

新光急診 張志華

Gunshot Wounds

- ED Management

Jack CF Chong, MD
Emergency Department
Shin-Kong Wu Ho-Su Memorial Hospital



男主持人

凶嫌林正偉
從右邊階梯
自行上舞台
開槍

遭流彈擊中死亡的
肢障男子黃運聖
在台下一距離
舞台約30公尺



天祐台灣

炮聲夾道 扁呂笑容僵住…中槍了



總統、副總統陳水扁、呂秀蓮昨天在台南拜票掃街時遭到槍擊，陳水扁腹部中彈後還苦撐揮手，背後的隨扈隨即攔腰撐住他的身體，而呂秀蓮也因腳傷面露痛苦。

記者林秀明／攝影

【記者辛啓松、鄭惠仁、凌珮君／台南市報導】

陳水扁總統和副總統呂秀蓮昨天下午到台南市遊街拜票，兩人同乘一輛吉普車，路過金華路三段時遭槍擊；陳總統腹部有皮肉傷，共縫了三十二針，呂副總統右膝裂傷，送奇美醫院治療後均無生命危險。

台南市警方在金華路三段十二號路面，找到兩顆彈殼，已由鑑識組送驗。這兩顆彈殼是土造子彈的；至於是否

這次槍擊案的子彈彈殼，仍待刑事局調查。

www.jack119.org



問題 (1)

● 請問 **.33** 口徑子彈的直徑是幾 **mm** ?

- A. 約 *11 mm*
- B. 約 *8 mm*
- C. 約 *5 mm*
- D. 約 *3 mm*

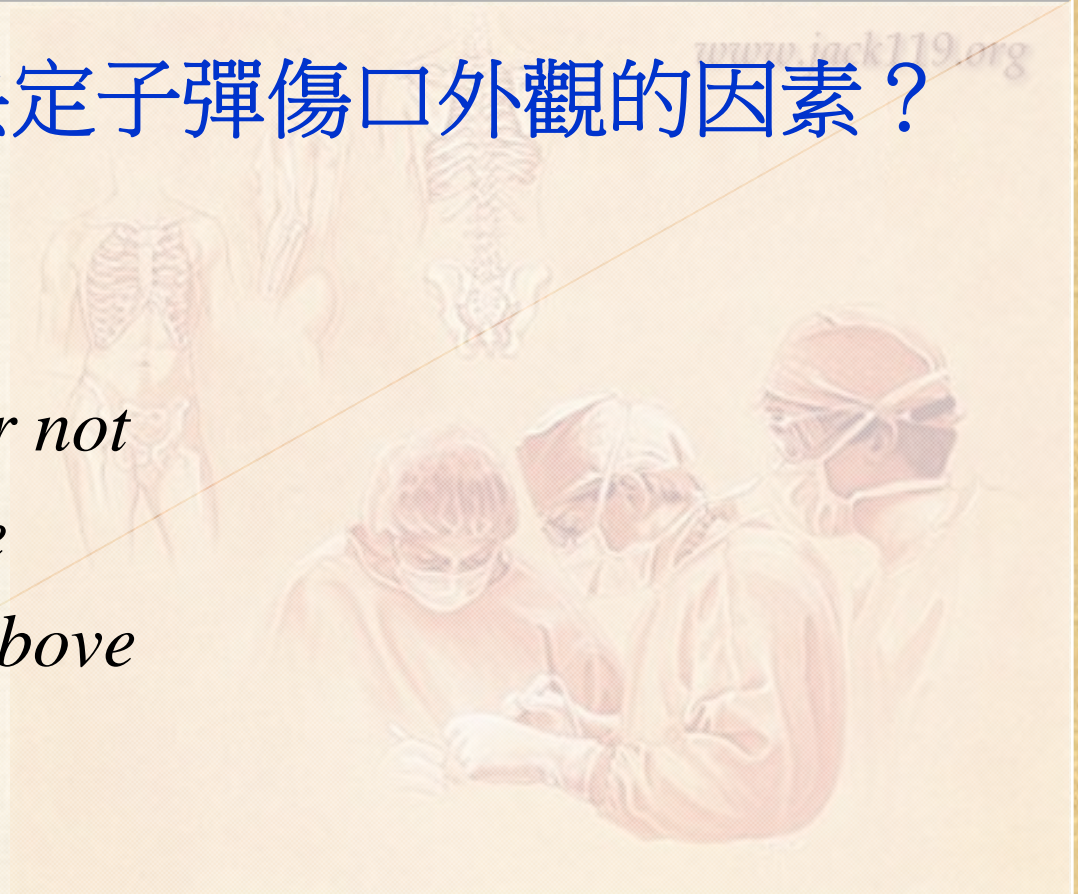


問題 (2)

- 何者不是**entrance wound**常見的特徵？
 - A. 傷口周圍有碳粒 (*soot*)
 - B. 傷口周圍有燒焦 (*seared*)
 - C. 傷口周圍有 *tattooing* 現象
 - D. 傷口有 *abrasion collar*
 - E. 傷口呈星狀且邊緣為 外推現象 (*everted*)

問題 (3)

- 請問何者是決定子彈傷口外觀的因素？
 - A. *Caliber*
 - B. *Velocity*
 - C. *Jacketed or not*
 - D. *Tissue type*
 - E. *All of the above*



問題 (4)

- 請問哪種子彈的傷害最可能併發 **vascular embolism** 的現象？

- A. *Lead nose*
- B. *Hollow point*
- C. *Fully jacketed bullets*
- D. *Teflon bullets*
- E. *Magnum rounds*

www.jack119.org



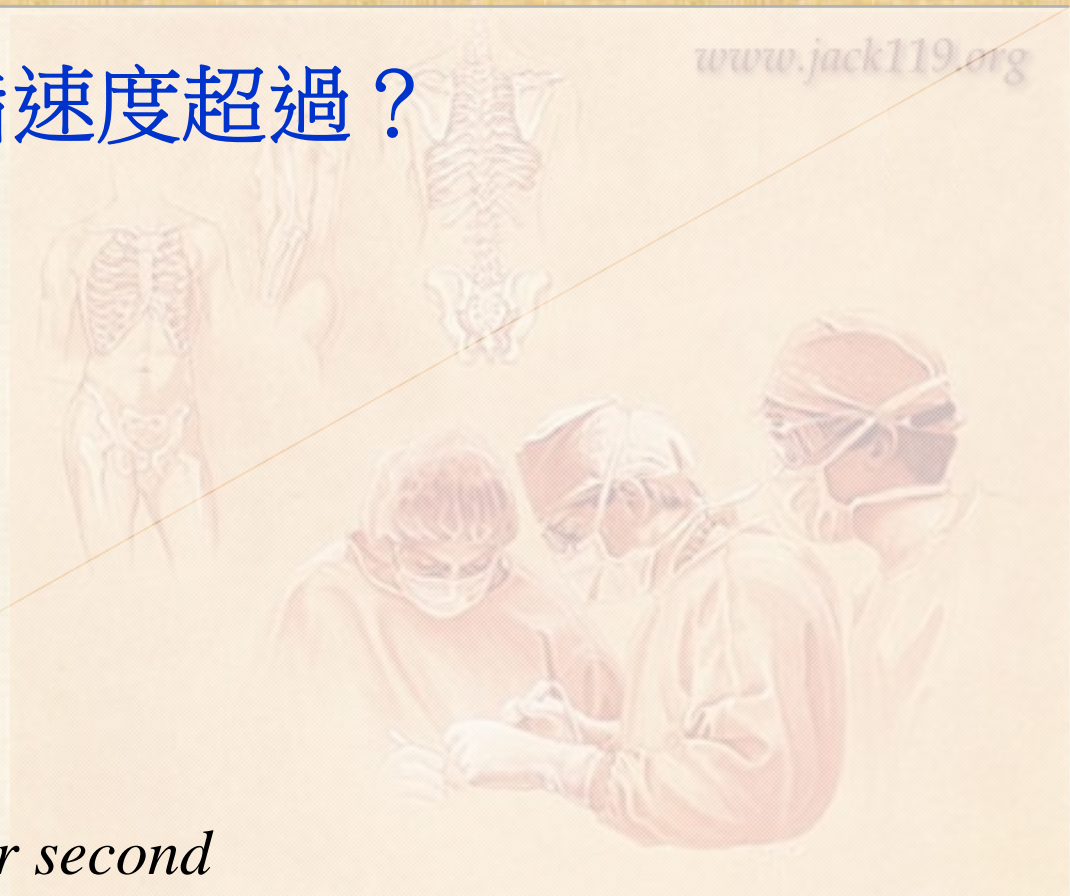
問題 (5)

- 高速子彈是指速度超過？

- A. 500 *fps*
- B. 1000 *fps*
- C. 1500 *fps*
- D. 2000 *fps*
- E. 2500 *fps*

Hint: fps = feet per second

www.jack119.org



Definitions

- **Missile injury**

- *any object that travels and causes physical contact and hence injury*

- **Ballistics (彈道學)**

- *motion of projectiles*

- **Internal ballistics**

- *study of projectiles in weapons*

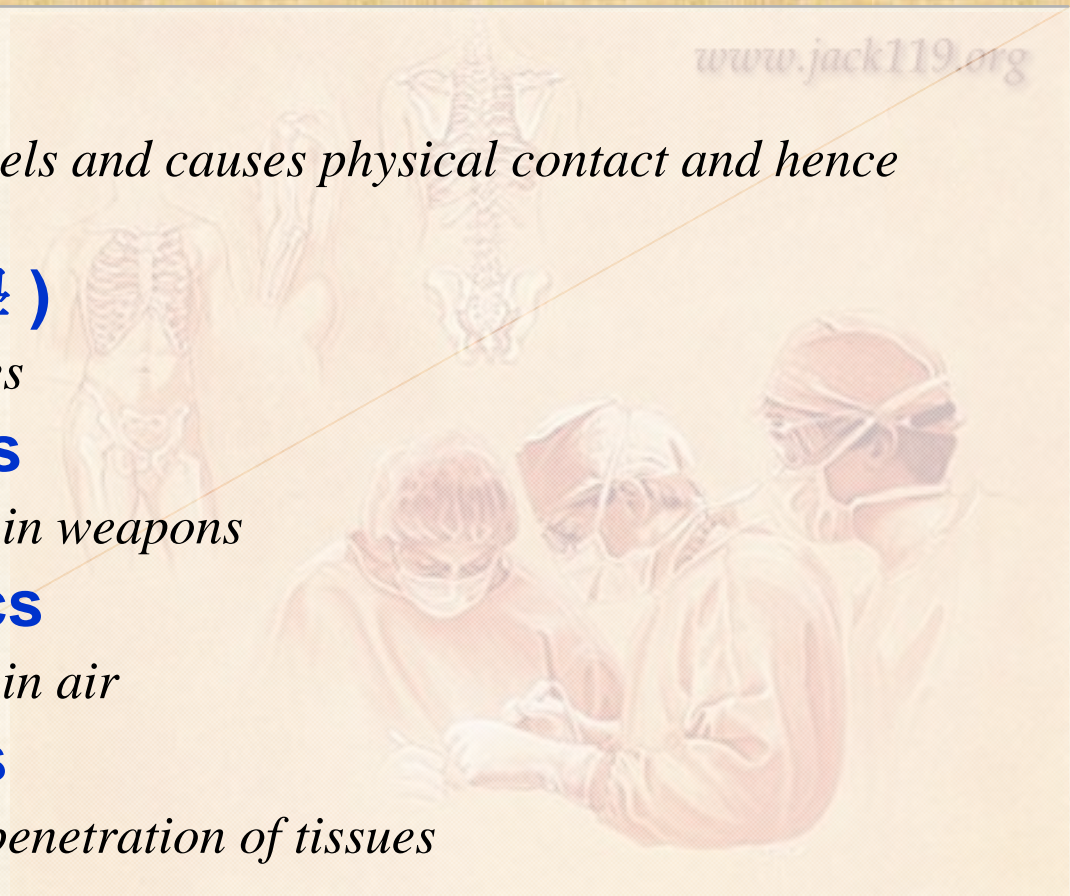
- **External ballistics**

- *study of projectiles in air*

- **Wound ballistics**

- *study of projectile penetration of tissues*

www.jack119.org



Wounding Potential

- **Rules**

- *Kinetic Energy = $\frac{1}{2}MV^2$*
- *Energy cannot be created or destroyed*

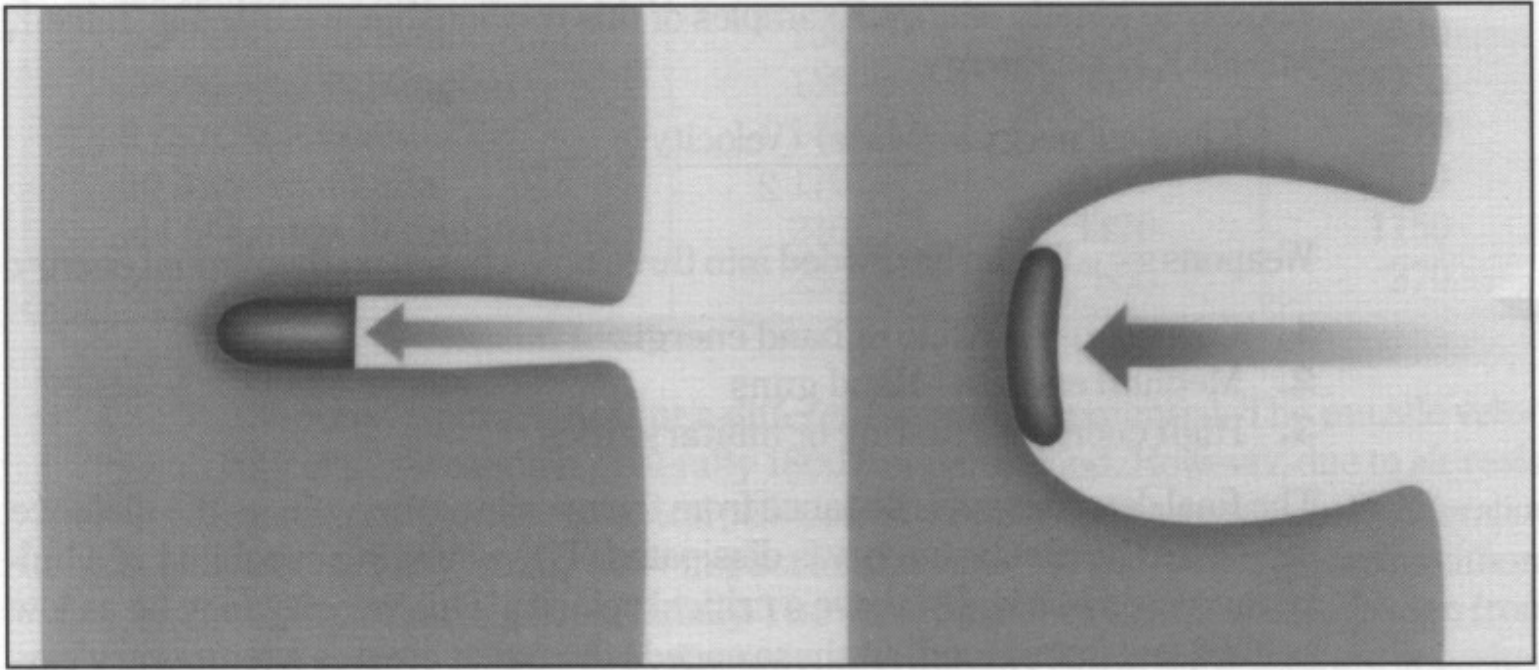
- **Consider**

- *Range*
- *Weapons*
- *Ammunition characteristics*
- *Path & entry profile*
- *Anatomy of impact site*

www.jack119.org



Cavitation



Energy exchange between moving object and body tissue

1. Surface area of impact point
2. Density of tissue
3. Velocity of projectile at impact

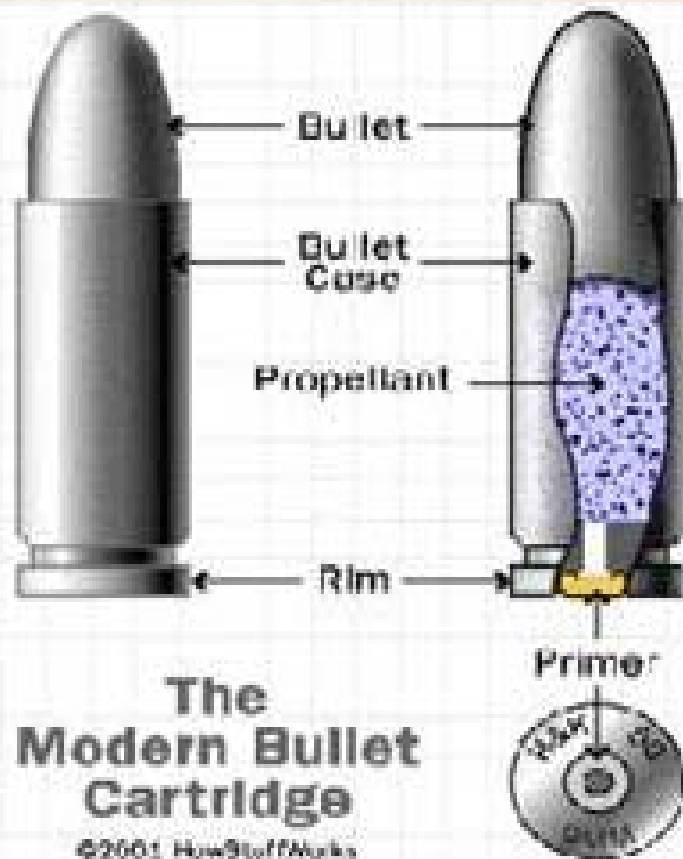
Wound at Point of Impact

www.jack119.org

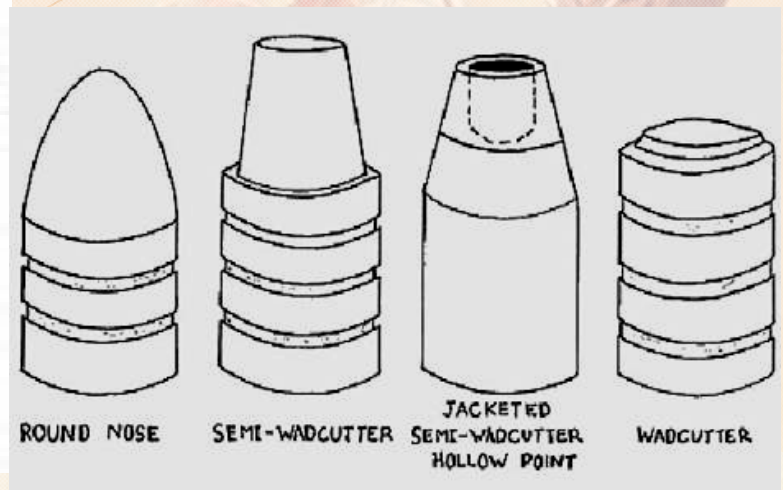


- Shape of missile ("mushroom")
- Ballistic tumble and yaw
- Fragmentation (shotgun, bullet fragments, special bullets)

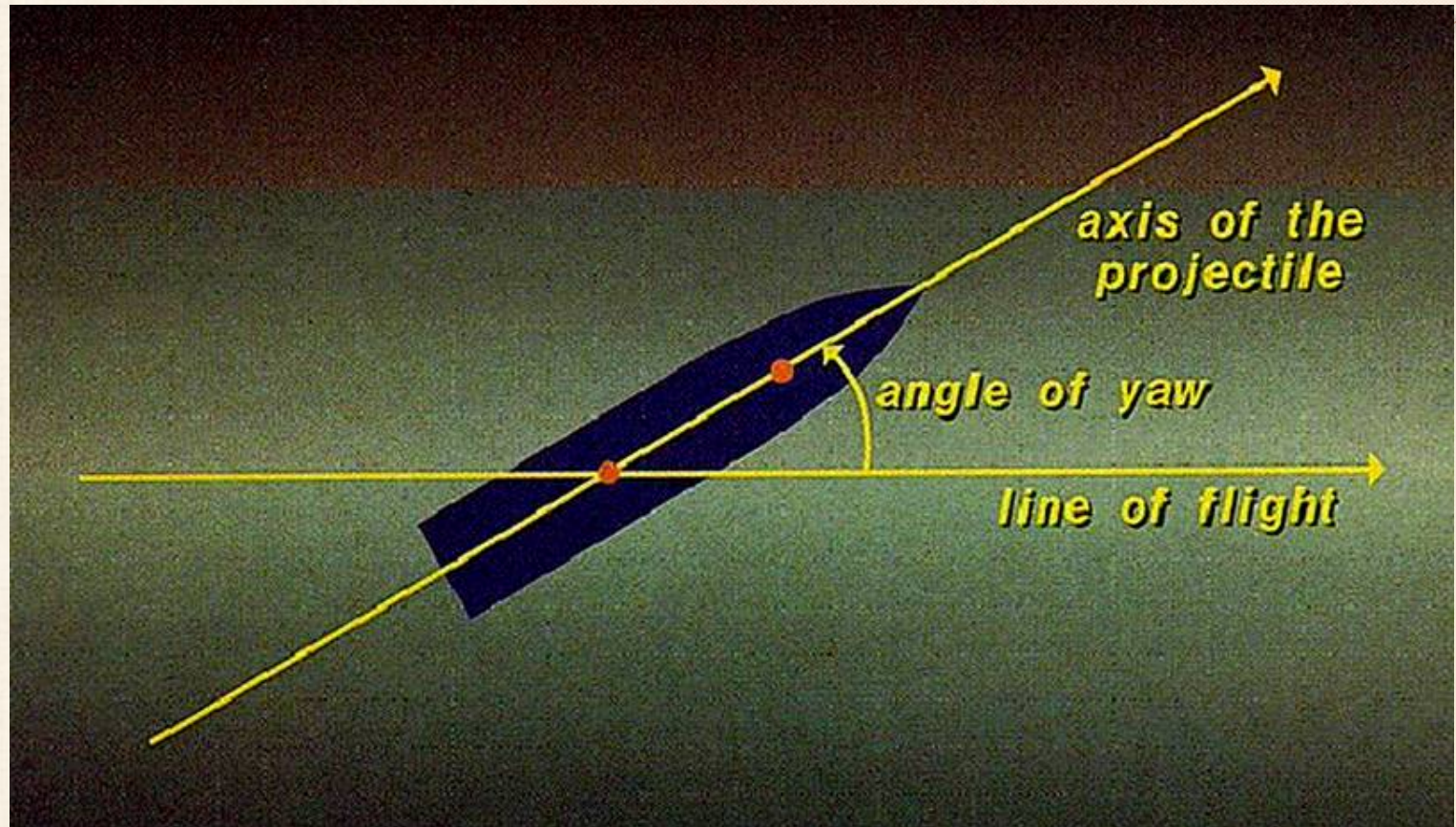
Mushroom (Deformation)



www.jack119.org

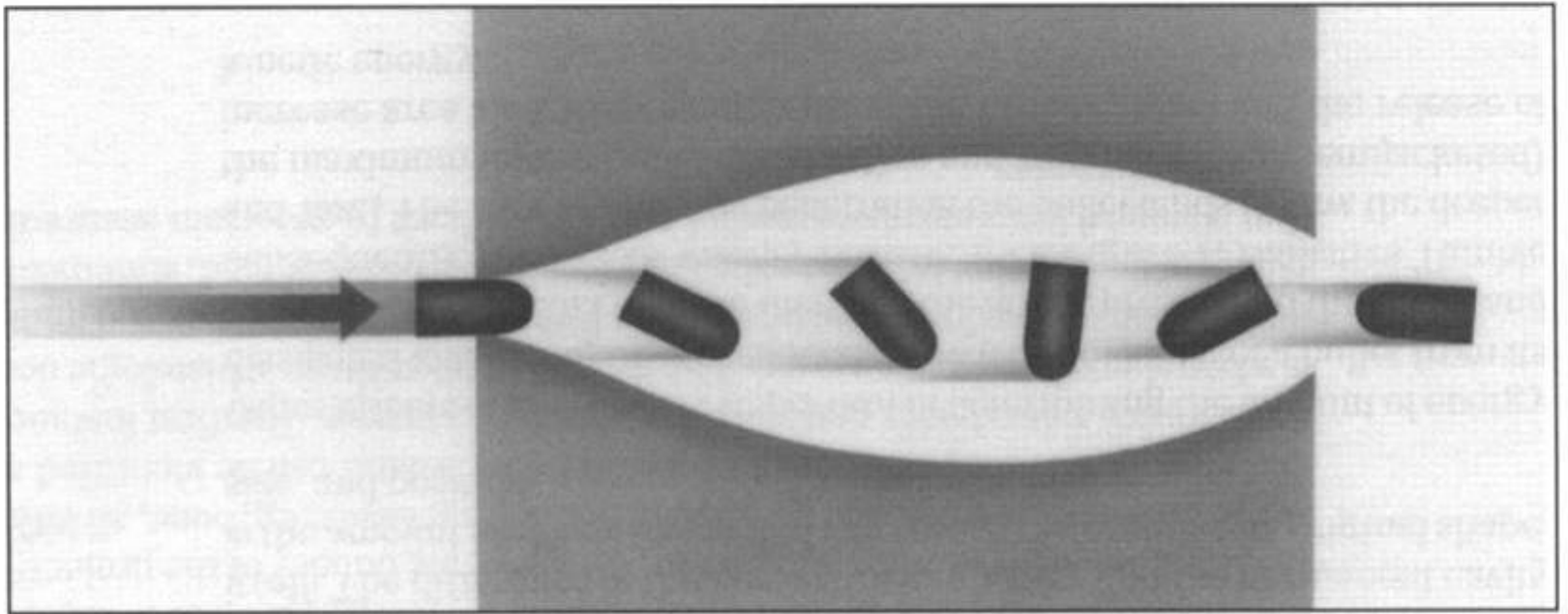


Yaw (偏航)



Tumble (翻滾) and Yaw

www.jack119.org



Bullets

- **Low-velocity missiles**

- *Lead bullets: melt if > 2000 ft/s*
- *Semijacketed bullets: lead nose / hollow point – designed to mushroom*

- **High-velocity missiles**

- *Fully jacketed with copper-nickel or steel*

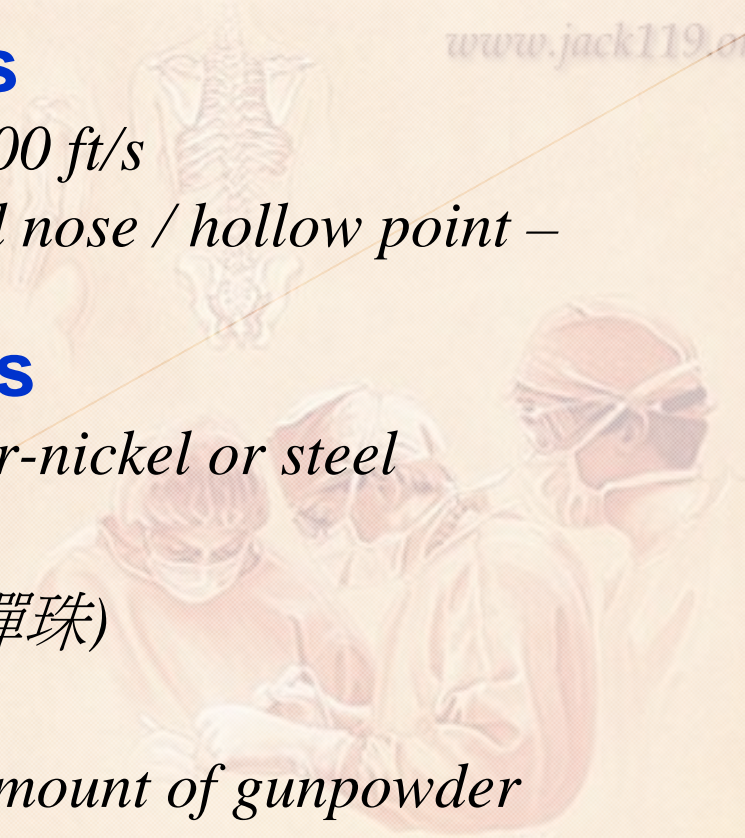
- **Teflon bullets**

- *Slugs (散彈), pellets (小彈珠)*

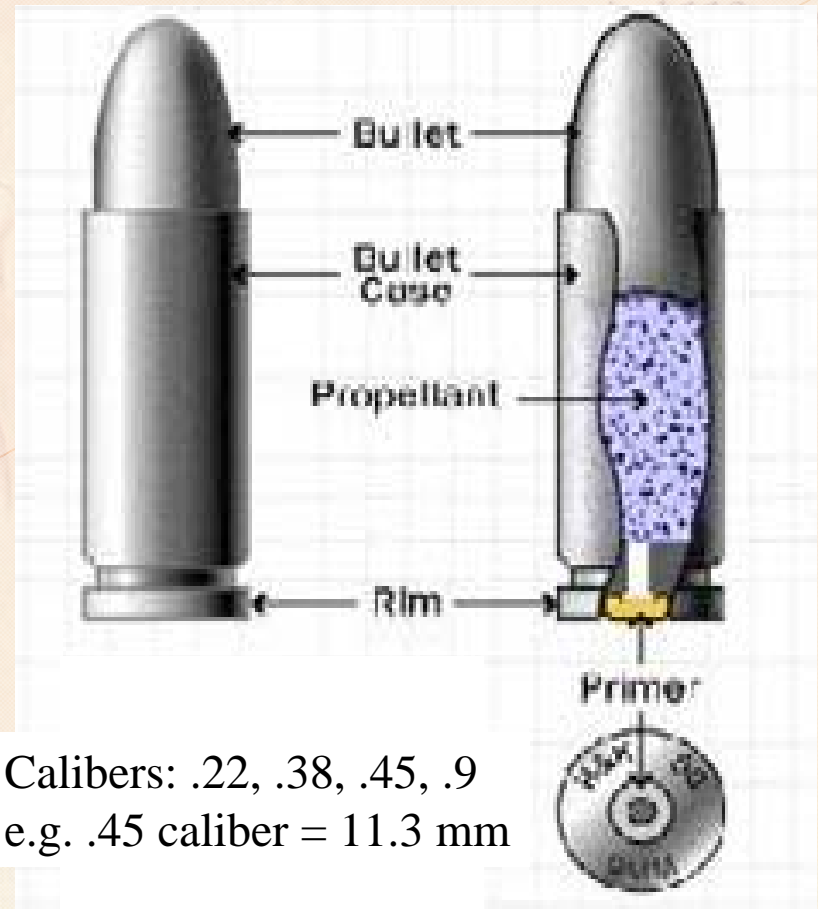
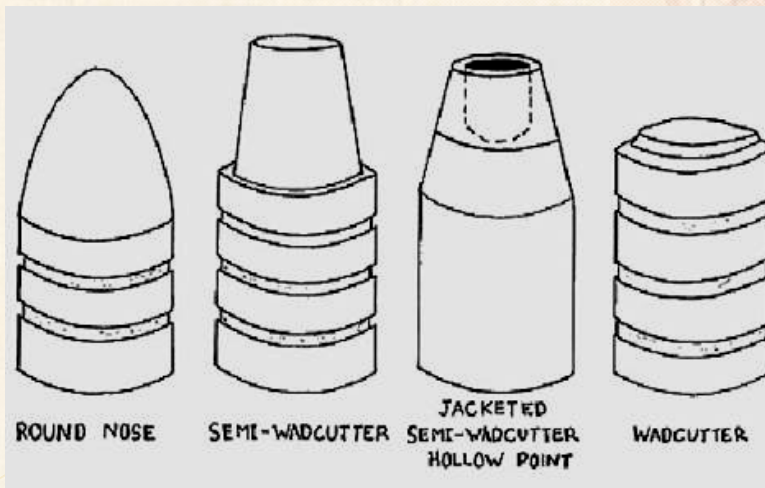
- **Magnum rounds**

- *Cartridges with greater amount of gunpowder*

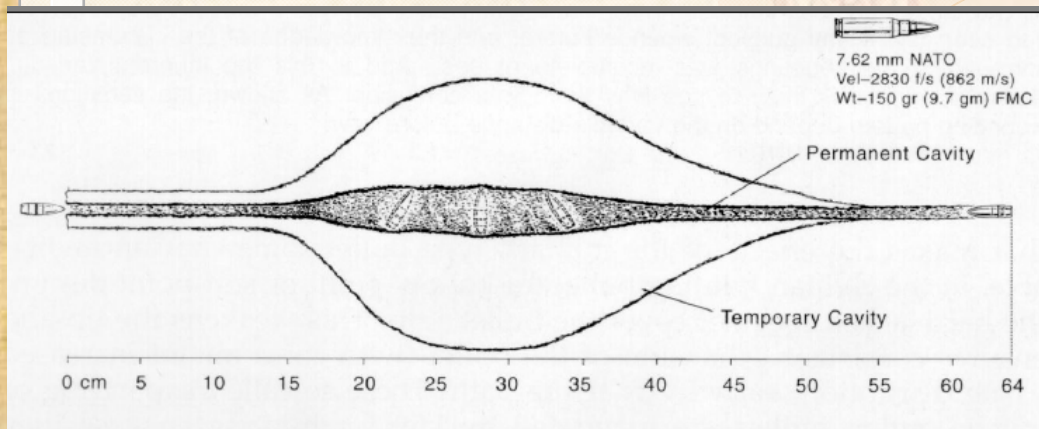
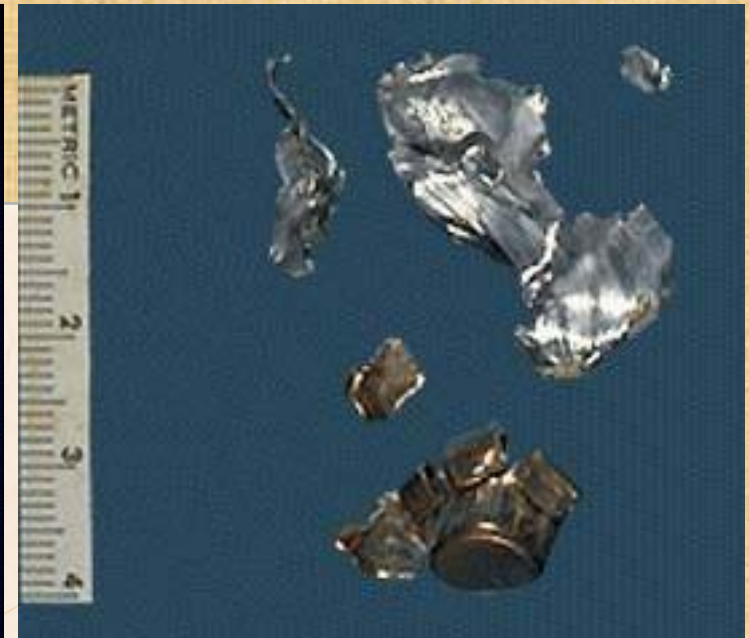
www.jack119.org



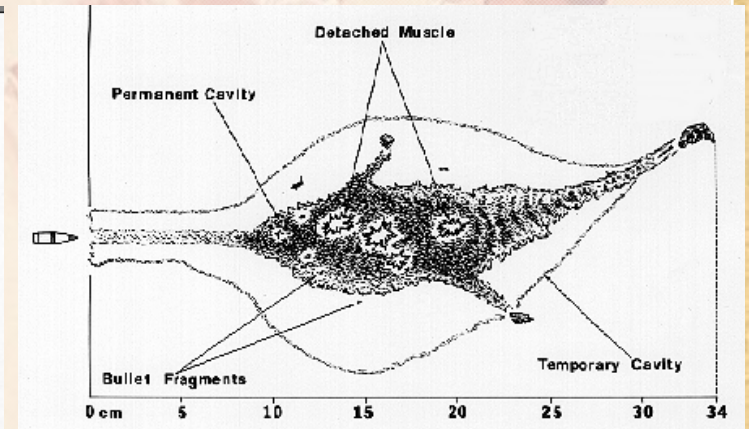
Low-Velocity Missiles



Calibers: .22, .38, .45, .9
e.g. .45 caliber = 11.3 mm



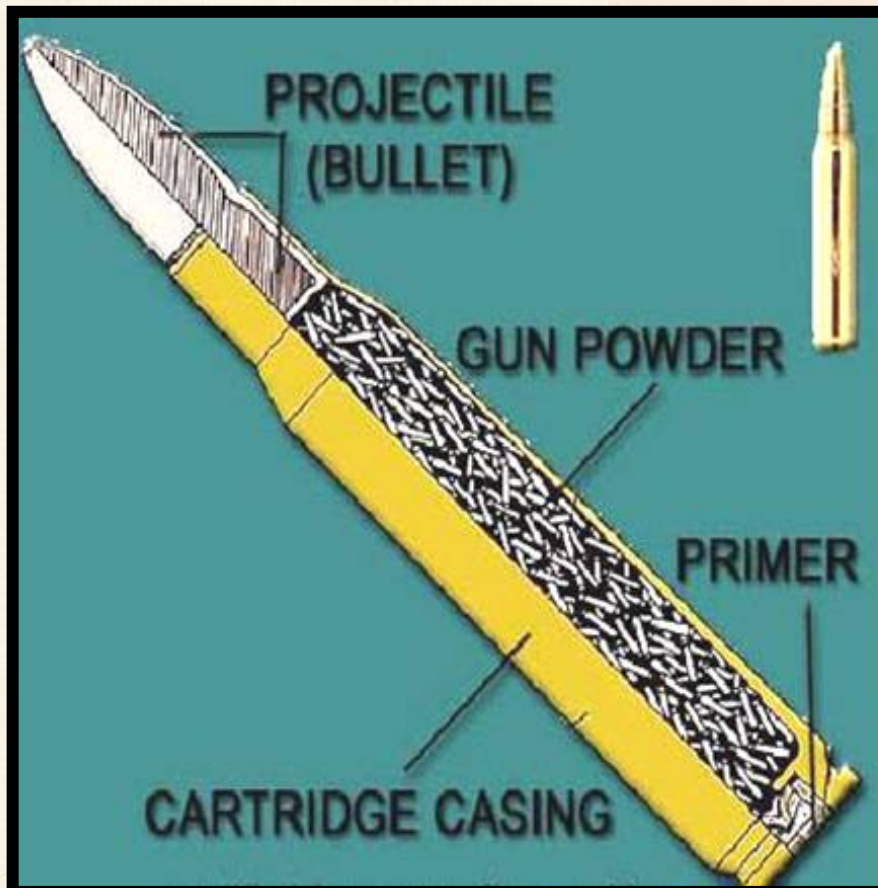
M80, velocity = 2800 fps



M16, velocity = 3035 fps

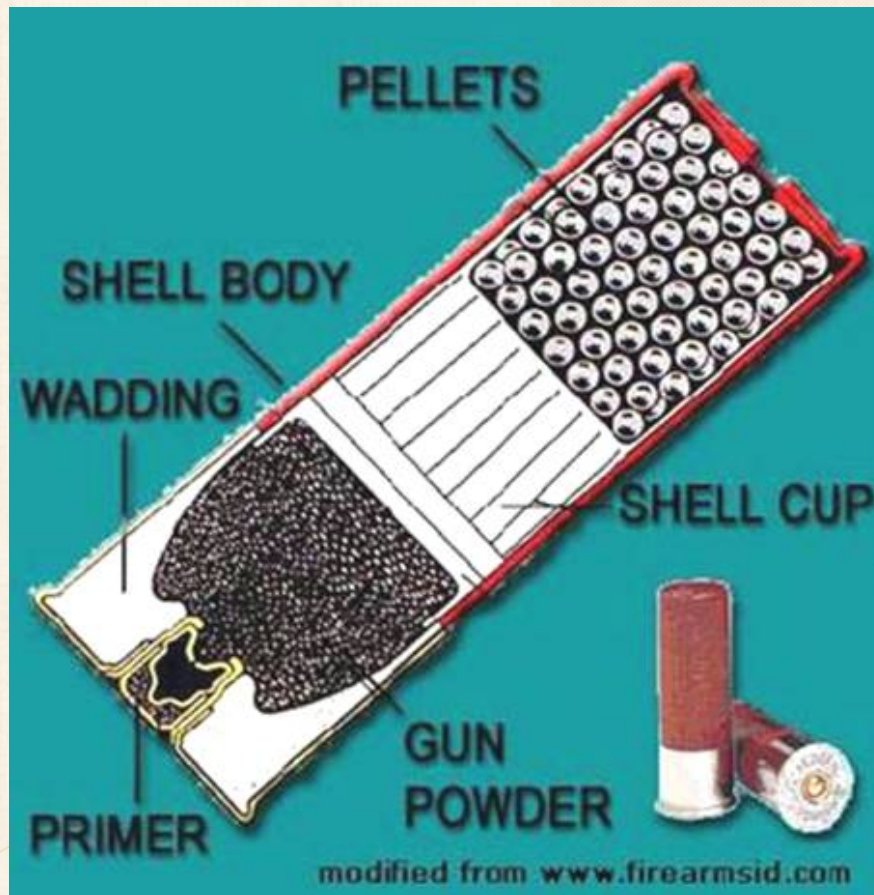
High-Velocity Missiles

www.jack119.org



AK-47

Teflon Bullets



Magnum Rounds (高彈藥量子彈)



Size



Energy Level of Projectiles

- **Kinetic energy**
 - *Kinetic Energy = $\frac{1}{2}MV^2$*
 - *Muzzle velocity \neq Impact velocity*
- **Low-energy weapons**
 - *Knife / hand energized missiles*
- **Medium-energy weapons**
 - *Hand guns*
- **High-energy weapons**
 - *Hunting / military rifles*

www.jack119.org

ATLS

Velocity and Energy Level

- **Conventional classification:**

- *Low velocity < 1000ft/s (305m/s)*
 - Handguns / air-rifles
- *Medium Velocity 1000-2000 ft/sec (305-610m/s)*
 - Shotguns
- *High Velocity >2000ft/s (>610m/s)*
 - Rifles / semi-automatic / automatic

- **BUT**

- *Energy of weapon \neq Energy on impact with tissue*
- *The velocity of a projectile is highest at the muzzle and drops off steadily because of air resistance*
- *Treat the wound not the weapon*

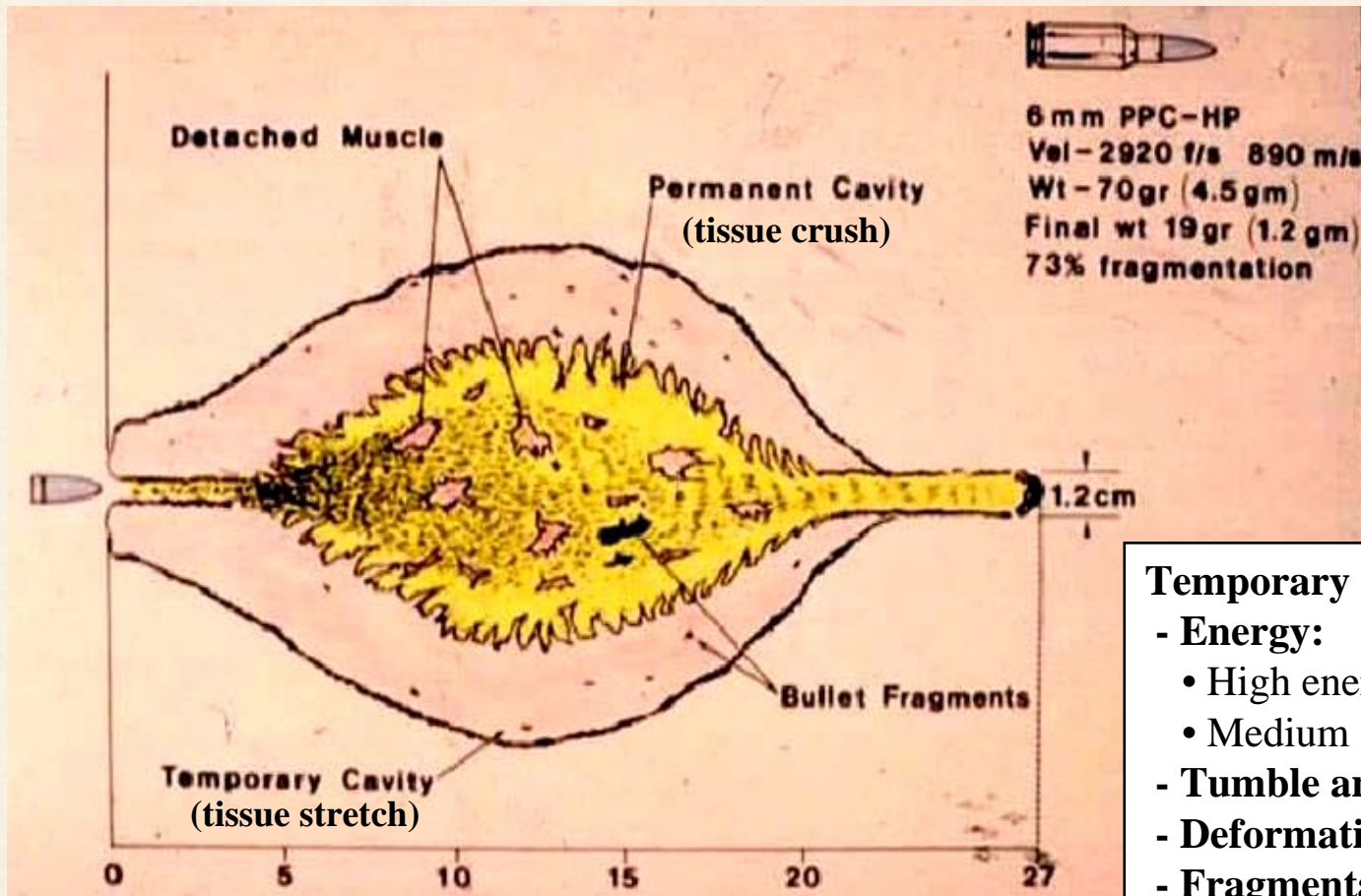
www.jack119.org

Missile Kinetic Energy

www.jack119.org

Caliber and Manufacturer	Bullet Weight (Grains)	Velocity (Feet/Second)	Energy (Feet/Pound)
Rifle Ammunition			
.22 Remington Rim Fire	40	1180	124
6 mm, 243 Winchester	75	3500	2037
.300 H and L Magnum	180	3670	3670
.375 H and H Magnum	270	2720	4440
Handgun Ammunition			
.25 Remington Automatic	50	810	73
.32 Short Remington	80	745	100
.32 Automatic Remington	71	960	140
.357 Magnum Remington	158	1410	540
.38 Special Remington	158	855	255
9 mm Automatic	140	935	270
10 mm Automatic	170	1340	680
.44 Magnum Remington	240	1470	1150
.45 Automatic Remington	230	850	370

Temporary Vs. Permanent Cavity



Temporary Cavity:

- Energy:

- High energy = 30 x
- Medium = 5 to 6 x

- Tumble and yaw

- Deformation

- Fragmentation

Shotgun Wounds



- Spread occurs at 14 inches
- Close-range shots may introduce clothing and wadding (infection)
- Pool ball effect
- Blast effect
- Rarely exit
- Embolize
- Lethal at close range; ineffective at greater distance

(包裝、填塞物)

Shotgun Wounds

www.jack119.org



Shotgun Wounds

www.jack119.org



Range of Fire

- **Wound characteristics vary:**

- *Contact*

- The most devastation

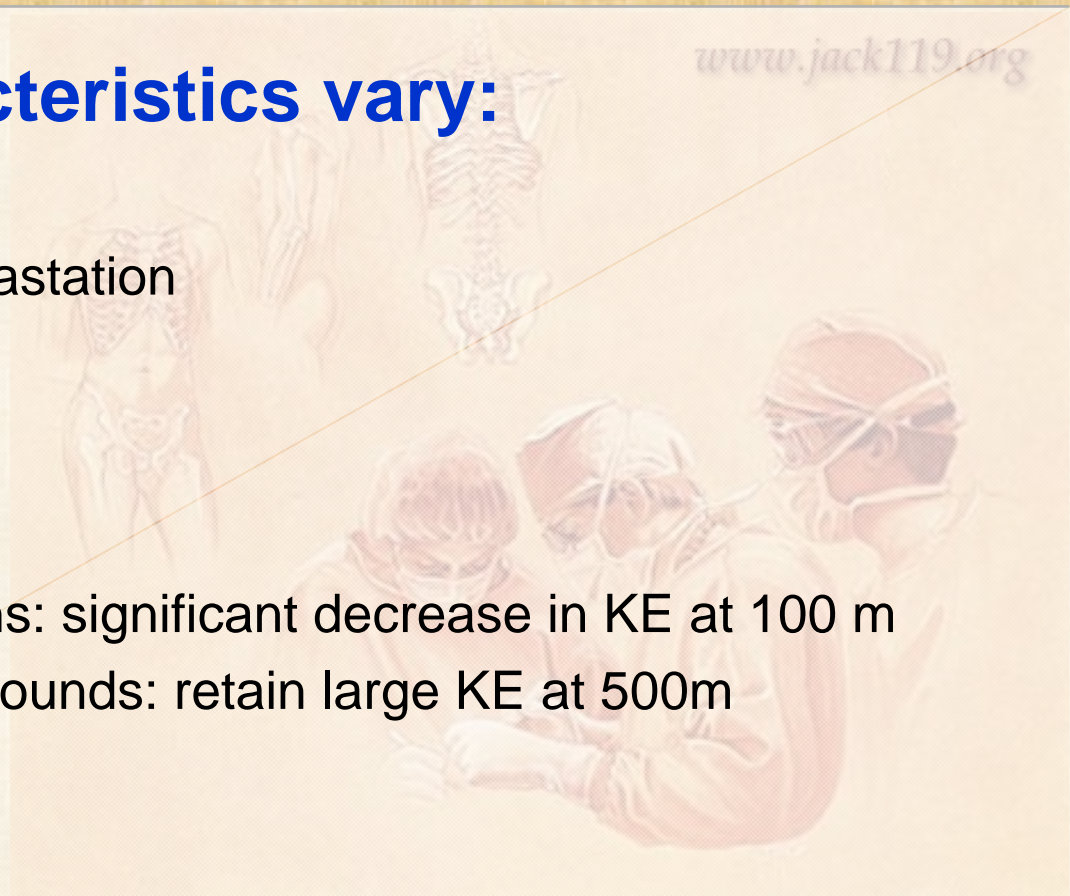
- *Close Range*

- Arm's length

- *Distant*

- Most handguns: significant decrease in KE at 100 m
- Most military rounds: retain large KE at 500m

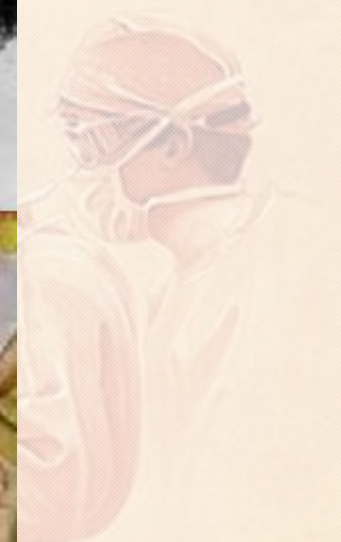
www.jack119.org



At Close / Contact Range



www.jack119.org

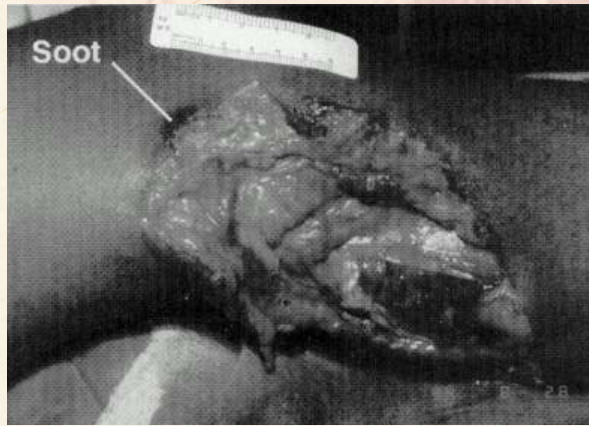
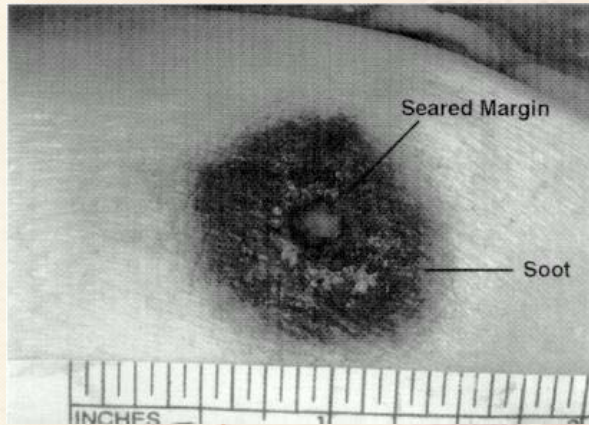


Entrance Vs. Exit Wounds

- **Caution!**
- **Wound appearance:**
 - *Type of projectile*
 - *Jacketed or not*
 - *Hollow-point / ball ammunition*
 - *Velocity*
 - *Yaw*
 - *Tissue type*
- **Legal purpose?**



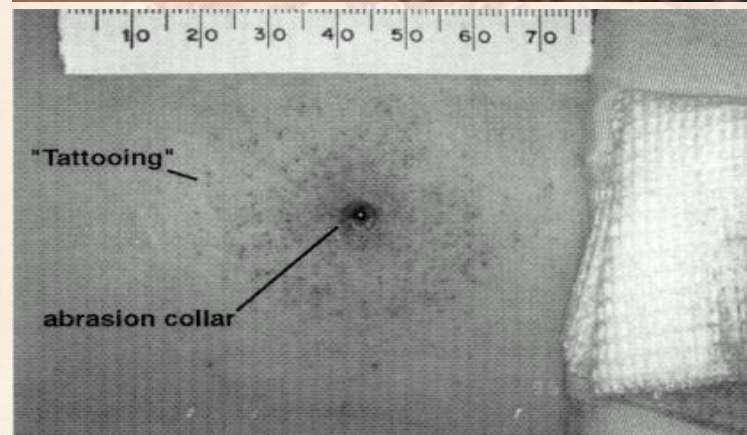
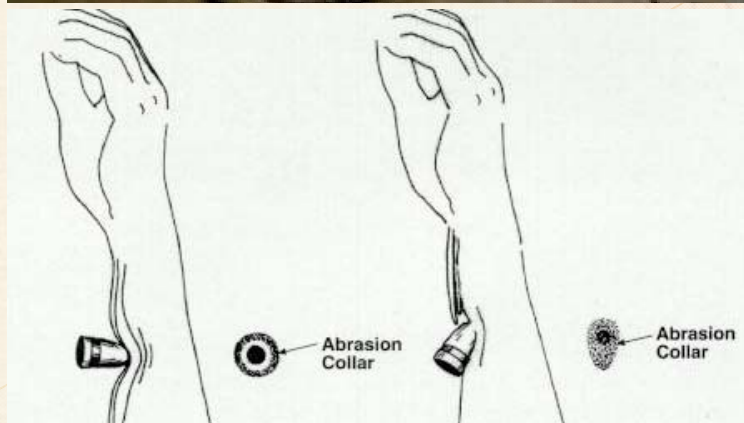
Entrance Wound



stellate tears are the result of injection of hot gases beneath the skin.

Soot is a carbonaceous material which will deposit on skin.

Entrance Wound

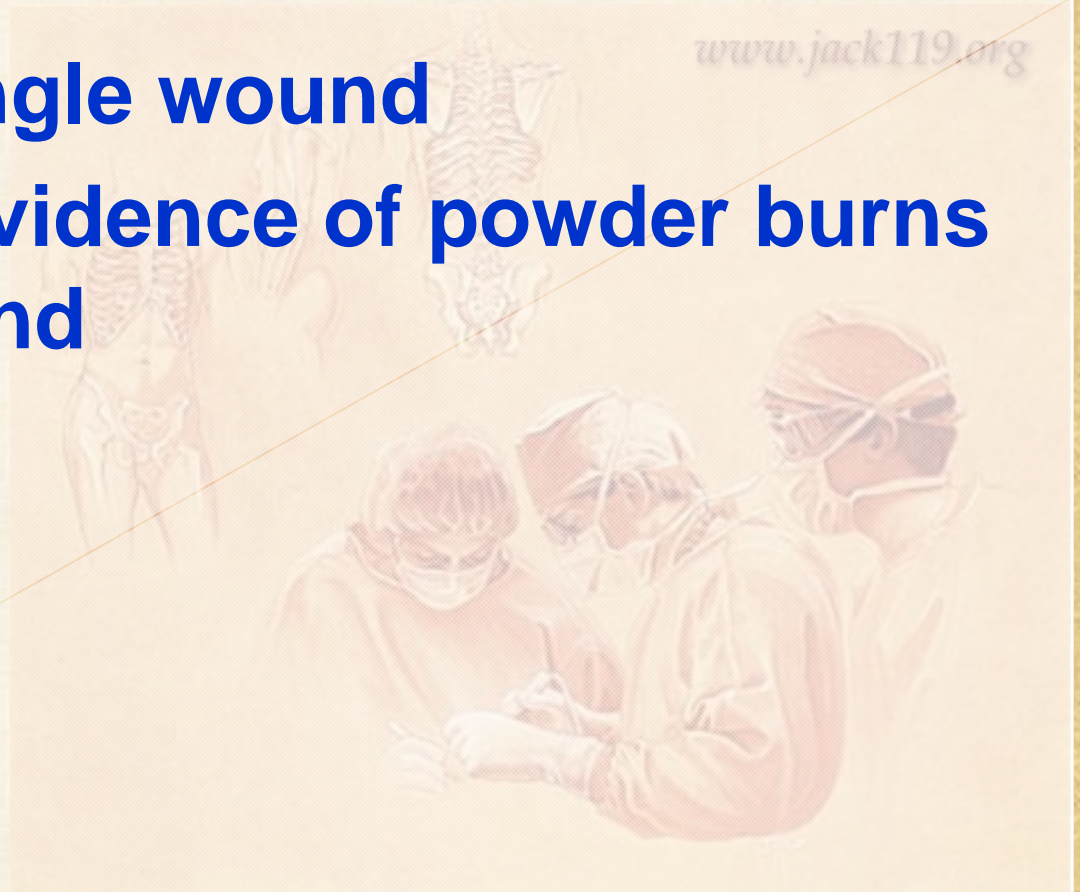


'Tattooing' = punctate abrasions from unburned grains of gunpowder.

Entrance Wound

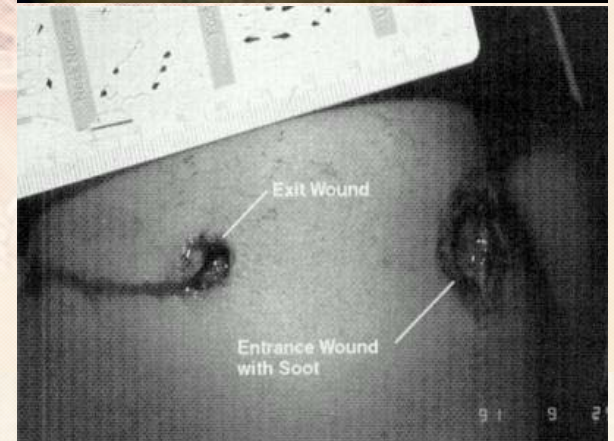
- Only one single wound
- Histologic evidence of powder burns around wound

www.jack119.org



Exit Wound

1. Skin edges are generally everted.
2. Abrasion collars and soot are not usually associated with exit wounds.
3. Tattooing is never seen at an exit wound.
4. Are NOT always larger than its corresponding entrance wound.
5. May not appear directly opposite the entrance wound.

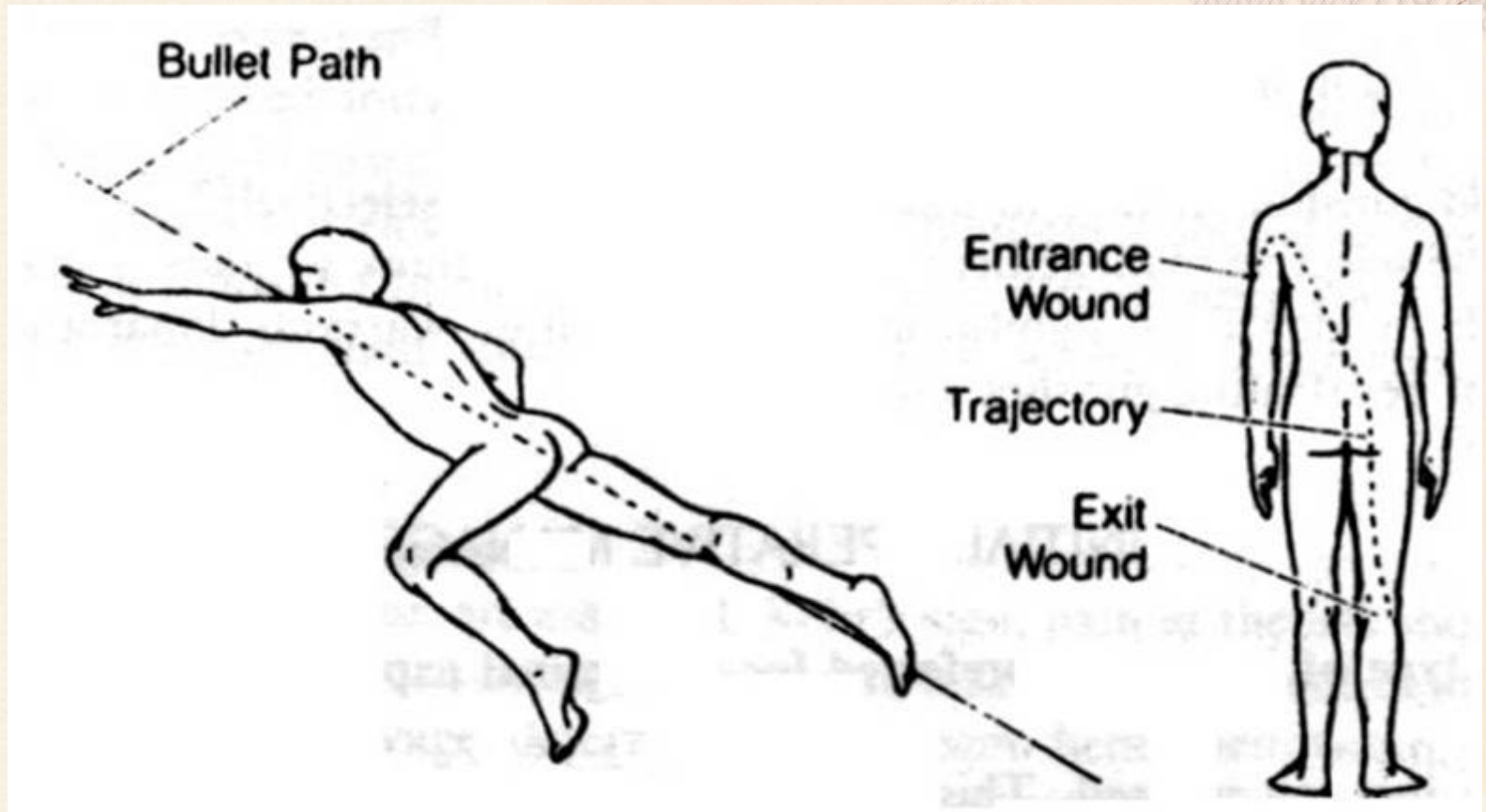


Clinical Purpose

- **2 holes = entrance & exit**
 - *Anatomy damaged*
 - *Type of surgical procedure*
- **Entrance**
 - *Round or oval with surrounding 1 to 2-mm blacked area of burn or abrasion*
 - *Close range: tattooing, subcutaneous air*
- **Exit**
 - *Stellate / slit-like in appearance*



Entrance Vs. Exit Wounds



GSW?

總統右腹流血 走進急診室 縫了32針

www.jack119.org



Vs.



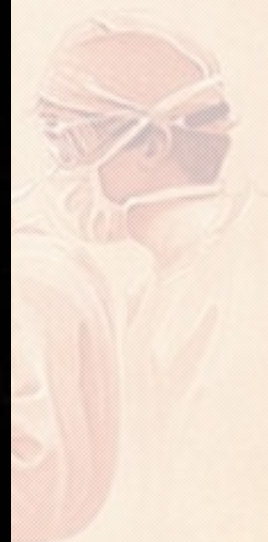
陳水扁總統昨天在台南市掃街拜票時中槍，子彈擦傷腹部，造成長約十一公分、寬與深各約兩公分的橫向裂傷。

記者胡經周／翻攝

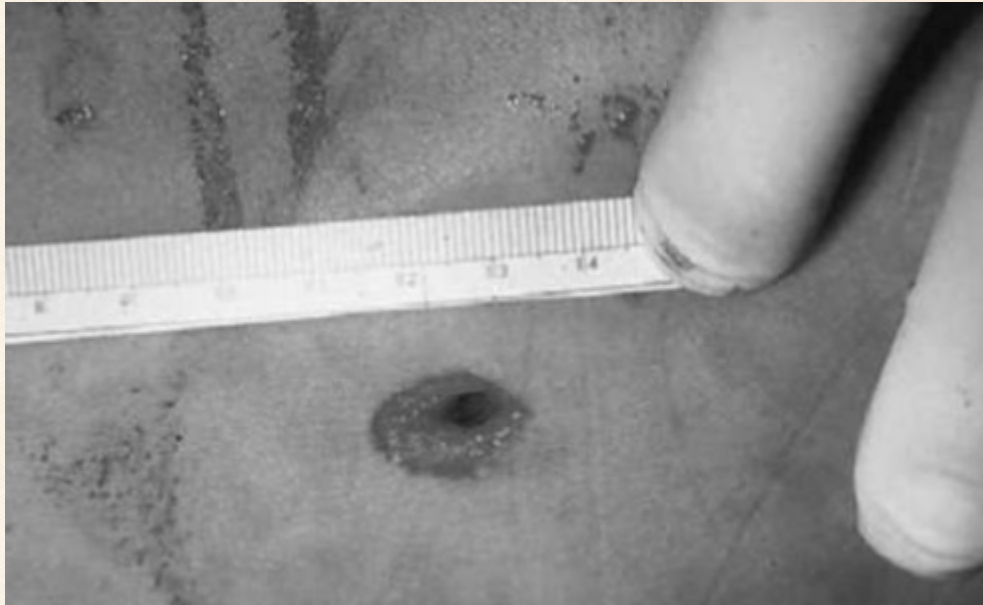
Entrance or Exit?



www.jack119.org



Entrance or Exit?



www.jack119.org

A 'shored' exit wound has the appearance of a 'false' abrasion collar. This false abrasion collar results when epithelium is forced outward and makes contact or is slapped against a supporting structure, i.e. floor, wall or furniture. A short exit may also be referred to as a supported exit wound.

ED Management

- **ATLS approach**
 - *A – B – C – D – E – Secondary survey - Transfer*
- **Consider Intra-abdominal injury**
 - *Small wounds can have associated extensive internal damage*
 - *Missile do not always travel in straight lines*
- **Signs of vascular injury**
 - *Hematoma, pulse deficit, bruit, pulsatile or uncontrolled bleeding*
 - *Need urgent investigation*
- **Wound description and projectile collection**
 - *Legal-forensic consideration*
- **Beware multiple wounds**

Abdominal GSW

- **Peritoneal penetration in > 80%**

- *Significant visceral injury in > 95%*
- *Laparotomy mandatory*

- **Studies**

- *Biplanar radiographs*
- *DPL* / FAST / CT / Angio*
- *Wound exploration – impractical*
- *PE alone – unreliable (FN > 20%)*

Imaging



- Look for FBs, fractures, gas
- If cannot find bullet, re-examine patient!

Surgery

- **Indications**

- *Significant tissue damage*
 - Ecchymosis, swelling
- *Neuro-vascular injury*
- *Obvious contamination*
- *Joint involvement*
- *Unstable fractures*

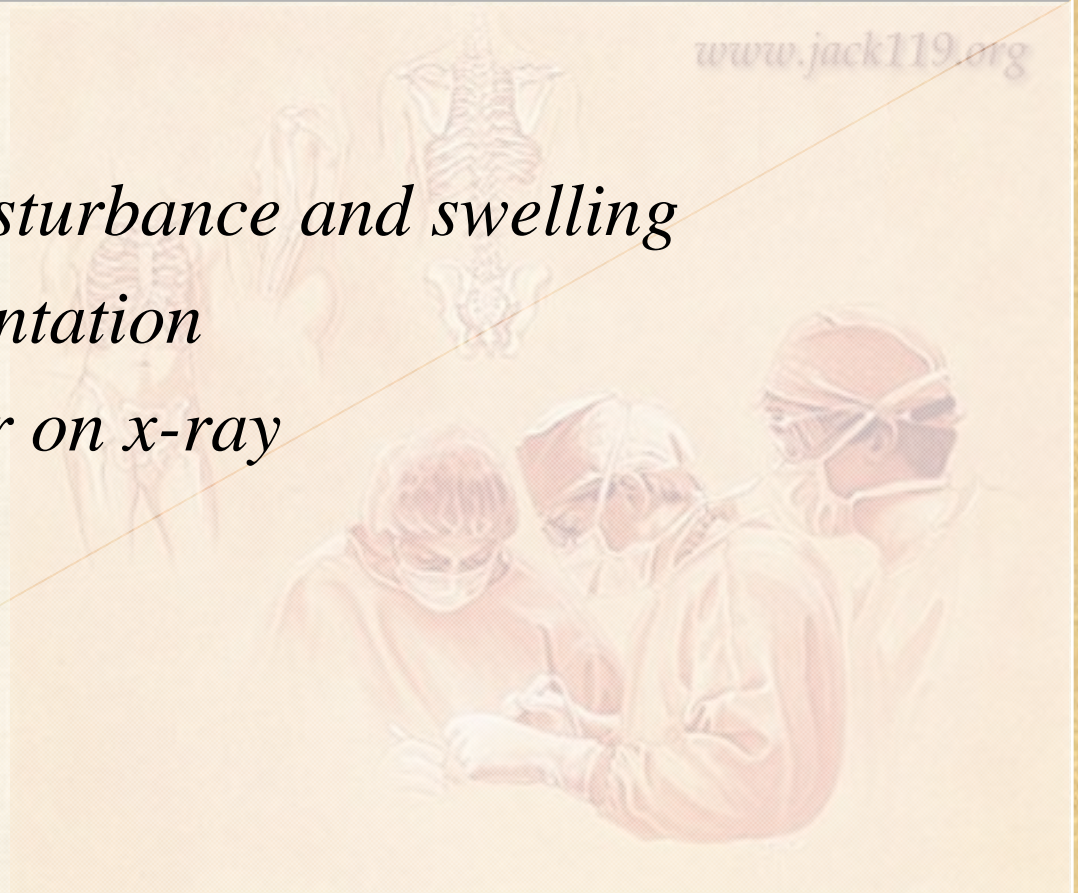
www.jack119.org



High Energy Transfer

- **Evidence**

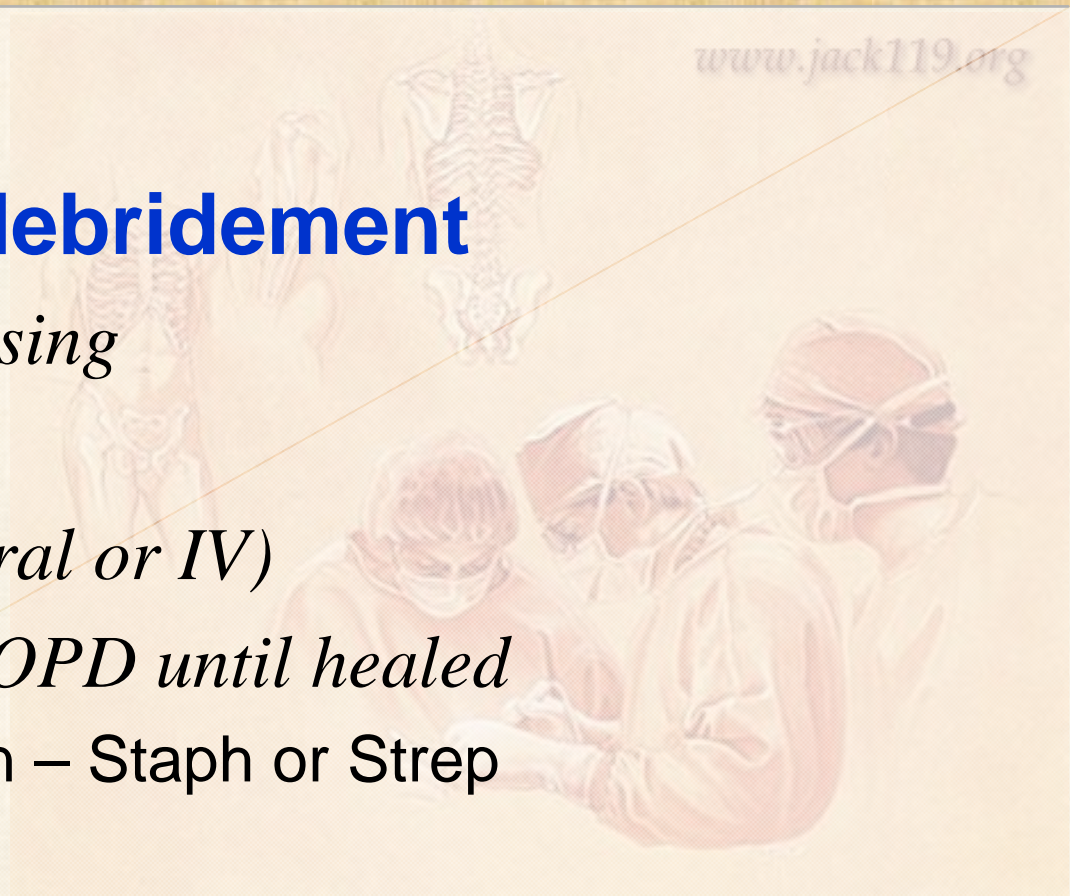
- *Functional disturbance and swelling*
- *Bullet fragmentation*
- *Visible cluster on x-ray*



Disposition

- **Surgery or**
- **Superficial debridement**
 - *Betadine dressing*
 - *Left open*
 - *Antibiotics (oral or IV)*
 - *Follow up in OPD until healed*
 - 2% infection – Staph or Strep

www.jack119.org



Questions ?



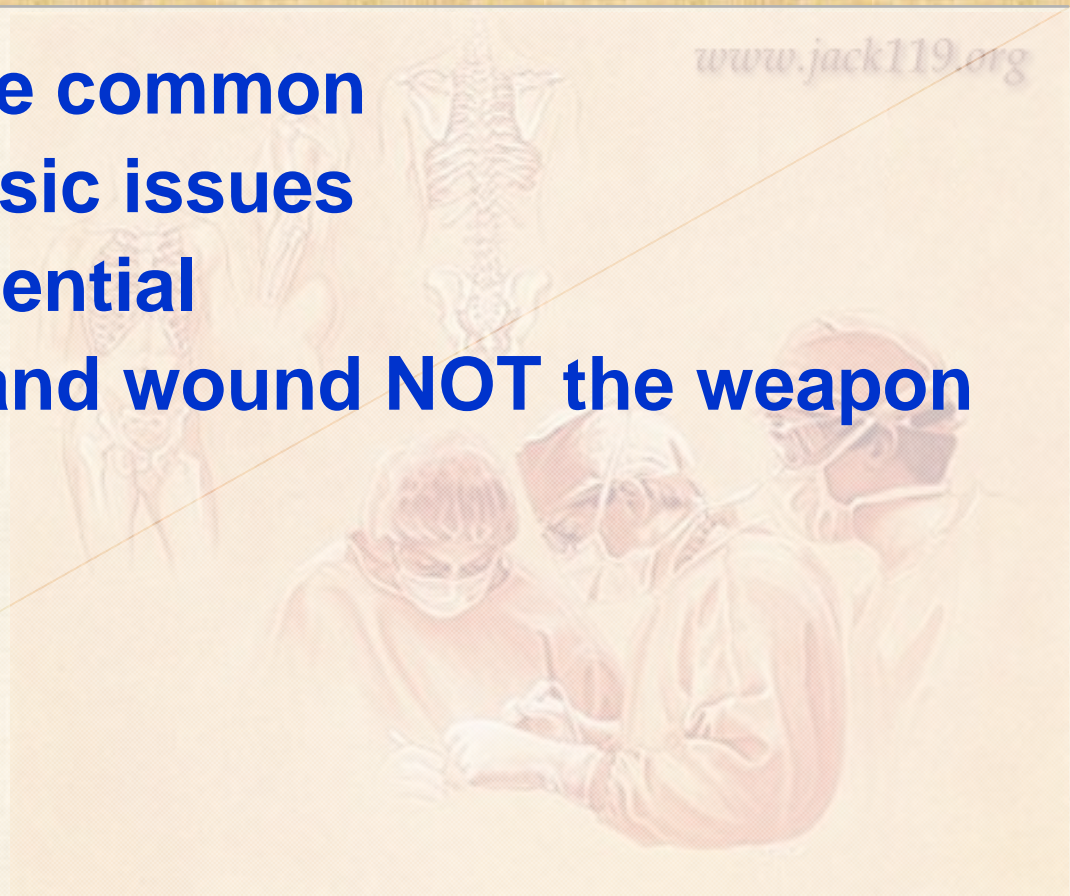
www.jack119.org



GSW: Summary

- More and more common
- Legal & Forensic issues
- Wounding potential
- Treat patient and wound **NOT** the weapon
- Surgery
- Antibiotics

www.jack119.org



Thank You



www.jack119.org

Fashion
Accessories