WOUND BALLISTICS

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Mechanisms of Wounding:
Treat the wound not the weapon

- Crush - laceration
- Stretch - cavitation
- Blast
- All are the effect of a transfer of energy.

Available Kinetic Energy
\[ \frac{MV^2}{2} \]

Energy Expended
\[ \frac{M(V_1^2 - V_2^2)}{2} \]

The velocity of the missile is the most significant determinant of its wounding potential

- Low energy: knife or hand-energized missiles
- Medium energy: handguns
- High energy (>600 m/s): military or hunting rifles

Factors affecting the severity of projectile trauma: the projectile

**Shape:**
- bullets are aerodynamic, fragments are irregular (air friction)

**Construction:**
- metal jacket, hollow-tip: stability of bullet after impact; stress fragments bullet which creates secondary projectiles

**Stability in air:**
- range, age of weapon, temperature of barrel, interference in flight (ricochet)
Non-deforming rifle bullet: full metal jacket (FMJ) military bullet

Full metal jacket rifle bullet (FMJ) in soft tissue

FMJ in soft tissue
Fragmented FMJ

Fragmentation occurs at the point of Maximum Kinetic Energy transfer.

Entry and exit wounds: FMJ-bullet, rifle

Penetration of the shoulder

FMJ-Bullet
Deforming and fragmenting rifle bullets: dum-dum

Semi-jacketed rifle bullet (SJ) in soft tissue: "dum-dum"

Behaviour of projectiles
Comparison FMJ- versus SJ-bullet

same energy and same scale

FMJ Vs. SJ bullets
Equal transfer of kinetic energy
Ricochet bullets

- Effect on a bullet after collision with an obstacle

Ricochet

FMJ rifle bullet

Ricochet: FMJ bullet

Wound from ricochet
Comparison FMJ-Bullet versus SJ-Bullet

Bone injuries

FMJ SJ FMJ SJ
Fragments

lightweight fast

Same energy

heavy

Fragment in soap

Fragment wound lower leg

Non deforming handgun bullet

Deforming handgun bullets

Handgun

9 mm Luger, full metal jacket
Boundary effect

Grazing gunshot of a 9 mm Luger full metal jacketed bullet

FMJ 350 m/s

Lead bullet 220 m/s
Factors affecting the severity of projectile trauma: the tissues

- Elastic properties of the tissues to which the energy transfer is applied:

- Limiting boundaries of tissues: brain in cranium

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Tissue factors

- Tissue elasticity: severity of damage
  - Excellent Tolerance: Lung, Skin
  - Good tolerance: Skeletal muscle, Empty bowel wall
  - Non-elastic: Brain, Liver, Spleen, Kidney
    - Rupture
  - Fluid-fill organs: Heart, Full bladder, Full stomach
    - Intestine: may be rupture
  - Bone: fracture from direct impact or energy transfer

Clinical applications

GSW

Clean or Dirty

Red textile fibres transferred in a retrograde direction are macroscopically visible

Microscopic demonstration of displaced jeans fibres from the entrance region (blue) and the exit region (red) in a bullet track of series 1 at a distance of 15 cm from the bullet entrance site (×100 magnification)
Conclusions

• High index of suspicion
• Don’t believe what you see
• Use knowledge guiding imagination