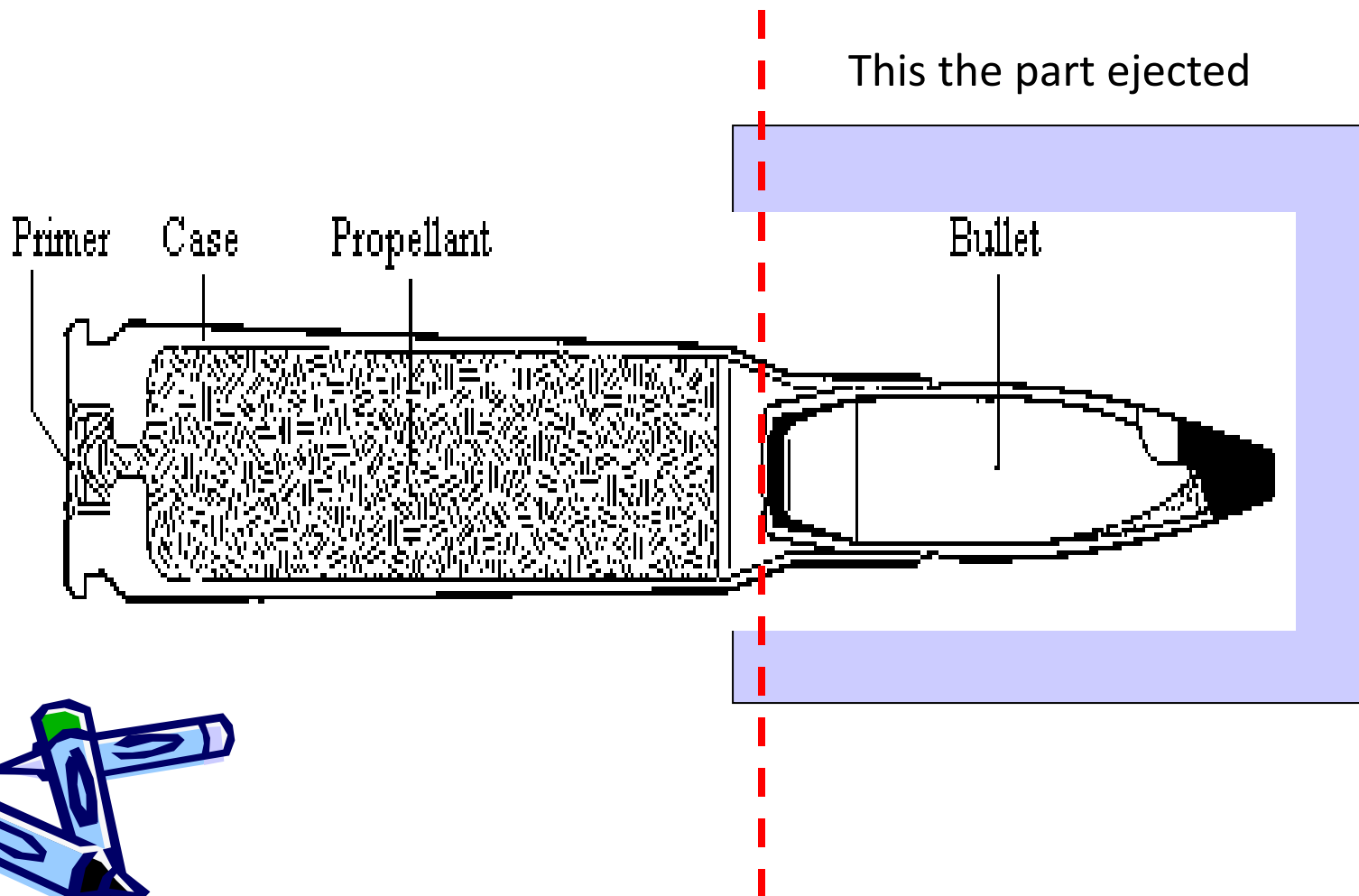
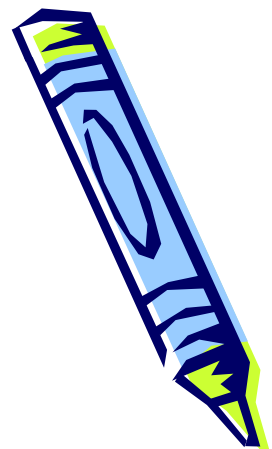
RIGHT TWIST



Calibre



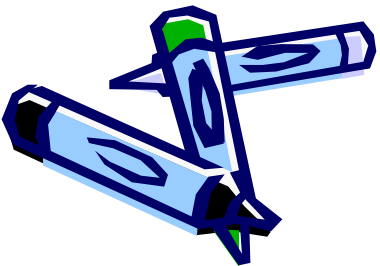
Fires a single projectile.



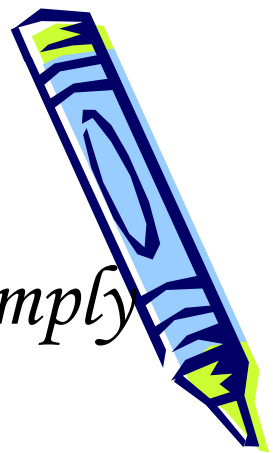
Ballistics



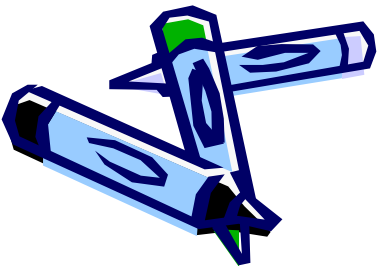
- *There are three areas of ballistics*
- *Internal ballistics, - within the barrel of the gun*
- *External ballistics, - from time of discharge until it reach the target.*
- *Terminal ballistics – movement within the target.*



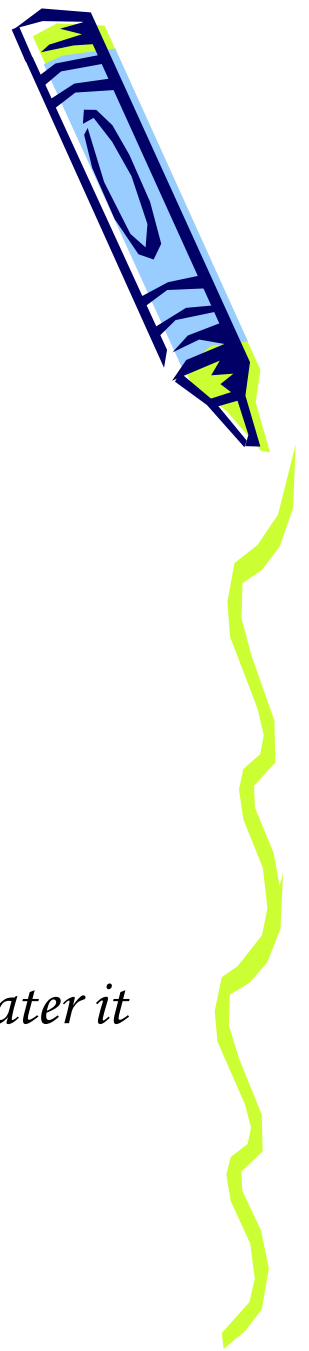
Internal ballistics



- *In the smooth bore weapon the shot simply traverse the length of the barrel.*
- *In the rifles the 'rifling' imparts a rotational movement to the bullet. – gyroscopic movement. Bullet spins around it's own axis.*
- *This stabilizes the bullet and make it more steady.*



External ballistics:

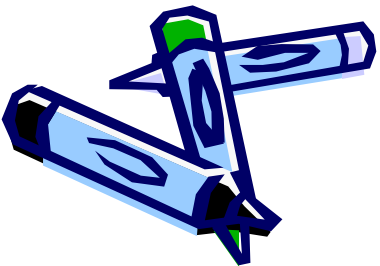


- *Shot guns*

- *Initially the shot stay together,*
- *As the energy is lost the 'shot' starts to separate,*
- *A cone shape spread of individual pellets,*

- *Rifles*

- *Due to the gyroscopic spin bullet travel for a greater distance,*
- *As it reaches the end of it's path it start to wobble. Later it tumbles along the trajectory.*

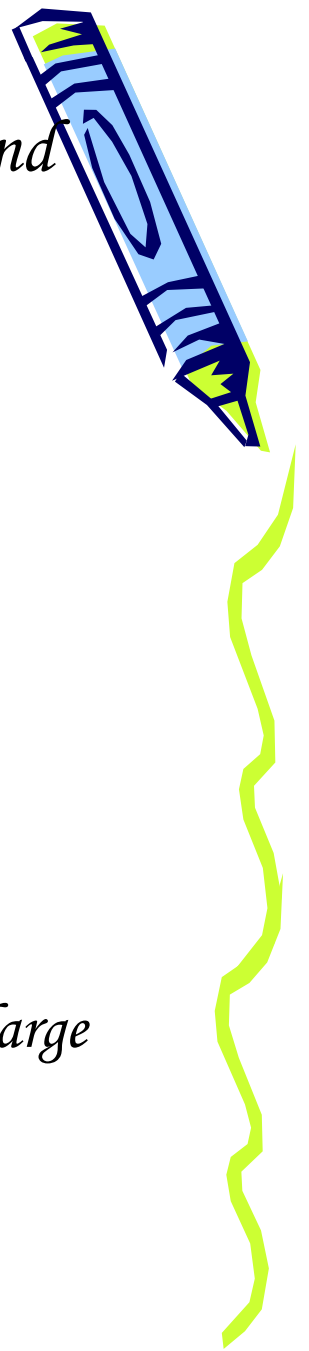


Terminal ballistics (Wound ballistics)

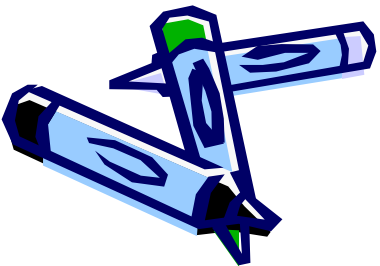


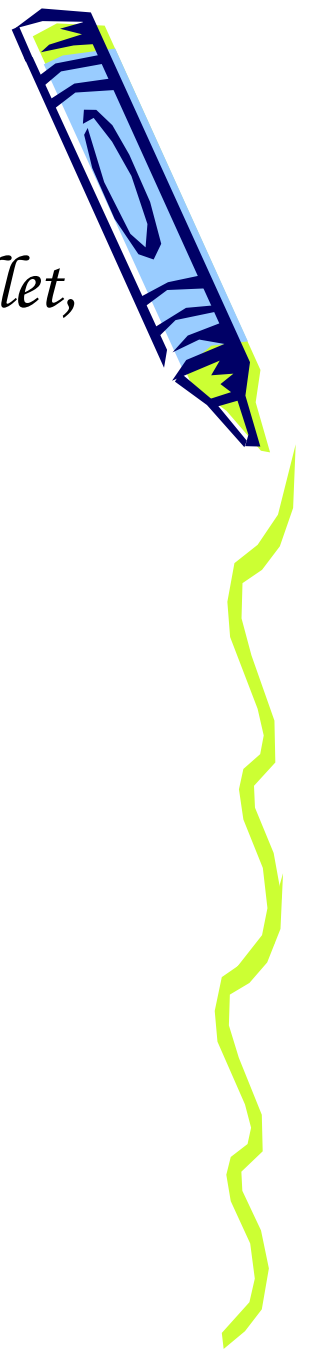
- *Everything depends on the kinetic energy bullet possesses.*
- *Determined by $K.E. = WV^2/2g$ or $MV^2/2$*
- *If the velocity is doubled the kinetic energy will be quadrupled.*
- *Amount of tissue destruction is proportionate to the amount of kinetic energy lost during the period it traverse the tissue.*



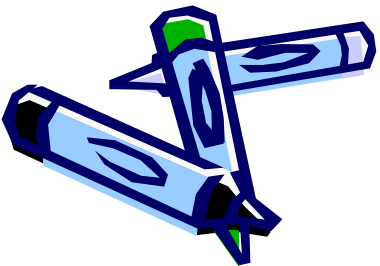


- *As the bullet traverse through the tissue it crushes and shred the tissue around.*
 - *Permanent cavity*
- *It also flings tissues outward*
 - *Temporary cavity-*
 - » *Lasts for 5-10 milliseconds.*
 - » *Up to 12 times the diameter of the bullet.*
 - » *Alternating positive and negative pressure.*
 - » *Size depend on the consistency of the tissue.*
 - » *If the bullet/pellet stops within the tissue a large amount of energy is lost to the tissue so the destruction is more.*



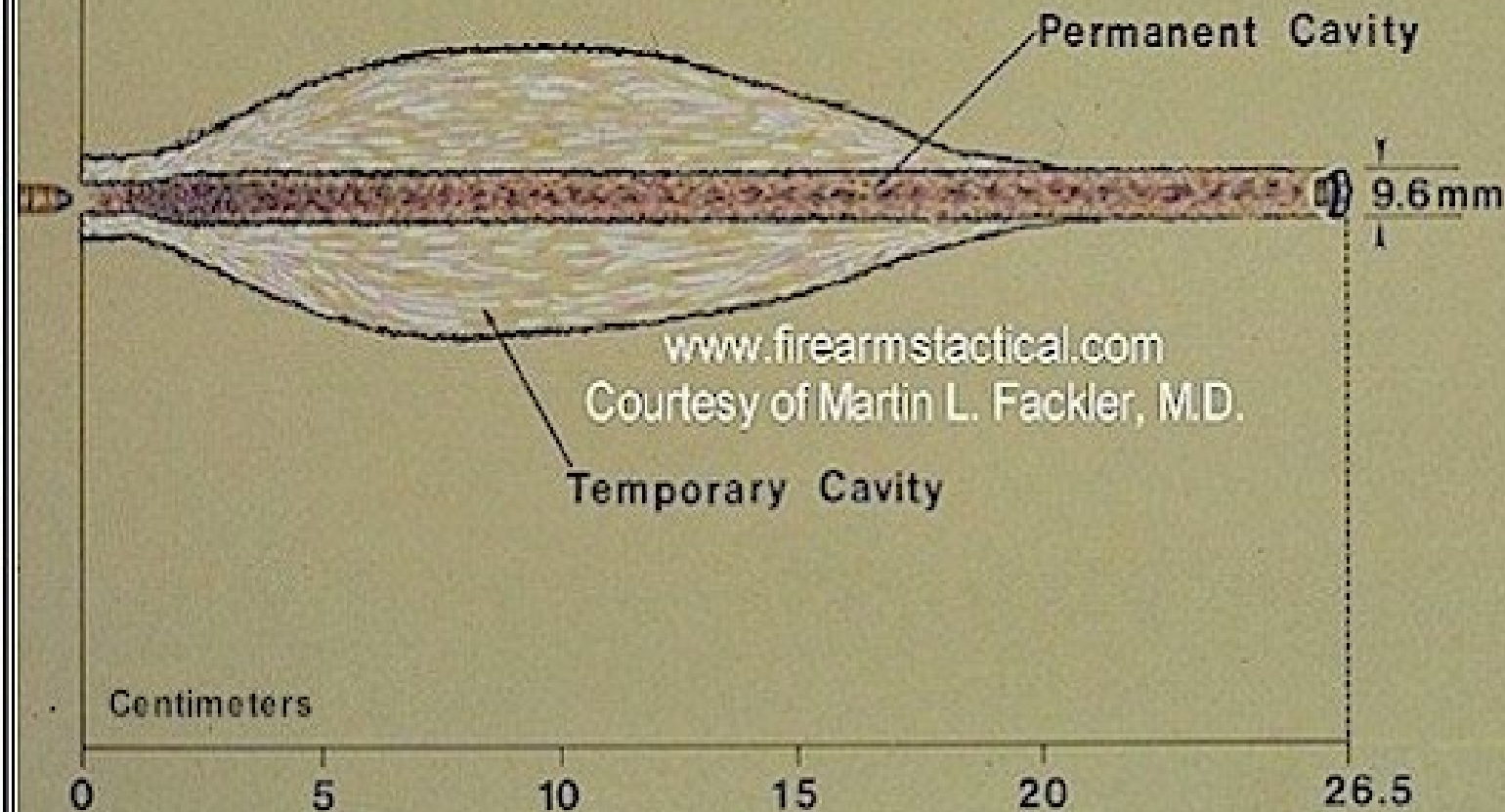


- *Loss of energy also depend on;*
 - *Amount of kinetic energy possessed by the bullet,*
 - *Angle of yaw,*
 - *Features of the bullet-*
 - » *Size of the bullet,*
 - » *Construction- jacket + or –*
 - » *Expanding bullets,*
 - » *Soft nose bullets,*
 - » *Hollow point bullets,*

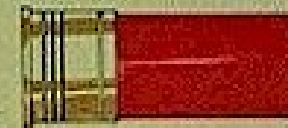




.22 Long Rifle (5.56mm) HP
Vel - 1272 f/s (388 m/s)
Wt. - 37 gr (2.4 gm) lead



www.firearmstactical.com
Courtesy of Martin L. Fackler, M.D.



12 Gauge Shotgun
Rifled slug 17.6 mm diam.
Vel-1513 f/s 461 m/s.
Wt. 437 gr 28.3 gm

Permanent Cavity

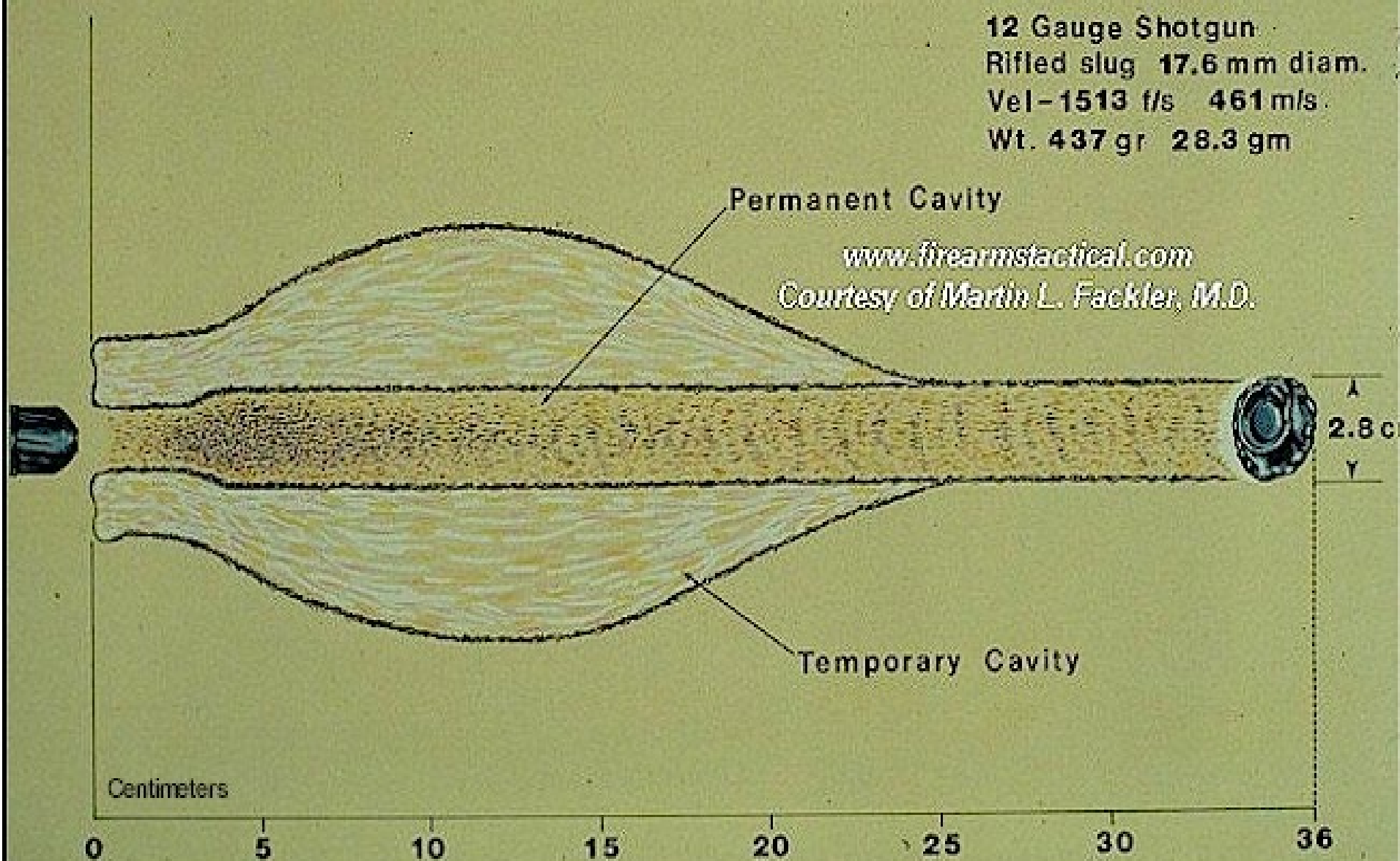
www.firearmstactical.com
Courtesy of Martin L. Fackler, M.D.

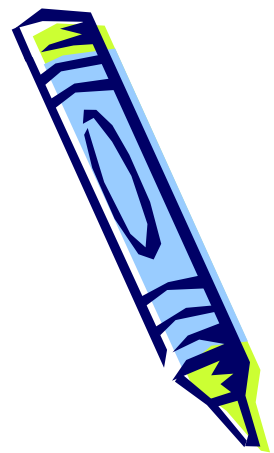
Temporary Cavity

A
2.8 c
Y

Centimeters

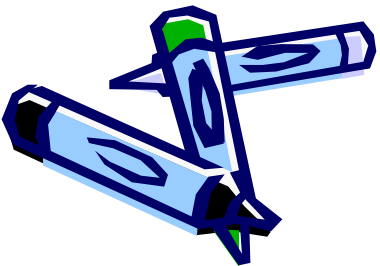
0 5 10 15 20 25 30 36





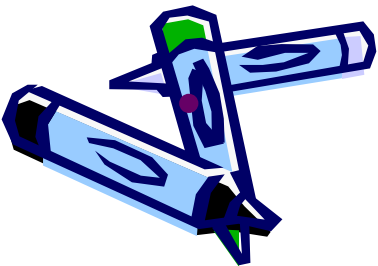
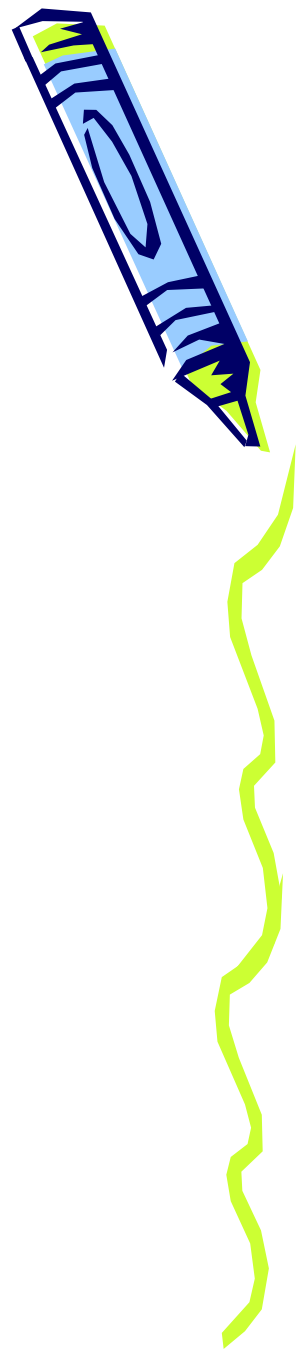
Classification of Gunshot Wounds:

- *Entrance and Exit wounds.*
- *Contact, Near-contact, close range, intermediate and distant range wounds.*
- *Rifle firearm and smooth bore weapon injuries.*



Features of Entrance Wounds - General

- *Inverted margins*
- *Abraded margins ('abrasion collar') – usually not in shotgun wounds*
- *Dirt ring or bullet wipe*
- *Fibres may be found in the wound*
- *Smaller defect than the diameter of the bullet*
- *Burning, Blackening, Tattooing*
- *Internal beveling,*
- *Muzzle imprint*
- *High CO amount*

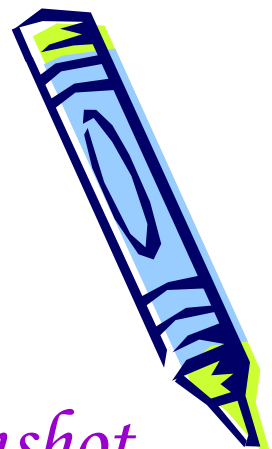


General Features of Exit Wounds

- *Usually everted*
- *No abrasion collars (unless 'shored')*
- *a larger wound than the entrance wound,*
- *bony fragments being forced out through the skin*

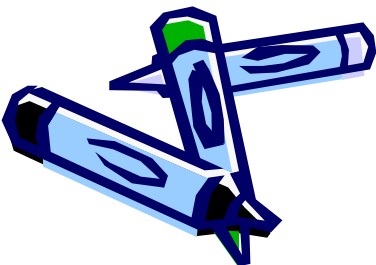


When a suspected case of gunshot injuries is found;

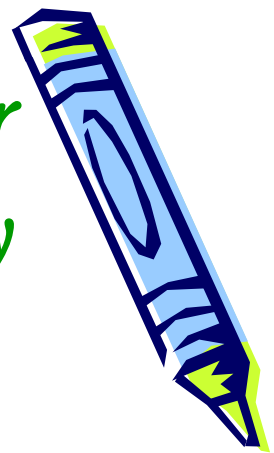


- *Firstly try to determine whether they are gunshot injuries,*
- *If they are then try to distinguish entrance wounds from exit wounds.*

This will give you the 'baseline' to investigate further.



When you find circular perforating/penetrating wound in a body what are the possibilities

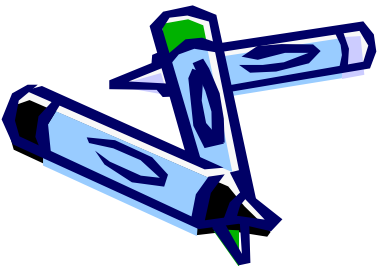
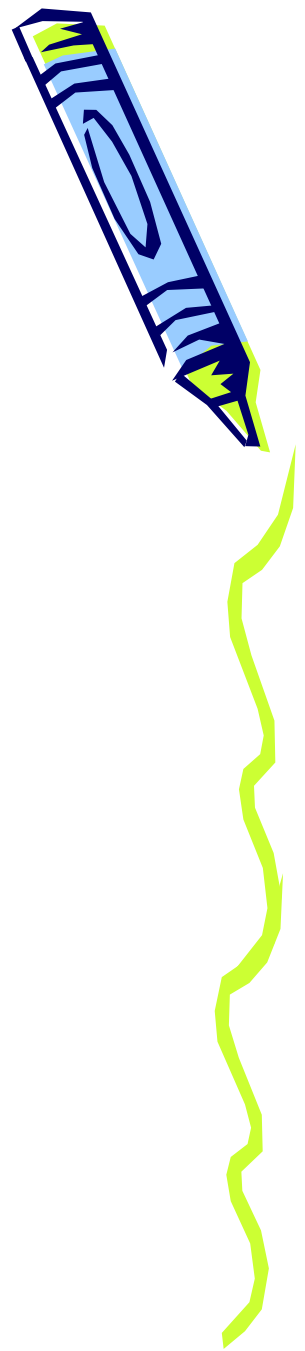


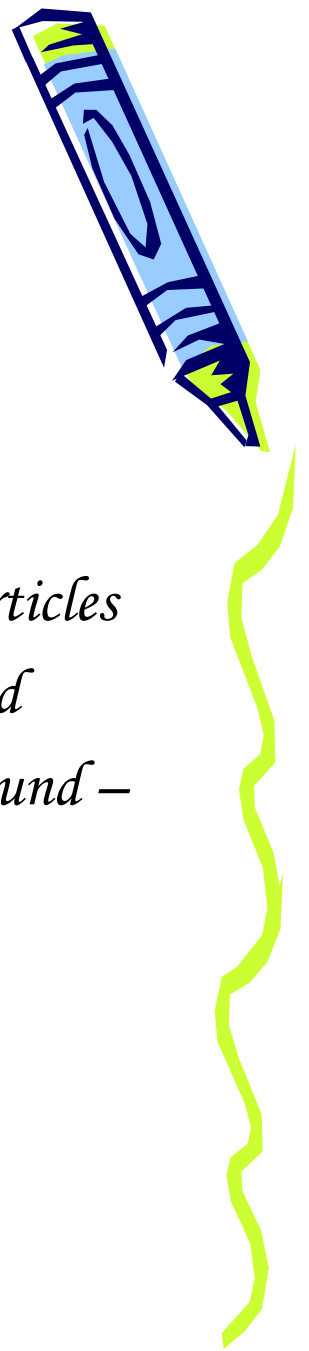
- Stabs by a weapon with a circular cross section – uncommon*
- Considering the incidence gunshot injury is much commoner.*
- Then look for other characteristic features of firearm injuries, which are due to.....*



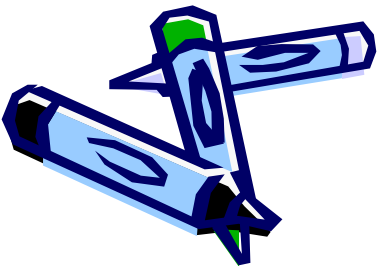
When a gun is fired

- *A jet of flame up to 6",*
- *A cloud of gas,*
- *Burning and unburnt grains of gunpowder,*
- *Soot,*
- *Vaporized metal from bullet*



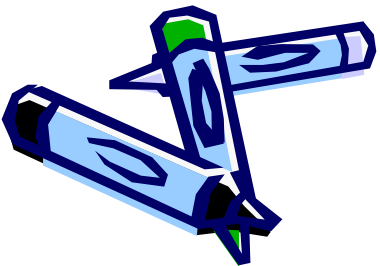
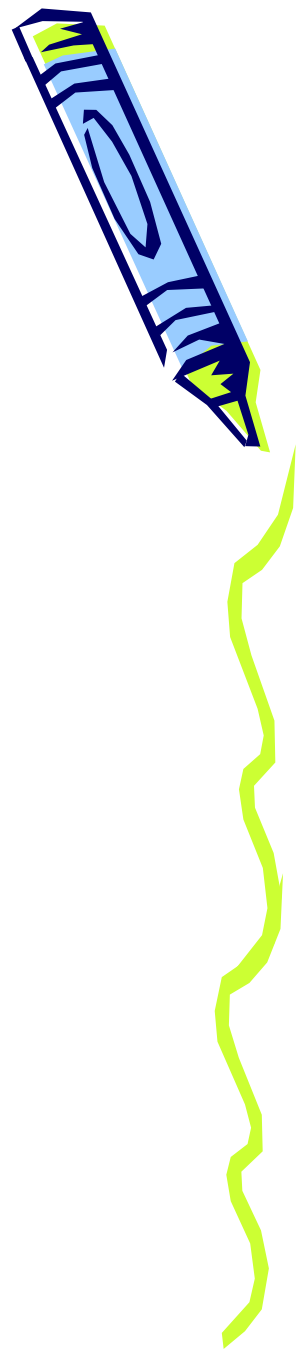


- *Burning, blackening and tattooing.*
 - *Burning – due to flame*
 - *Blackening – due to deposition of partly or burnt gunpowder.*
 - *Tattooing – small abrasions caused by gunpowder particles*
 - *If one or more of BBT is present it is a gunshot wound*
 - *However absence of BBT doesn't exclude gunshot wound – distant shot, intermediate object.*
 - *Abrasion collar – in bullet injury*

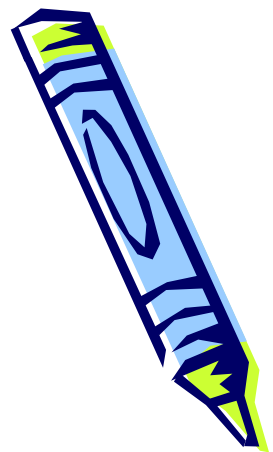


Range of fire;

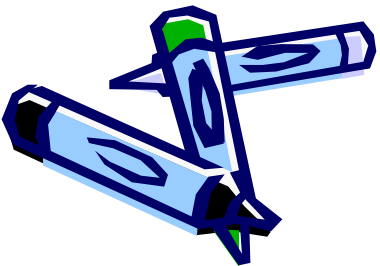
- *Contact –*
- *Near contact –*
- *Close –*
- *Intermediate range,*
- *Distant wounds*



Contact range:

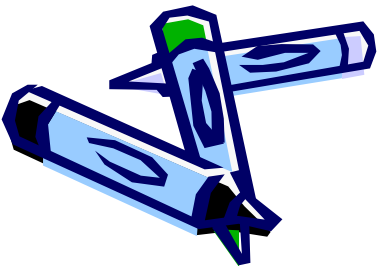
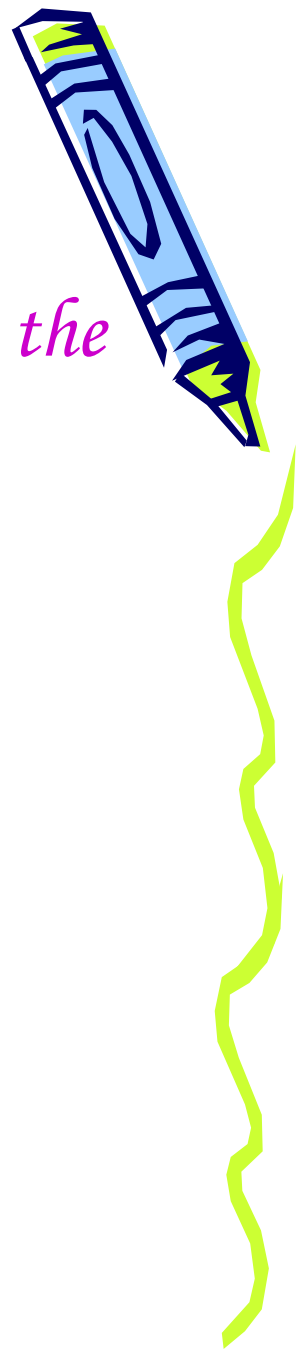


- *Hard or loose contact.*
- *In 'hard'*
 - *all the material exiting the gun goes beneath the skin.*
 - *Seared blackened margin.*
 - *Circular perforating injury.*
 - *Gas going in to the tissue causes bulging of tissue.*
 - *Muzzle imprint*
 - *Over head it might be of stellate shape.*
 - *Back spatter on to the gun./ or even on to hand or arm.*



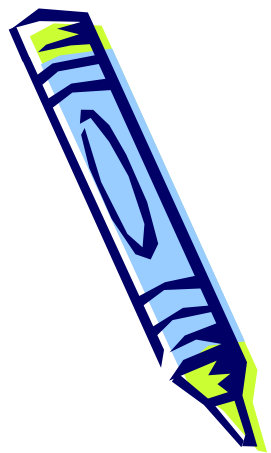
In loose contact;

- *Muzzle is in contact with the skin but due to the recoiling effect it moves away from the skin.*
- *Muzzle imprint may not be there.*
- *Soot deposition around the entrance.*



Near contact & close range

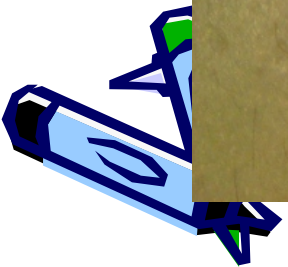
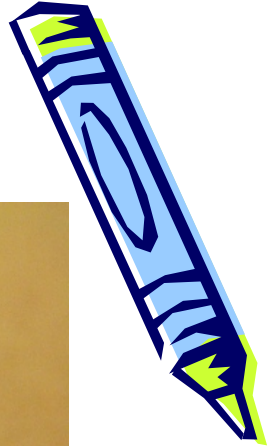
- *Near contact is almost in contact - < 10mm.*
- *BBT around the wound.*
- *Seared margin.*
- *Examination of the clothes may reveal these in some cases.*



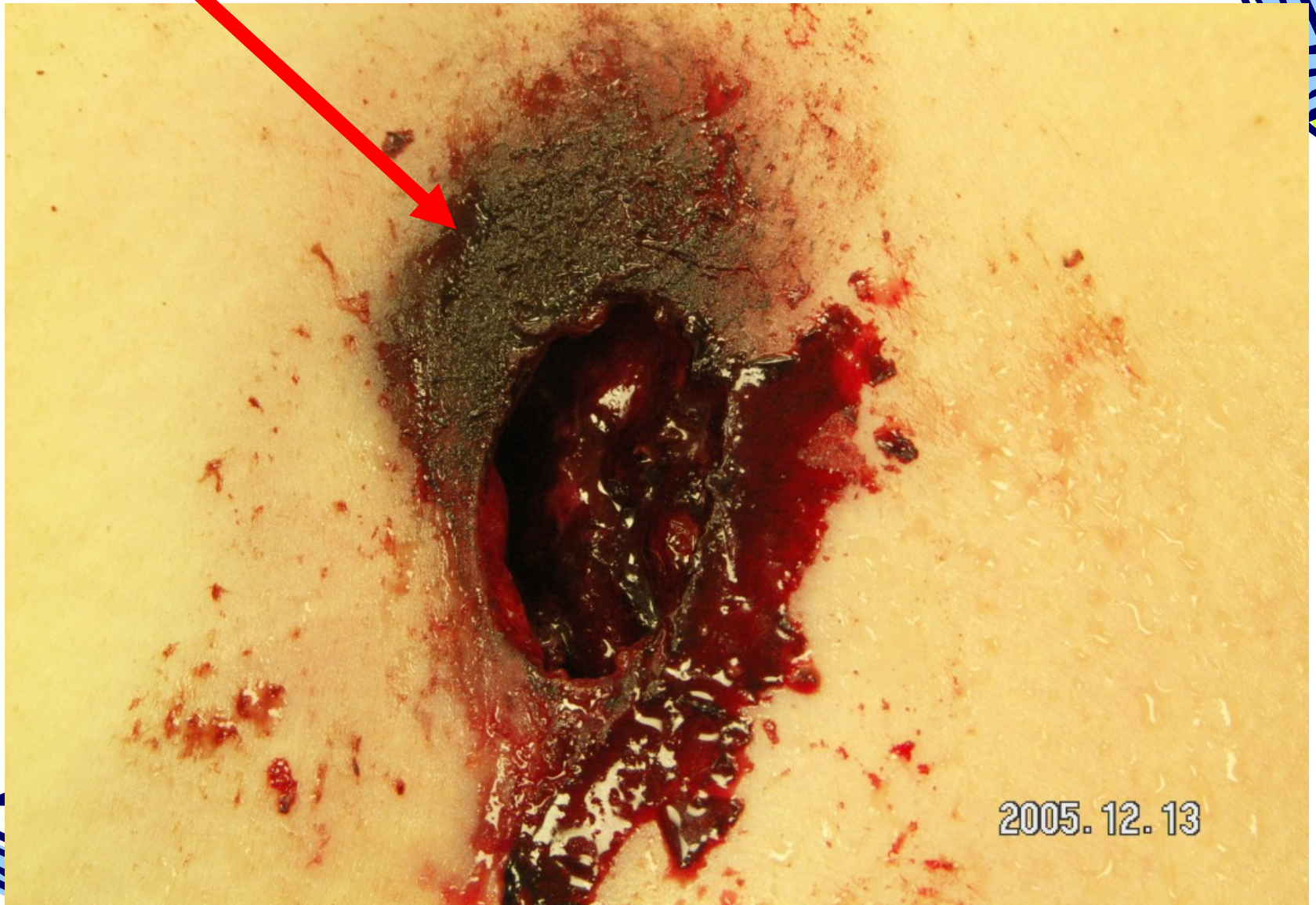
Seared margins;



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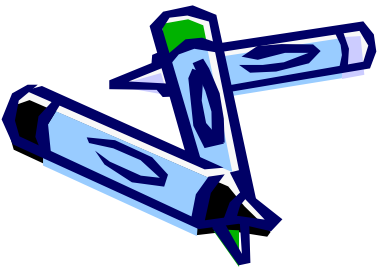


Blackening;

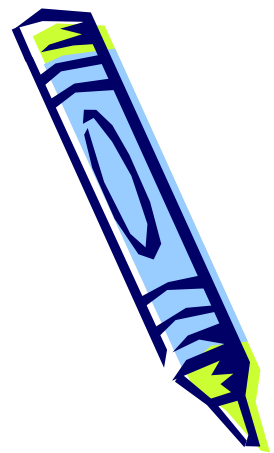


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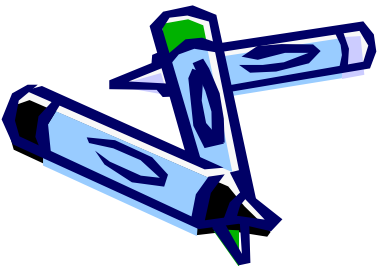
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Intermediate range;

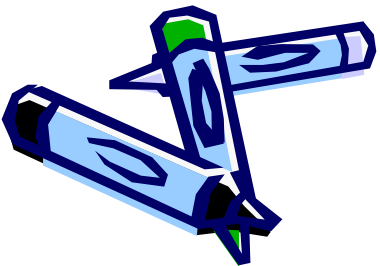
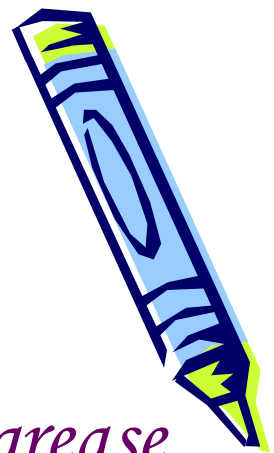


- *No burning is seen.*
- *Blackening and tattooing both or only tattooing is seen.*
- *In the absence of these features clothes should be examined for these features.*



Distant shot;

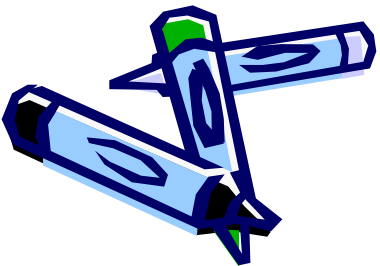
- *All BBT absent.*
- *In rifle firearm wounds abrasion collar and grease ring present.*
- *Smooth bore weapons there will be multiple wounds due to 'lead shot'. Exact number depend on the type of the bullet. (some lead balls might miss the target.)*



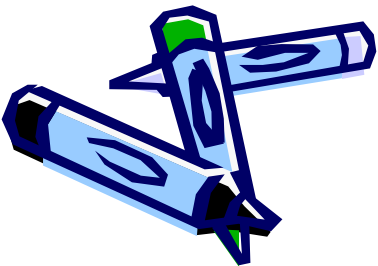
*Do the features differ according to the type of the gun? Rifle or smooth bore
yes.....*



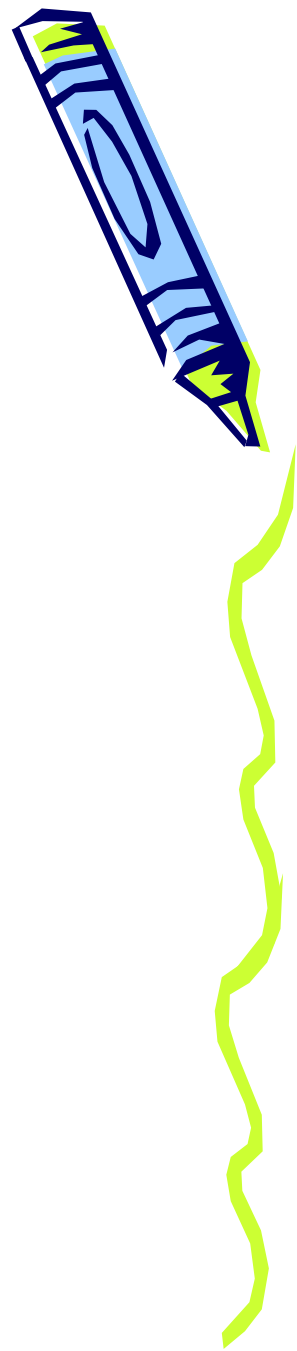
- Smooth bore weapon cause larger wounds than rifles.*
- BBT effect is more pronounced in smoothbore weapons.*
- In smoothbore guns up to close – intermediate range wads might cause additional injuries.*



- *In smoothbore weapons shape and features of the wound varies.*
- *It becomes progressively larger, irregular and then break-up in to smaller wounds as pellets separate.*
- *Single hole.....rat hole wound (Scalloped edges)----
--satellite wound----separation of pellets further ---
-----complete separation.....*



Special situations – rifle firearms and bullets



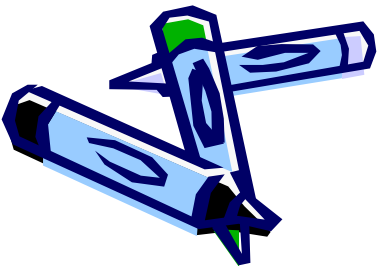
- *Ricochet bullets.*
- *Bone injuries.*
- *Bullet wipe.*
- *Back spatter.*
- *Scalp wounds.*
- *Intermediate objects.*

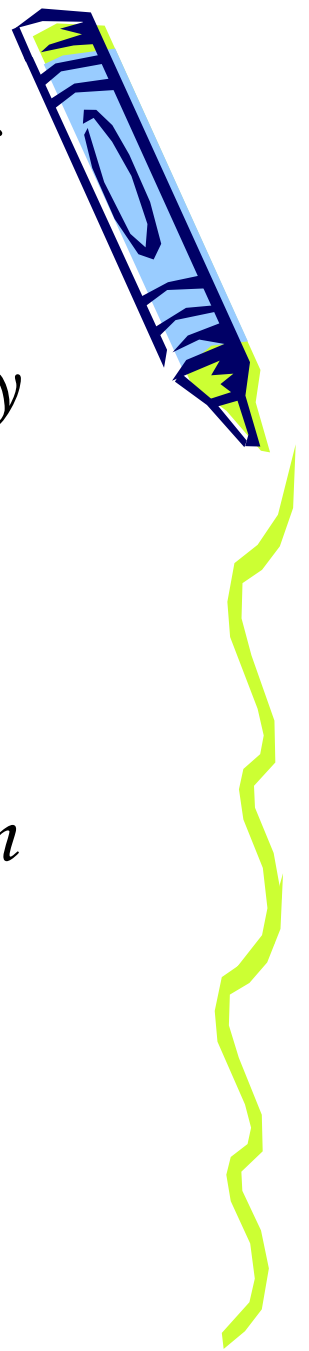


Ricochet bullets;

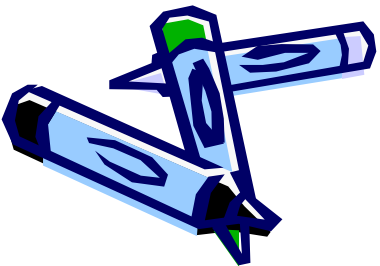


- *Depending on the type/shape of the bullet and striking surface.*
- *Bullet striking a hard surface usually bone it reflects off it and change the trajectory.*
- *Ricocheting could occur outside or inside the target.*
- *Bullet tumbles and might hit the target or exit in sideways.- makes irregular entry wounds and larger exit wounds.*



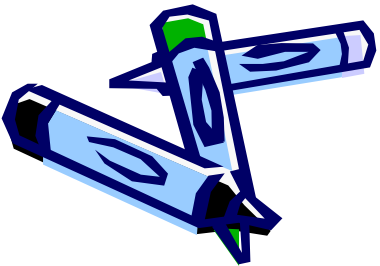


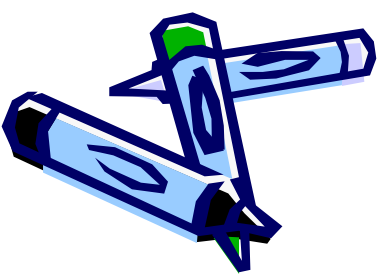
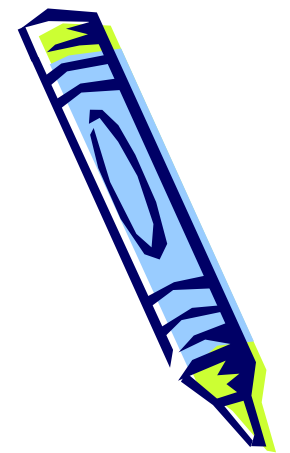
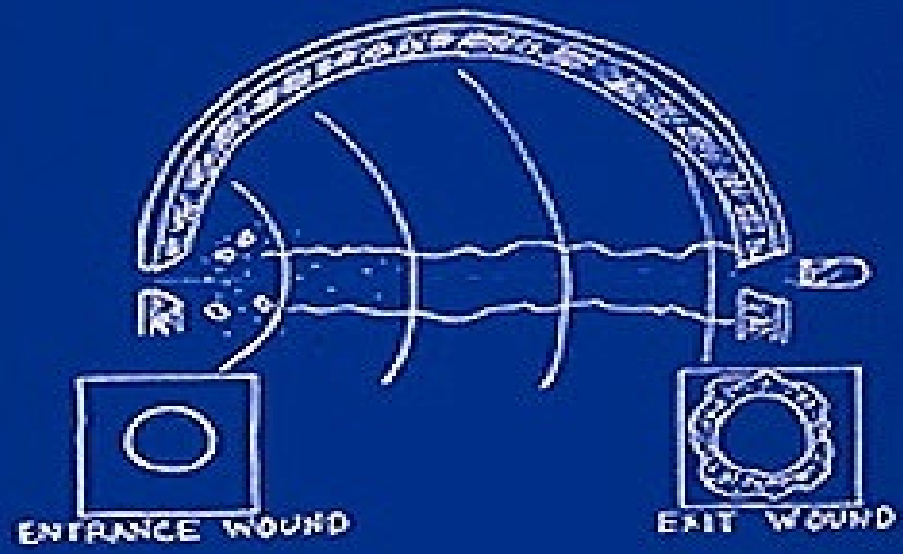
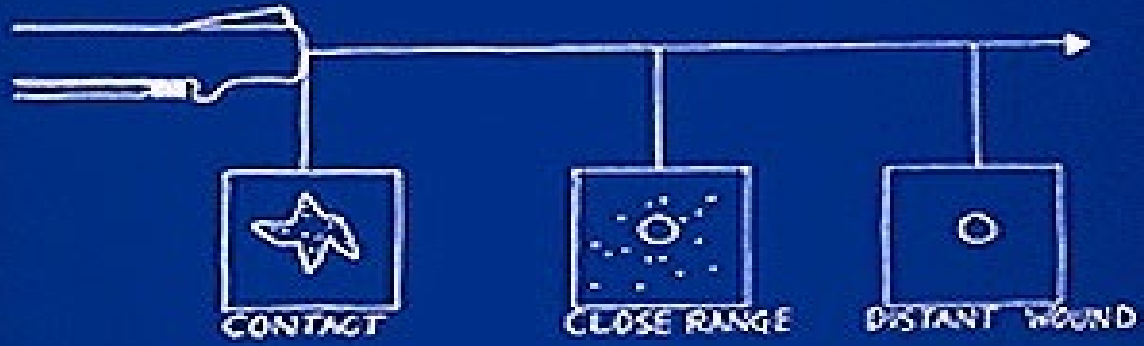
- *In the skull ricochet will cause specific effects*
- *Bullet might reflect and exit through the entry again.*
- *Or change the direction.*
- *Sometimes bone might break off. This might complicate the matters since bone particles can exit resulting in multiple exits.*



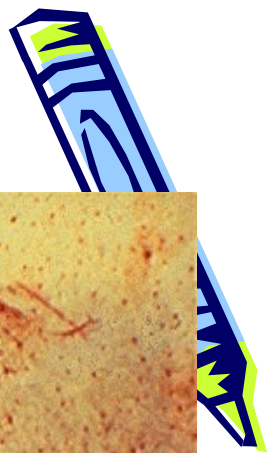
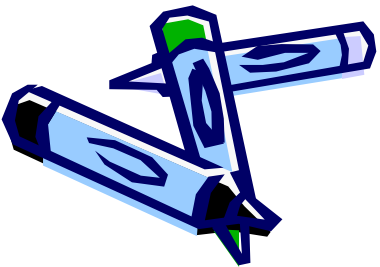
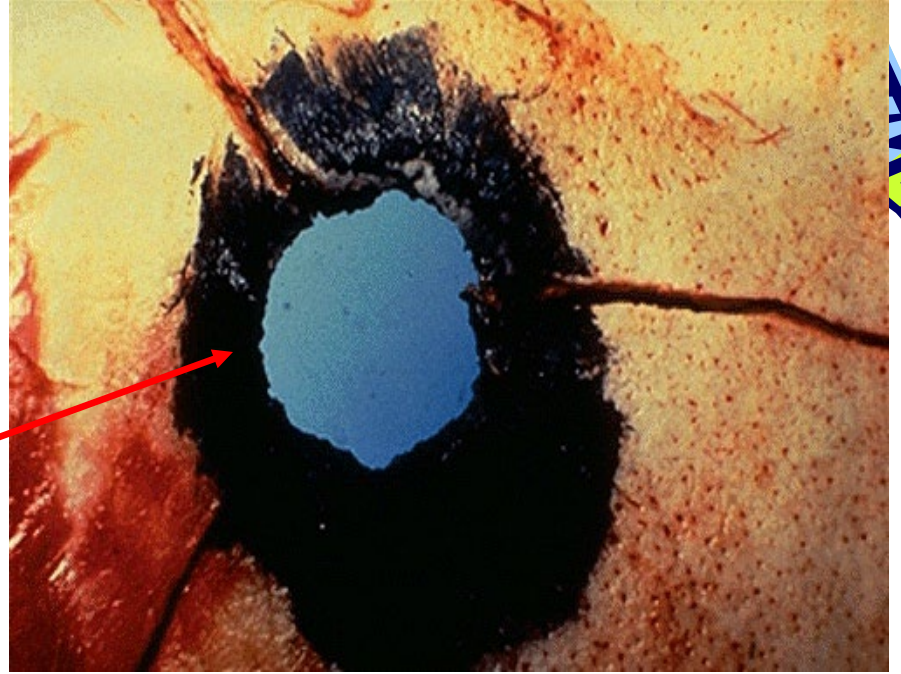
Bevelling:

- *A phenomena seen in 'thick' bones.*
- *As the bullet traverse the thickness it causes a cone shape bone loss. Base of the cone towards the direction of the bullet.*





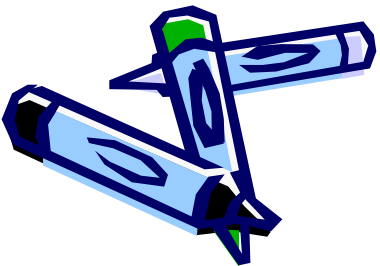
Bevelling



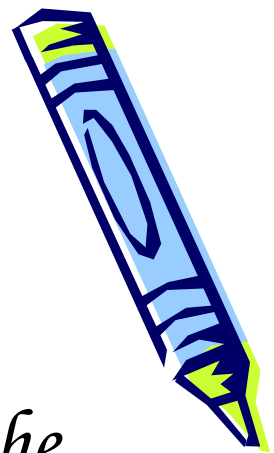
Therefore:



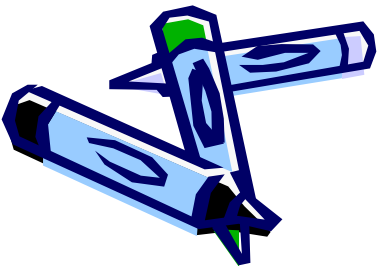
- *Internal/inner bevelling – on the inner table of the skull – due bullet travelling in – entry wound of the skull.*
- *External/outer bevelling - on the outer table of the skull – bullet travelling out – exit wound of the skull.*



Bullet wipe

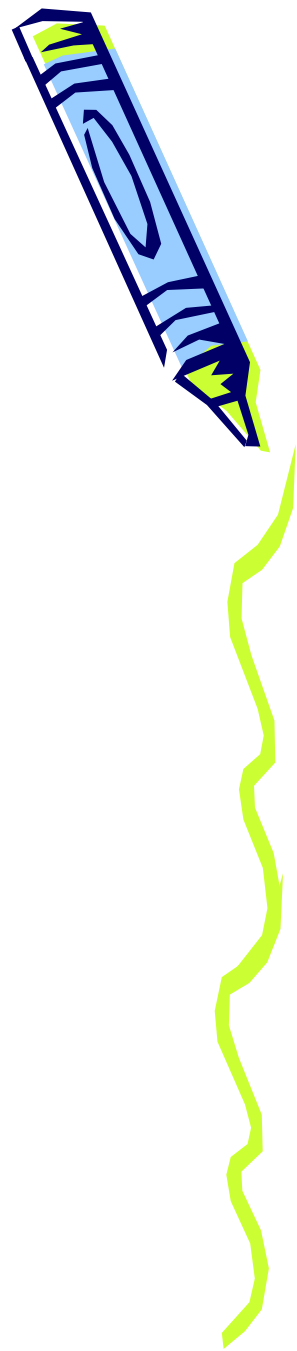


- *Material is deposited along its path through the barrel.*
- *Grease, oil & others etc....is wiped on the tissue.*
- *Edge of the entry retains this.*



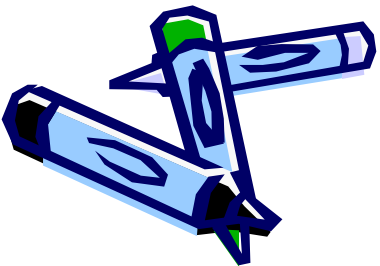
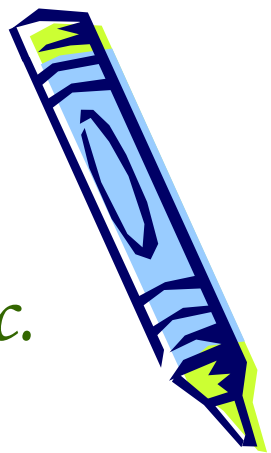
Back spatter;

- *Ejection of blood and tissue from the entry.*
- *Might deposit on the barrel or hand.*
- *Important in determining the circumstances;*
 - *Own hand in suicides,*
 - *Assailant's hand in homicides.*
 - *Important in tracing the weapon.*



Intermediate objects;

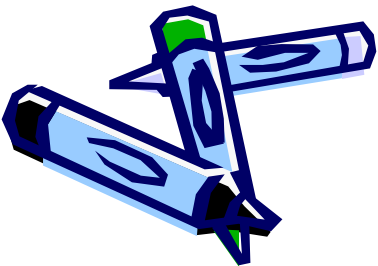
- *Shot through glass, wooden objects, clothes etc.*

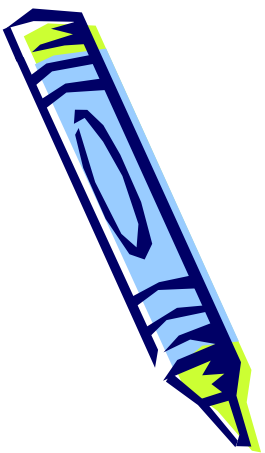


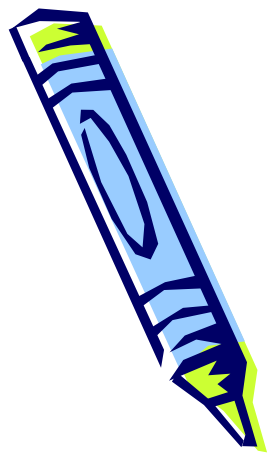
Atypical gunshot wounds



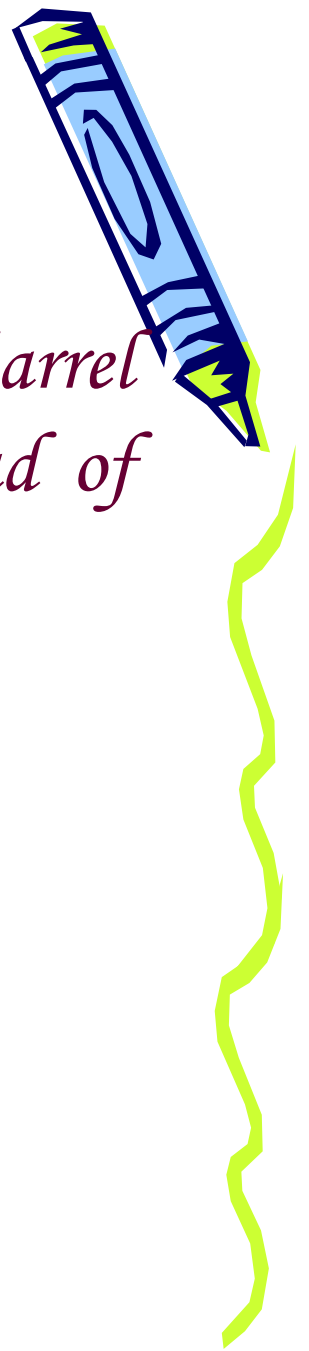
- *Stellate shape entry over bone – in contact wounds- due to gas expanding under the scalp.*
- *Irregular shape entry – bullet striking sideways.*
- *Shored exit – abrasion around the exit, skin striking a hard surface at the exit site, e.g. victim lying against a wall, exit and re-entry at chest and arm etc..*
- *Re-entry wounds – no abrasion collar, no BBT, large wound etc....*



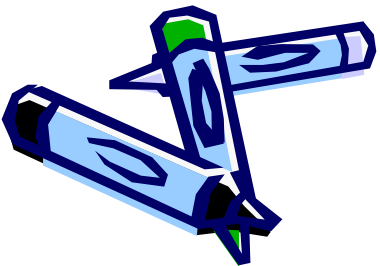




Smooth bore weapon – special situations;

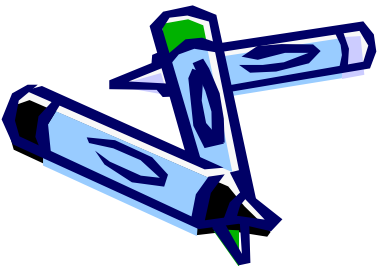


- *Choking of the barrel – narrowing of the barrel towards the muzzle. This reduces the spread of the pellets and hence increases the accuracy.*
 - *Full choke – whole length*
 - *Half choke – latter half*
 - *Quarter choke – latter quarter*
 - *End choke – only the muzzle end.*



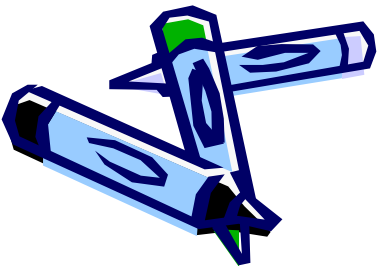
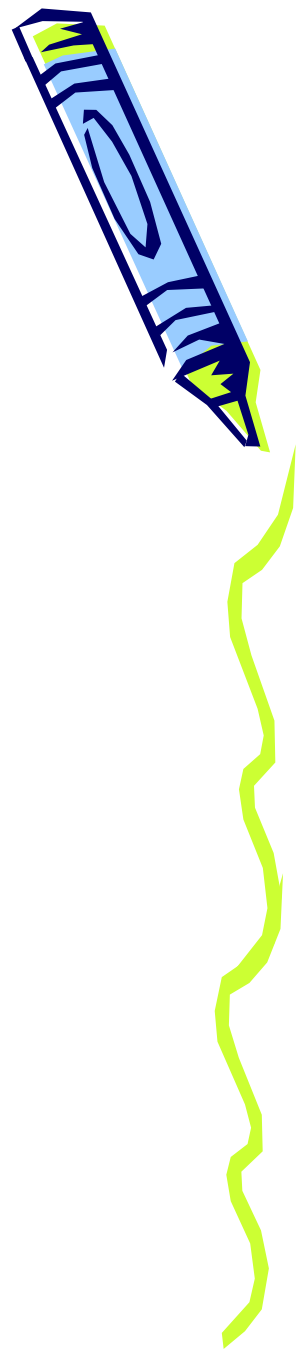


- *Sewn off shot guns – barrel is cut to reduce the length, easy to conceal. But spread is more and sure to hit in homicidal efforts.*
- *Home made guns- ‘Gal katus’ – crude, use usually shot gun cartridge or sometimes muzzle loading, rarely bullets. BBT is more pronounced.*

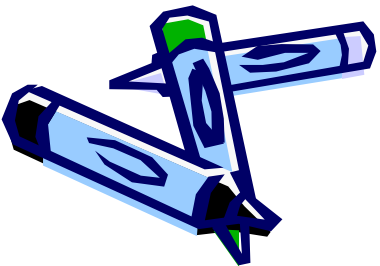
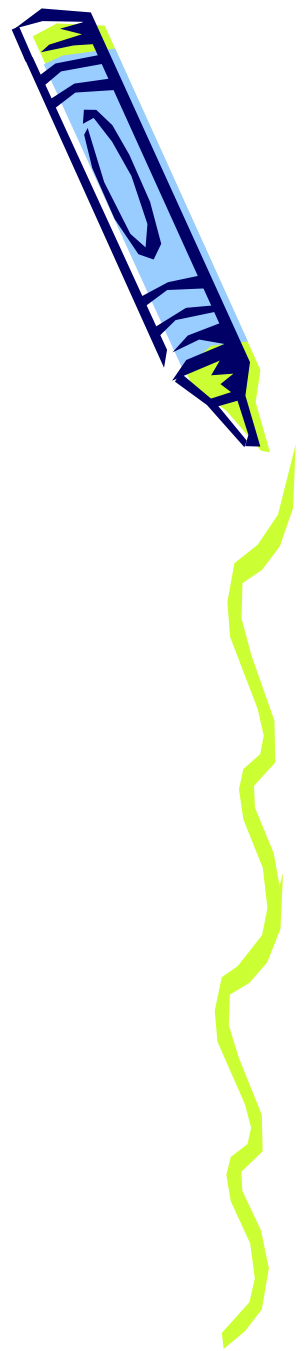


Investigating a firearm injury – clinical/autopsy

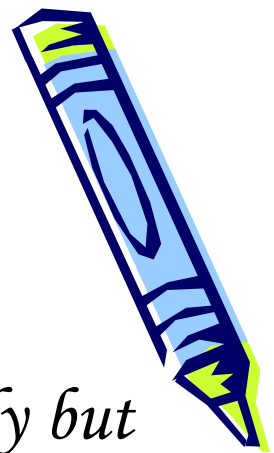
- *Scene visit whenever possible.*
- *Detail history.*
- *Determine the number of shots.*
- *Differentiate entry and exit wounds.*
- *Determine the range of fire.*
- *Determine the direction of fire.*
- *Determine the manner of death.*
- *Determine the cause of death and mechanism.*



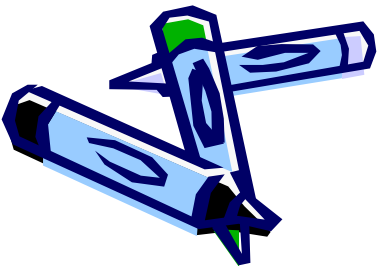
- *Identifying the weapon and assailant.*
- *Interpreting atypical wounds or findings.*



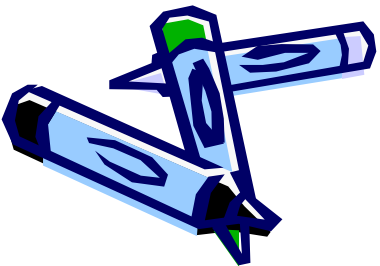
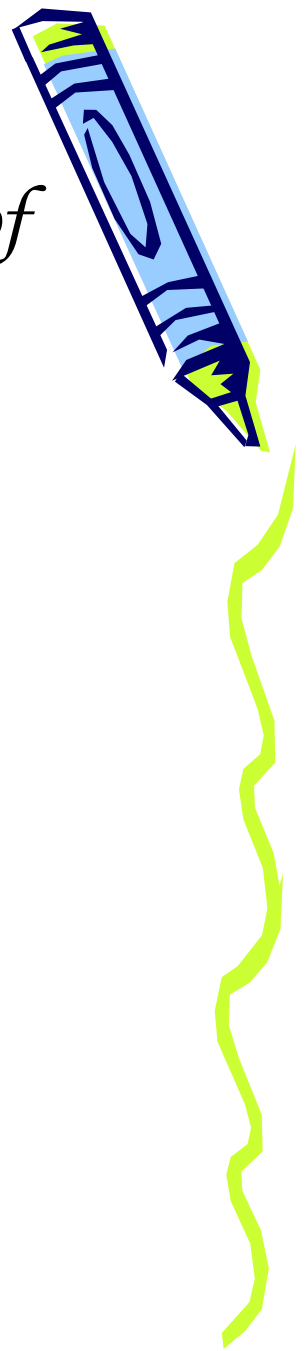
Circumstances of Death



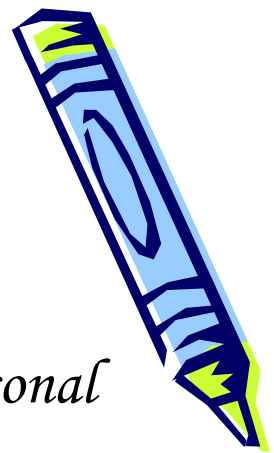
- *Accidental, Homicidal or Suicidal.*
- *Accidental wounds could occur anywhere in the body but usually single. Unless the weapon is an automatic one like T56 in burst mode.*
- *Suicidal wound are also usually single, in accessible sites. Weapon is held in hand in cadaveric spasm or found near by.*
- *On some occasions if victim has uses a special mechanism to fire the weapon you might find wounds atypical of a suicide.*



- *Look for other associated injuries suggestive of violence before determining the manner.*



Autopsy procedure



- *Scene visit.*
- *Detail external examination- including clothes and other personal items.*
- *BBT might have been retained in clothing.*
- *Blood drip marks to determine the posture of the victim at or after the incident.*
- *Gunshot residue from hands – police has to do.*
- *X-ray in all cases – pre-hand knowledge about a presence of a projectile in the body. Get AP and Lat. Views to determine the location of the bullet.- easy for removal.*
- *Do not touch the bullets or pellets with metallic instruments.*
- *Use fingers- otherwise it will damage it and make it difficult to compare and analyze them.*

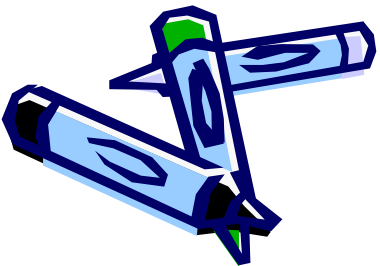




Autopsy procedure contd.



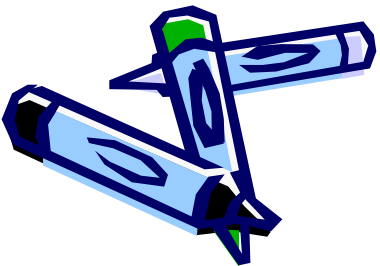
- *Photographs and diagrams before starting the dissection.*
- *Description of injuries – external should be in details and very specific.*
- *Always try to find the corresponding exit for a particular entry.*
- *On internal dissection try to trace the trajectory of the missile.*
- *Send all garments to Gov. Analyst when necessary.*
- *Hand over recovered bullets to the Police.*



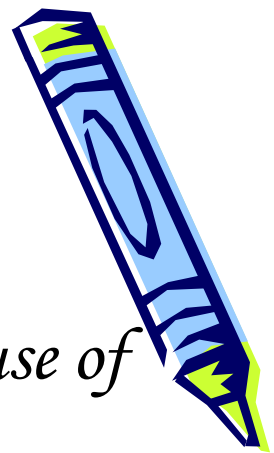
Autopsy procedure contd.



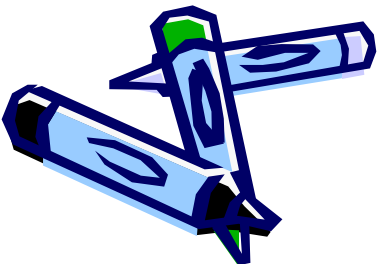
- *Careful dissection – step by step, documentation of each step and photographs.*
- *Always try to find the lodged bullets/pellets*
- *Try to determine the possibility of volitional activity.*



Writing cause of death



- *Write the most apparent injury as the immediate cause of death;*
 - *Cerebral laceration,*
 - *Laceration of the heart etc.*
- *Underlying cause is firearm injury/gunshot injury etc..*
 - *You may choose the proper term according to the case.*
 - *Firearm injury might imply other types of injuries caused by firearms.*
 - *Do not comment much about the type of fire arm.*
 - *If you find a bullet inside better mentioned as bullet injury rather than saying rifle firearm because home made shotguns might use bullets.*



Injuries due to explosions



AP Photo

Objectives

- *Basic understanding about different types of explosions.*
- *To know the different kinds of injuries resulting from blasts.*
- *Scene investigation of bomb blasts.*
- *Determining the range of blast effects.*
- *How to investigate a case of blast injury/death.*
- *Identify the problem faced during investigation of a case of blast injury/death.*

What is an explosion/blast

- *Exothermic chemical reactions that release their energy in a very short time interval.*
- *There are three primary fields of application for these effects: propellants, explosives and pyrotechnics.*
- *Propellants create a high gas pressure for driving projectiles.*
- *Creates a heat wave and flame spreading outward radially from the centre of blast.*

What are the instances where explosions occur?

- *High explosive used – bombs of different types.*
- *Mechanical explosions – in factories, gas, oxygen cylinders.*
- *Commonly occur as a terrorist acts.*
- *Small bombs used in rivalries between opposing parties.*
- *Suicide bombing – strapping the bomb to the body*
 - *e.g. killing of president Premadasa, Rajiv Gandhi*

Blast

- *Blast or pressure wave spreading out.*
- *Heat wave spreading out.*
- *Flame spreading from the centre.*
- *Flying missile originating from the bomb itself or surrounding objects.*
- *Collapsing of surrounding structures.*

Injuries occur as a result of all these effects.

- *Severity of the injuries depend on;*
 - *Size of the explosion/bomb.*
 - *Proximity of an individual to the epicentre of the explosion.*
 - *Amount and nature of flying missile.*
 - *Amount and the degree of damaged caused to the surrounding structures.*
 - *Position of the victim at the time of explosion.*

Injuries

- *Contact or close contact*
 - *Complete disruption - only small parts of the bodies will be left. Identification is a problem.*
 - *Even the object lying close by will be totally disintegrate*
 - *Localized disruption of the body – in a suicide bomber, useful in identifying the bomber and also the reconstruction of the position of victims.*

Close range victim

- *Injuries due to flying missiles.*
 - *Marshall's triad- abrasions, discrete contusions, and puncture lacerations.*
 - *Dust tattooing - discolouration due to gunpowder etc.*
 - *Internal injuries due to penetrating missiles.*
- *Burns and charring due to flame.*
 - *Singeing of hair, burning of clothes, flash burns.*
 - *Might cause difficulty in identification.*

Distant range

- *Injuries due to ;*
 - *Falling masonry – cuts, lacerations, crush injuries, traumatic asphyxia etc...*
 - *Poisonous gases – from the bomb or surrounding objects.*
 - *Electrocution,*

- *Blast effect;*
 - *It is a sound wave.*
 - *Can traverse through the body.*
 - *Most disruptive effects are seen at air –solid-fluid interfaces.*
 - *Hollow or fluid filled organs are vulnerable.*
 - *Due to different levels of vibration.*
 - *Cause internal injuries without any particular external injuries.*
 - *Haemothorax, pneumothorax, rupture of liver.*
 - *Rupture of middle ear/ear drum.*
 - *Rupture of bladder, intestine, damage to lung.*

Investigation

- *Magistrate has the authority to handle the inquest.*
- *Scene visit as a team.*
- *Protect the scene.*
- *Transport the bodies.*
- *Separate body bags.*
- *Number and photograph – generally, individually before removal.*
- *Sketch.*
- *Registration at mortuary and post mortem.*

Manner of death

- *Not a problem unless of the rare occurrence of dumping of a body killed somewhere else.*
- *Almost always accidental – except the suicide bomber.*

Cause of death

- *Immediate cause depending on the underlying injuries.*
- *When gross injuries are present this is difficult.*
- *So even give as a very 'general' cause as 'bomb explosion'*
- *Individual PMs should be done because of other liabilities and claims – compensation, insurance etc.*

Thank you