Ballistics

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Ballistics

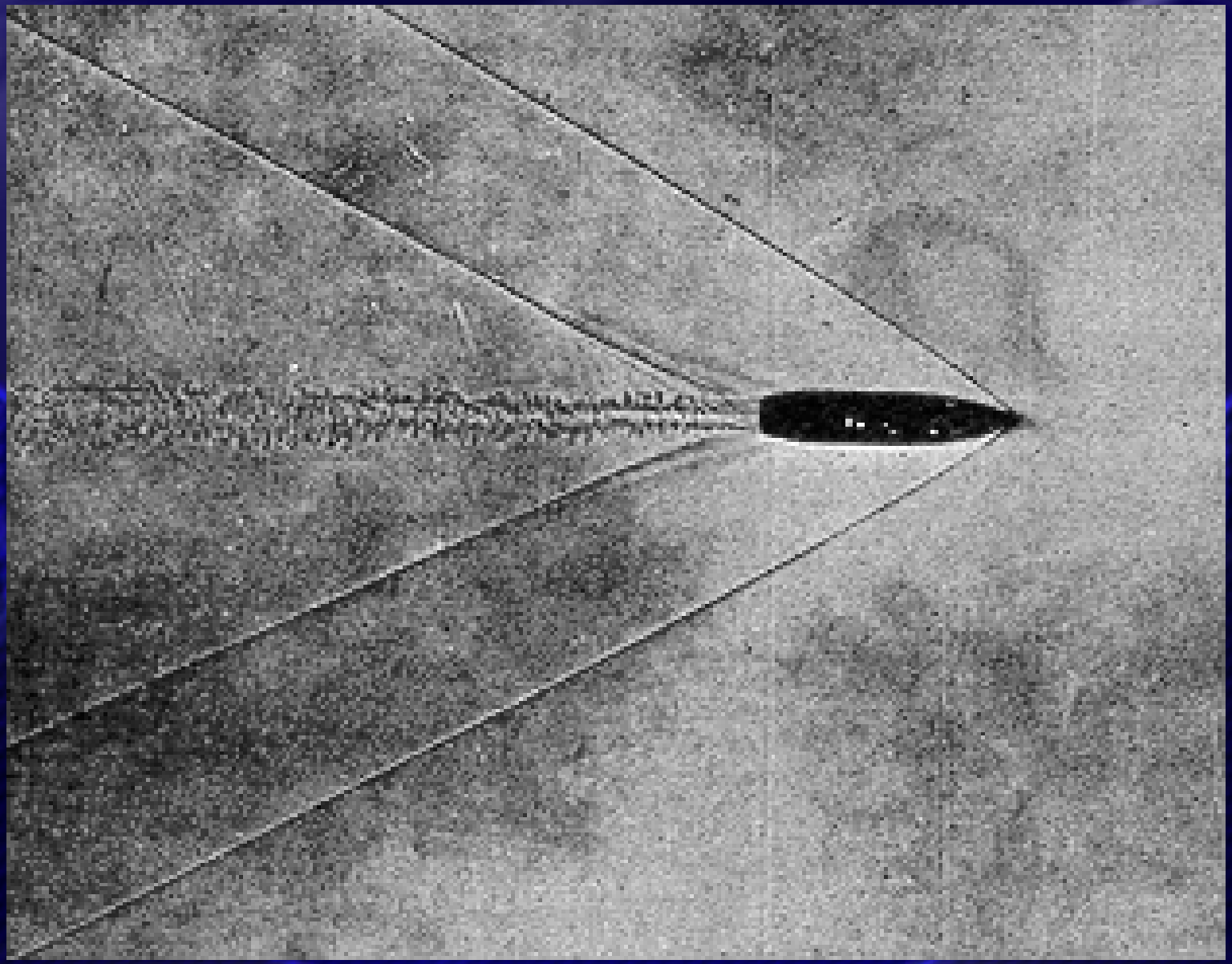
- **This lecture is designed to provide one with the basic insight into the nature of ballistic injuries . . . . . .**
- **Understanding of how projectiles carry and transfer energy . . . . .**
- **Understanding direct and indirect injuries . . . . . .**
- **Scene information . . . .**
- **Patient information . . . . .**
- **And Patient assessment .**

Projectiles

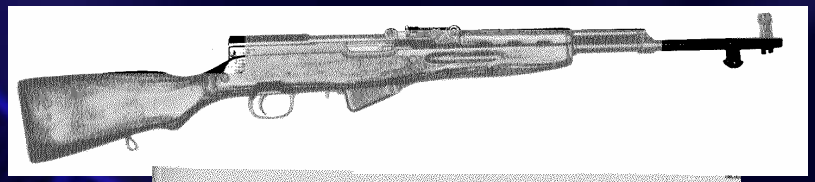
- **Any material that travels has the ability to injure , be it a shard of glass , a falling object , or a bullet .**
- **The energy within that projectile is dependent on the velocity , the weight (or mass in zero gravity) , and distance .**
- **Air resistance slows an object , as do barriers , gravity can accelerate .**
- **Material makeup and design of a projectile can determine how energy is transferred to the target .**

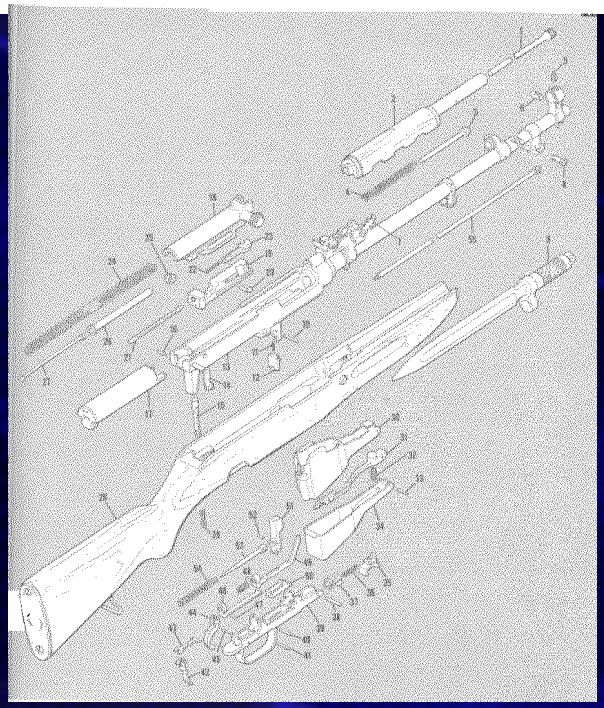
kE = [(V2 / 7000) / 64.32] x grains

- **Kinetic energy is a factor of velocity squared , divided by 7000 (the number of grains in a pound) , divided by a correction factor of 64.32 , then all multiplied by the grain weight of the projectile .**
- **Velocity usually plays the major role in the energy**
- **Over whelming weight (mass) can makeup for a slow velocity .**
- **Shape of a projectile will determine how well a object can slice through atmosphere and hence how well it will maintain velocity .**
- **Low velocity is under 2000 feet/second .**
- **High velocity is above 2000 feet/second .**



Ballistics



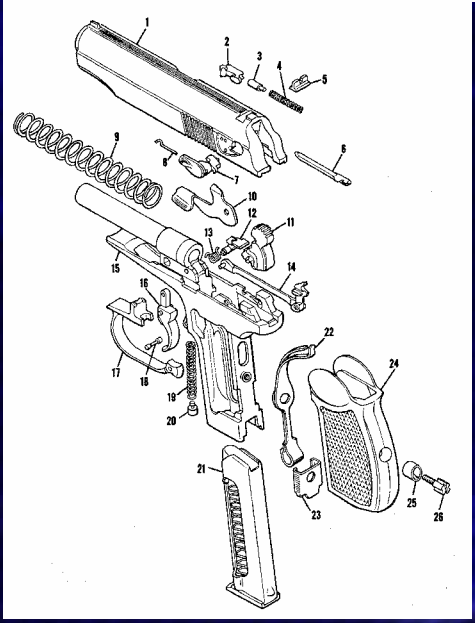


- Assault Rifle
- 120 Grain bullet
- 2800 feet/second

- kE = 2090 foot pounds of energy at the muzzle , but this will fall off with distance to target .

- High velocity

Ballistics

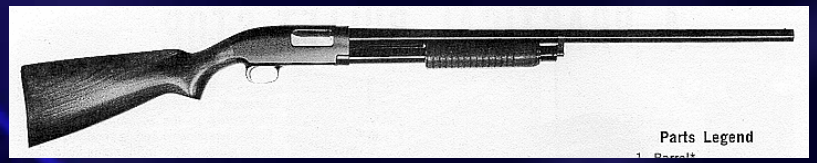


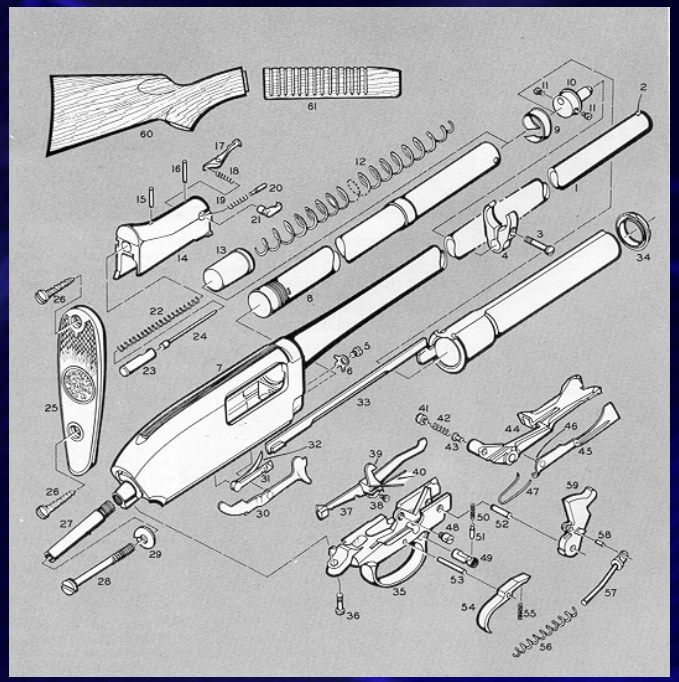
- Auto loading pistol
- 9 mm , 95 grain
- 1060 feet/second

- kE = 237 foot pounds

- Low velocity

Ballistics





- Shot Gun
- 1 1/4 oz lead shot
- 1200 feet/second

- kE is determined by the grains of the individual pellet .

- kE = 4.4 or less foot pounds for # 6 shot , energy falls off rapidly

- Very low velocity

Ballistics

- **Not all projectiles need come from fire arms !!!**

- **3000 pound car**
- **30 mile per hour (44 feet/second)**

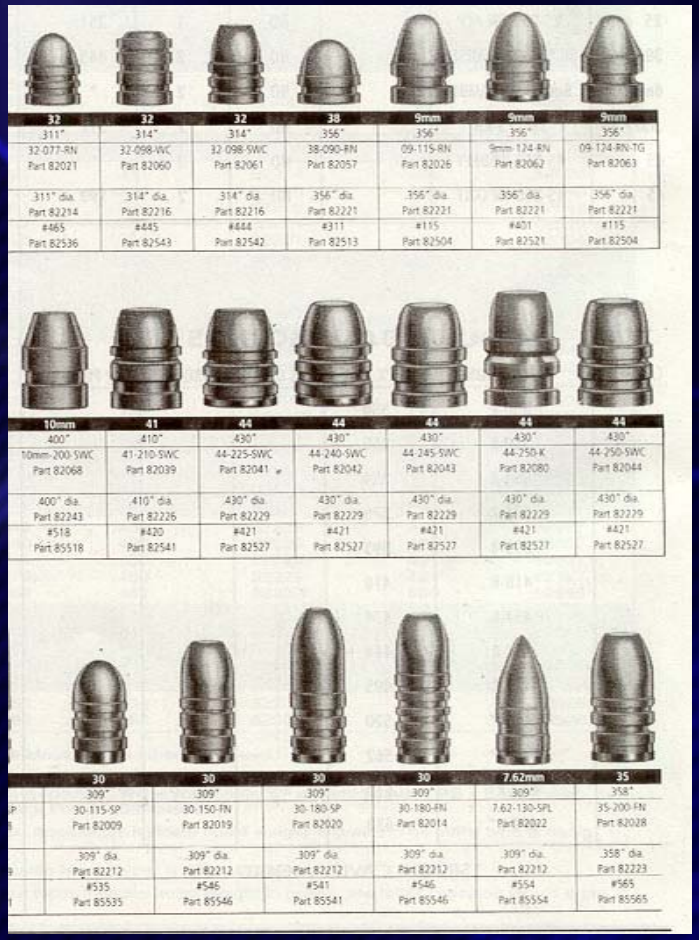
- **kE = 91,000 foot pounds of energy to a pedestrian (361,194 foot pounds at 60 mph)**

- **Very low velocity but very high mass .**

Projectile Design

- **Soft Lead**
- **Partial Jacket , Soft Point**
- **Full Jacket , Pistol and Military Ball**
- **Hollow Point**
- **Wad Cutter**
- **Explosive**
- **Tracer**

Soft Lead



32	32	32	38	9mm	9mm	9mm
.311"	.314"	.314"	.356"	.356"	.356"	.356"
32-077-RN Part 82021	32-098-WC Part 82060	32-098-SWC Part 82061	38-090-RN Part 82057	09-115-RN Part 82026	9mm-124-RN Part 82062	09-124-RN-TG Part 82063
.311" dia. Part 82214	.314" dia. Part 82216	.314" dia. Part 82216	.356" dia. Part 82221	.356" dia. Part 82221	.356" dia. Part 82221	.356" dia. Part 82221
#465 Part 82536	#445 Part 82543	#444 Part 82542	#311 Part 82513	#115 Part 82504	#401 Part 82521	#115 Part 82504

10mm	41	44	44	44	44	44
.400"	.410"	.430"	.430"	.430"	.430"	.430"
10mm-200-SWC Part 82068	41-210-SWC Part 82039	44-225-SWC Part 82041	44-240-SWC Part 82042	44-245-SWC Part 82043	44-250-K Part 82080	44-250-SWC Part 82044
.400" dia. Part 82243	.410" dia. Part 82226	.430" dia. Part 82229	.430" dia. Part 82229	.430" dia. Part 82229	.430" dia. Part 82229	.430" dia. Part 82229
#518 Part 85518	#420 Part 82541	#421 Part 82527	#421 Part 82527	#421 Part 82527	#421 Part 82527	#421 Part 82527

30	30	30	30	7.62mm	35
.309"	.309"	.309"	.309"	.309"	.358"
30-115-SP Part 82009	30-150-FN Part 82019	30-180-SP Part 82020	30-180-FN Part 82014	7.62-130-SPL Part 82022	35-200-FN Part 82028
.309" dia. Part 82212	.309" dia. Part 82212	.309" dia. Part 82212	.309" dia. Part 82212	.309" dia. Part 82212	.358" dia. Part 82223
#535 Part 85535	#546 Part 85546	#541 Part 85541	#546 Part 85546	#554 Part 85554	#565 Part 85565

- Variety of shapes
- Hold together after impact well
- will expand somewhat
- transfer energy well
- maintain velocity well
- used for both high and low velocity applications
- very low tech , easy to make

Partial Jacket , Soft Point

- **Complex construction**
- **Lead core with copper jacket**
- **designed to enhance expansion yet maintain weight**
- **larger wound channels**
- **better energy transfer**
- **? More accurate at longer ranges ?**
- **Can be driven at higher velocities than lead only**

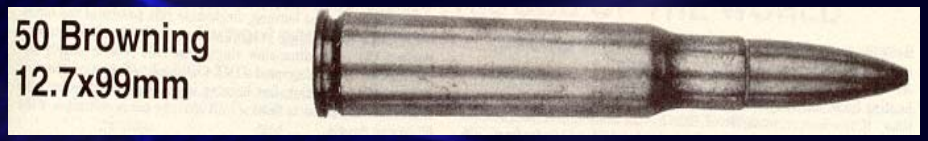
Full Metal Jacket

- **Rugged , can tolerate rough handling**
- **Usually military , surplus**
- **Can be driven at very high velocity accurately**
- **Limited wound channel**
- **Very little expansion**
- **Little transfer of energy**
- **Damage by shock wave**
- **More hard tissue damage**
- **Also common for handguns**

Hollow Point

- **Metal jacket , tip hollow**
- **More expansion than soft point at lower velocities**
- **More energy transfer at lower velocities**
- **Excellent handgun projectile**
- **Large amount soft tissue damage**
- **High tech to manufacture**

Explosive Projectile



- **Military projectile**
- **Explosive charge within the projectile**
- **Extensive tissue damage**
- **Fragments throughout wound area**
- **High velocity , long range**
- **Maintains velocity well**
- **Not common on the street**

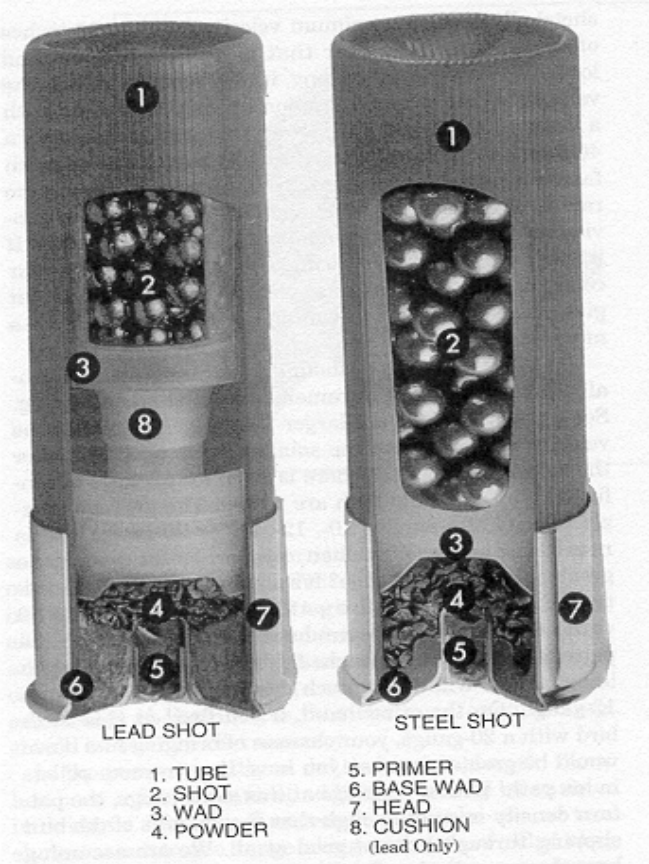
Tracer Projectile

- **Military application , for directing rapid fire , see where the projectile travels**
- **Not very accurate**
- **Surplus available**
- **Magnesium compound in tail of projectile that burns when fired**
- **Jacketed round**
- **Wound channel burned**
- **Extensive tissue damage**

Wad Cutter

- **Lead construction**
- **Flat tip , Ash can shape**
- **Usually handgun projectile**
- **Good energy transfer**
- **Does not maintain velocity as well**
- **Low velocity loading**
- **close in applications**
- **Maintains weight well after contact**

Shot



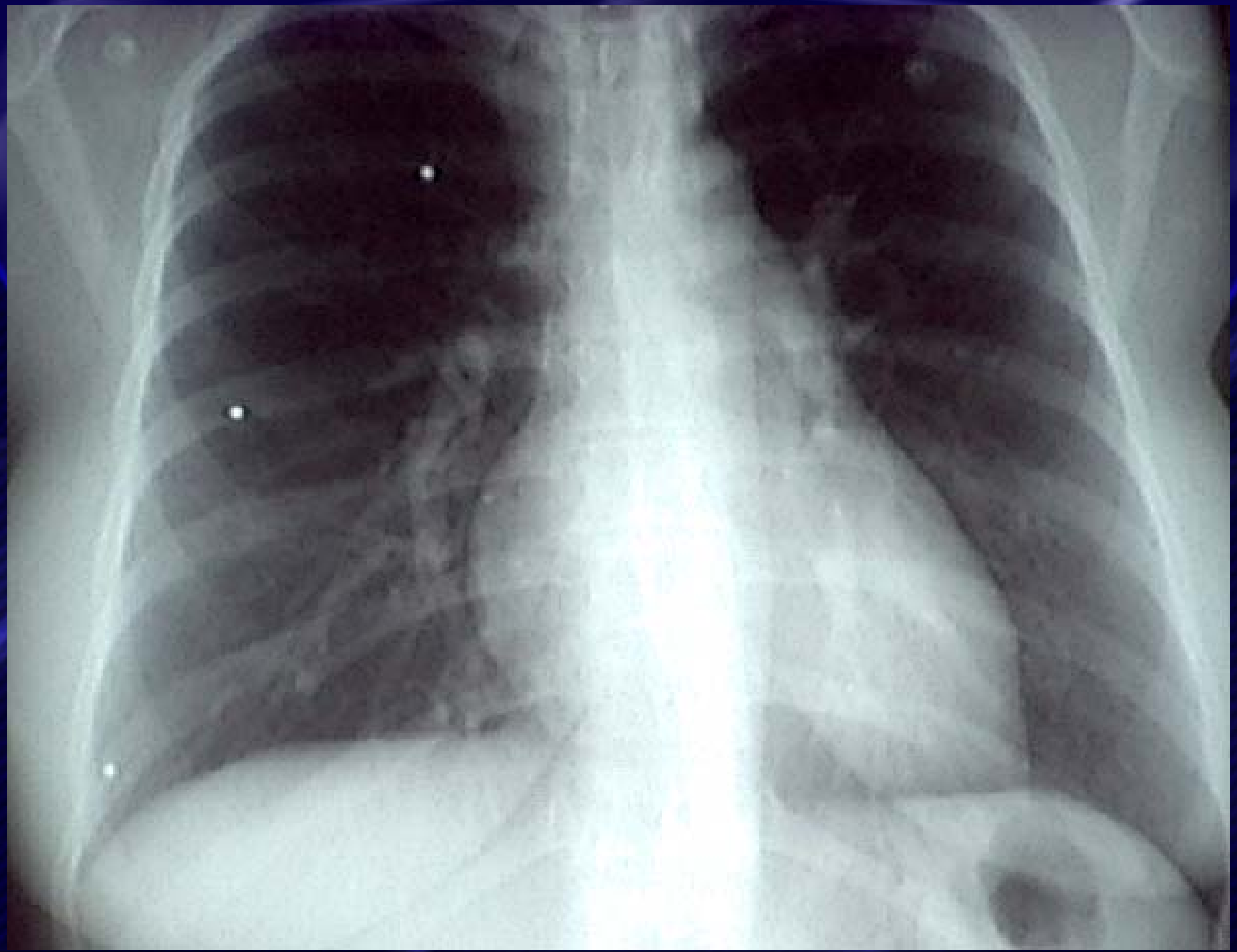
- **Multiple projectiles**
- **Variety of sizes**
- **Must calculate energy on the basis of individual pellets**
- **Jagged wound channel**
- **Distal embolization**
- **Short range**
- **Loses velocity and energy very quickly**
- **Varied composition**

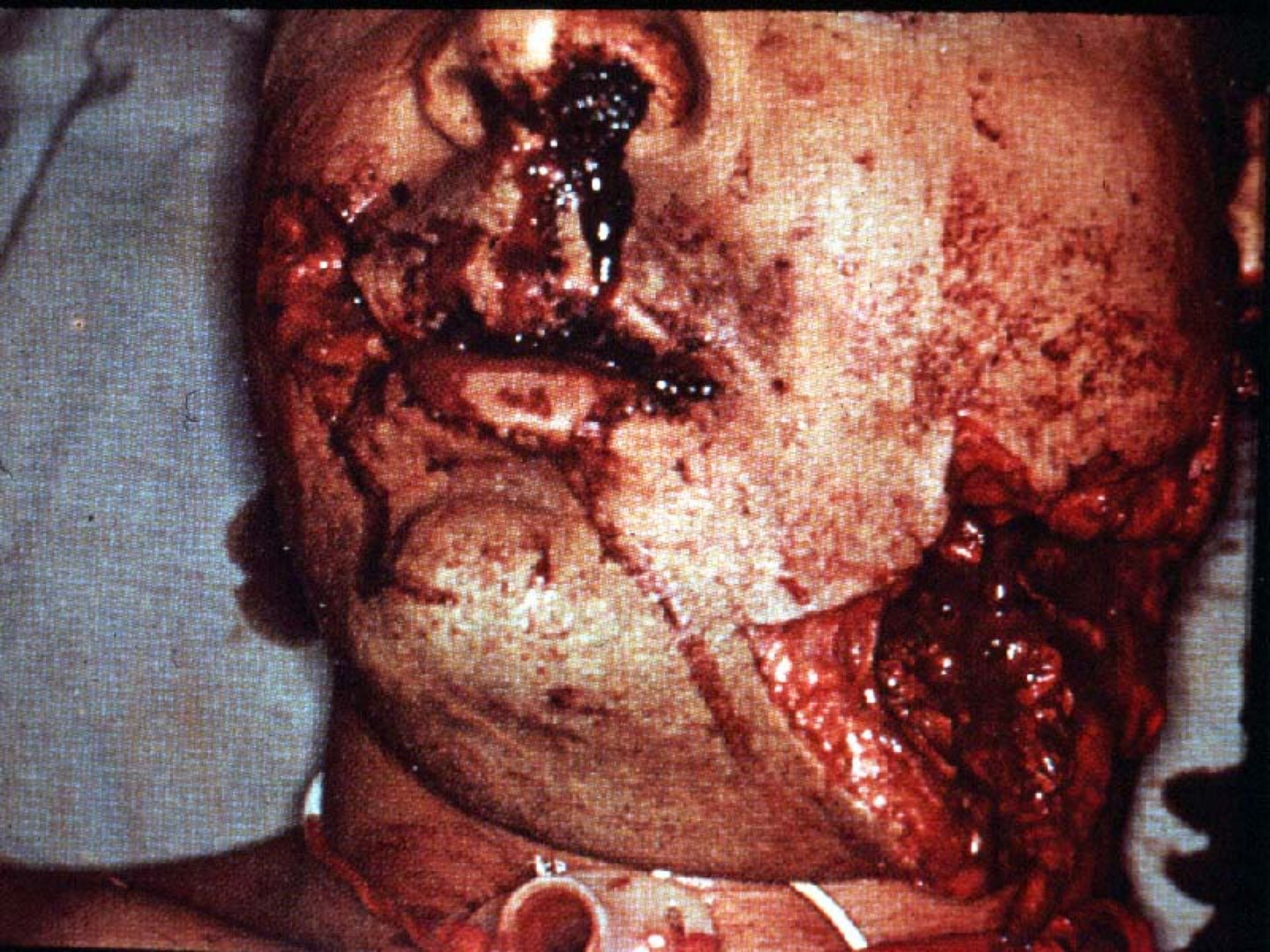
Pathology

- **Design Characteristics , Special Considerations :**
- **Maintain weight**
- **Deformability**
- **Expansion**
- **Fragmentation**
- **Multiple Projectiles**
- **Organ Damage**
- **Wound channel size**
- **Shock Wave injury**
- **Foreign material into wound**
- **Thermal**

Pathology

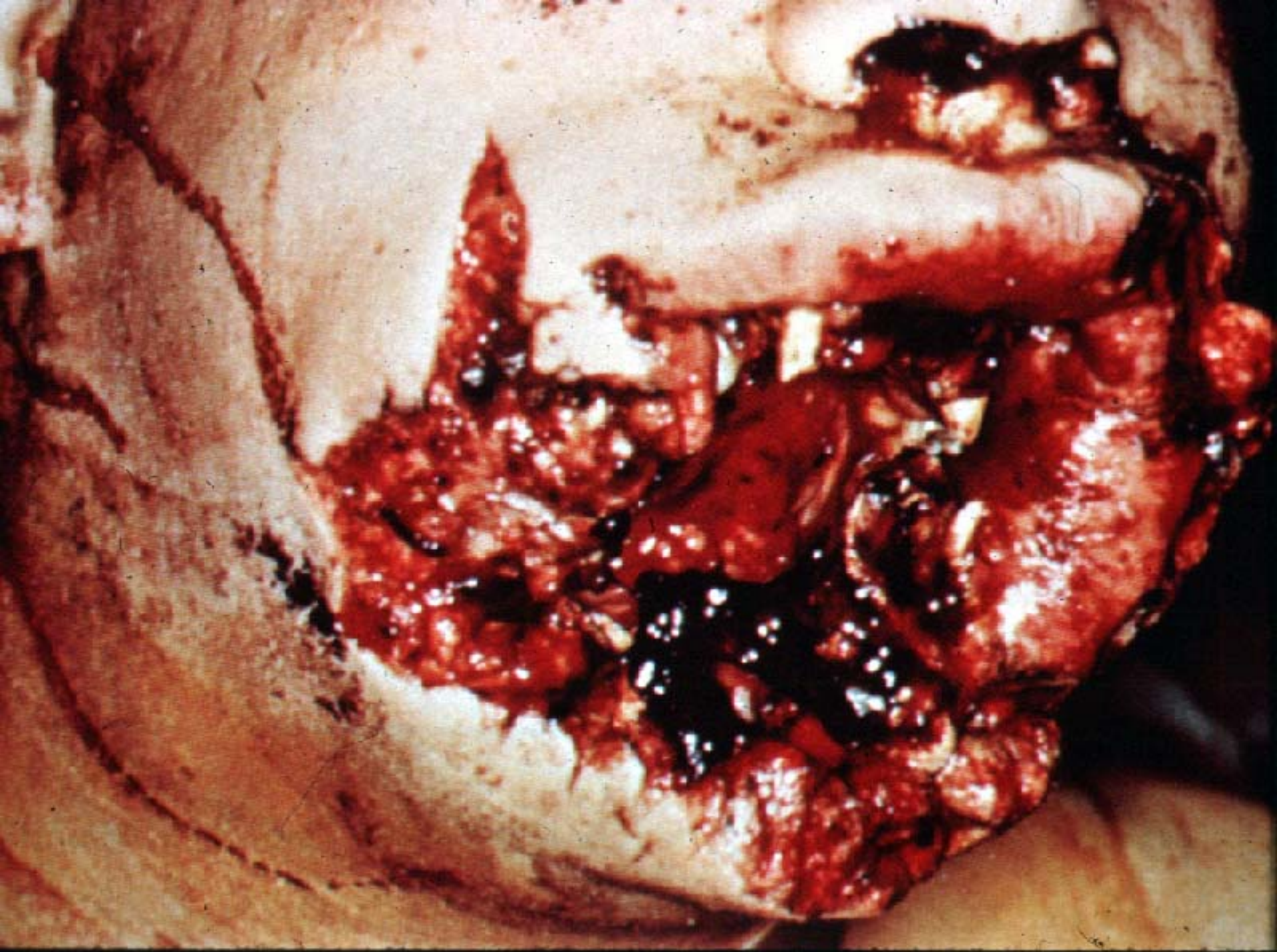
- **Projectiles injure soft and hard tissues**
- **One projectile can be a multi - system trauma**
- **Damage is a factor of design , velocity , and distance**
- **Transfer of energy is a factor of design and velocity**
- **Distal embolization can occur when a projectile slows enough and enters the vascular system**
- **Entry and exit wounds can lie ! ! ! ! ! ! Projectiles do not have to follow a straight line !**





Pathology

- **Kinetic energy is the similarity between MVA and GSW, massive amounts ! ! !**
- **50 % of deaths are due to exsanguination**
- **10 % from CNS injury**
- **Require rapid pressure application and evacuation , the one exception is that of a GSW to the head . The wound is just covered lightly**
- **Large bore IV's are needed for fluid replacement**
- **Do not delay transport for ANY REASON ! ! ! ! ! ! !**
- **GSW are Treated in the Operating Room , saved in the field**



Field Assessment

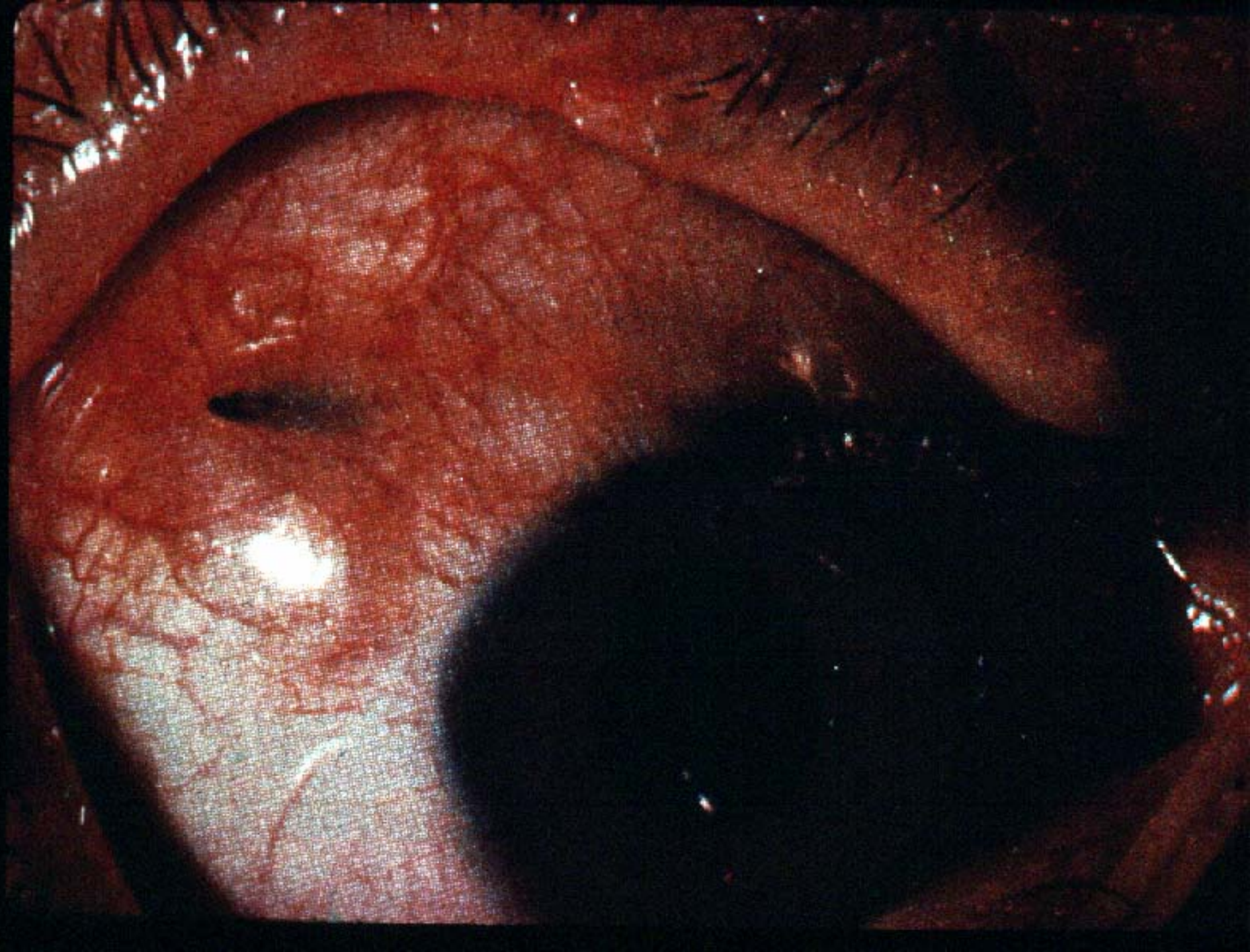
- **Scene Safety**
- **Do Incident Command ! !**
- **Who ‘s the patient ?**
- **How many ??**
- **Do not become one of the patients by going in without support**
- **Relay accurate information ASAP to the receiving hospital ! ! ! !**
- **A 5 minute ETA report will not cut it ! ! ! !**

Field Assessment

- **Observe details of the scene**
- **How far away was the gun from the patient ?**
- **How many shots fired ?**
- **What type of weapon ?**
- **Have someone search the area , someone could be down just around the corner**
- **Patient care but remember it is a crime scene too ! ! !**

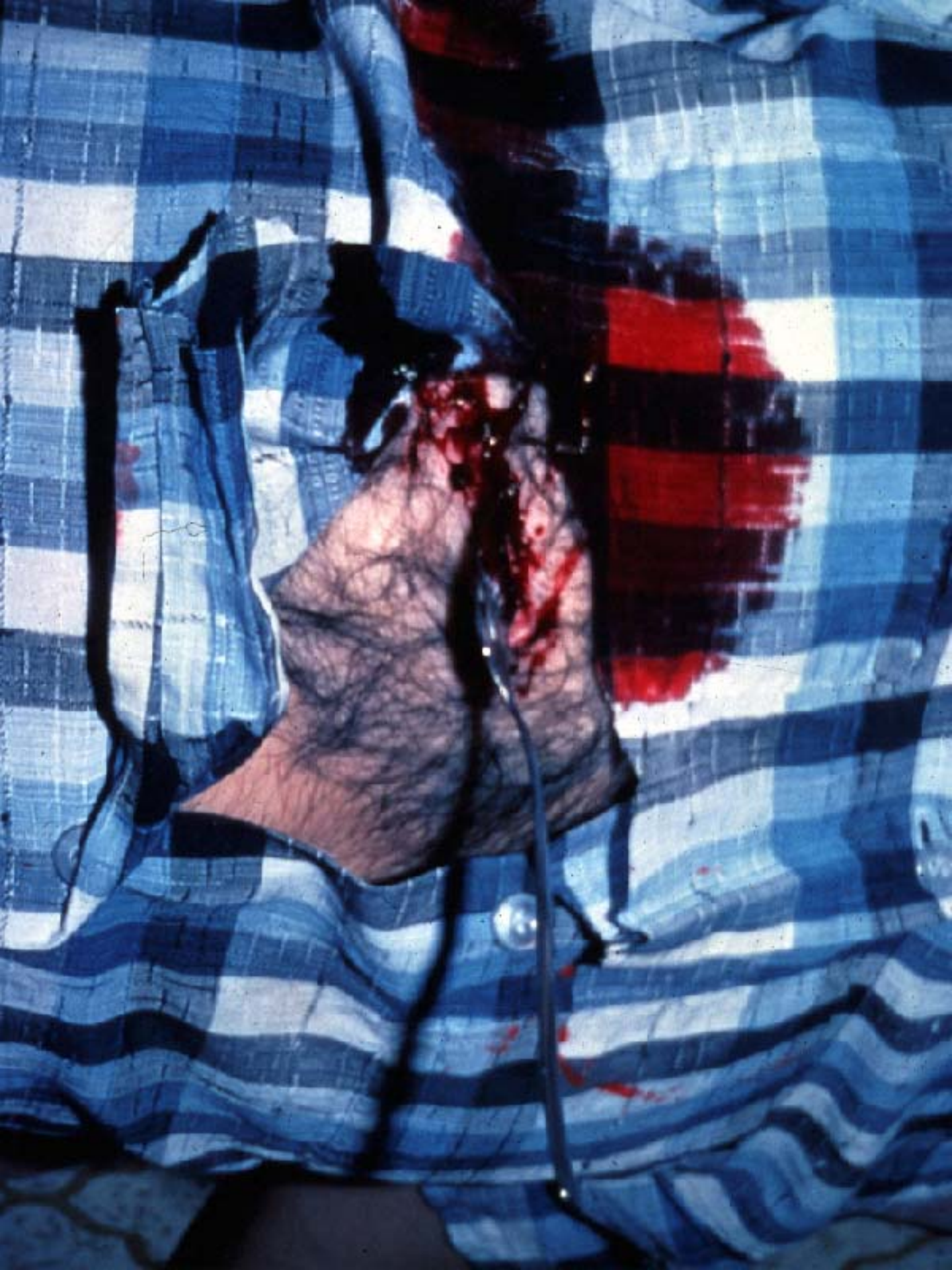
Field Assessment

- **ABC's**
- **Oxygenate**
- **Ventilate**
- **IV's and Fluid**
- **Rapid extrication**
- **Rapid Transport**
- **Meet any additional resources enroute ! ! !**
- **Smaller hospitals do have surgeons that can stop internal bleeding ! ! ! And temporize !**



Field Assessment

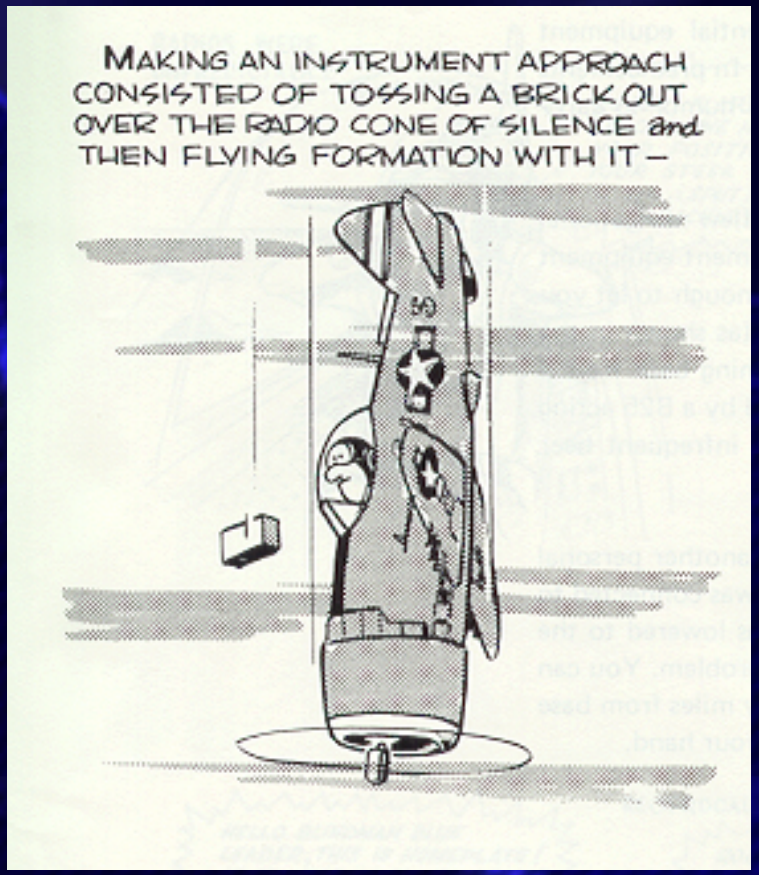
- **Document every item**
- **Serial vitals**
- **Serial ABC's**
- **Serial neurovascular**
- **Serial GCS**
- **Changes enroute**
- **Recheck dressings**
- **Recheck IV's**
- **Med Command as needed**
- **Nausea , vomiting , pupils , etc.**



Hospital Assessment

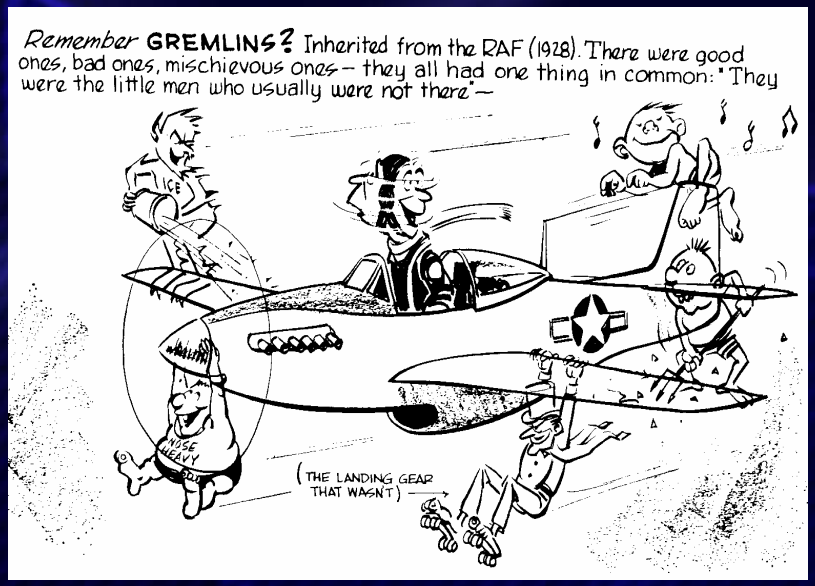
- **Get as much information as you can from the scene**
- **Know the number of patients coming**
- **Inform EMS the number you can handle**
- **Mobilize your resources**
- **Uncross-matched blood ASAP to ED and OR**
- **Mobilize the OR**

Hospital Assessment



- **On arrival , Repeat ABC's**
- **Repeat vitals**
- **Examine wounds**
- **Fluids / Blood as needed**
- **Expedite OR or diagnostics**
- **Remember a single GSW can be a multi-system trauma**
- **Fix any pneumothorax before diagnostics**

Hospital Assessment

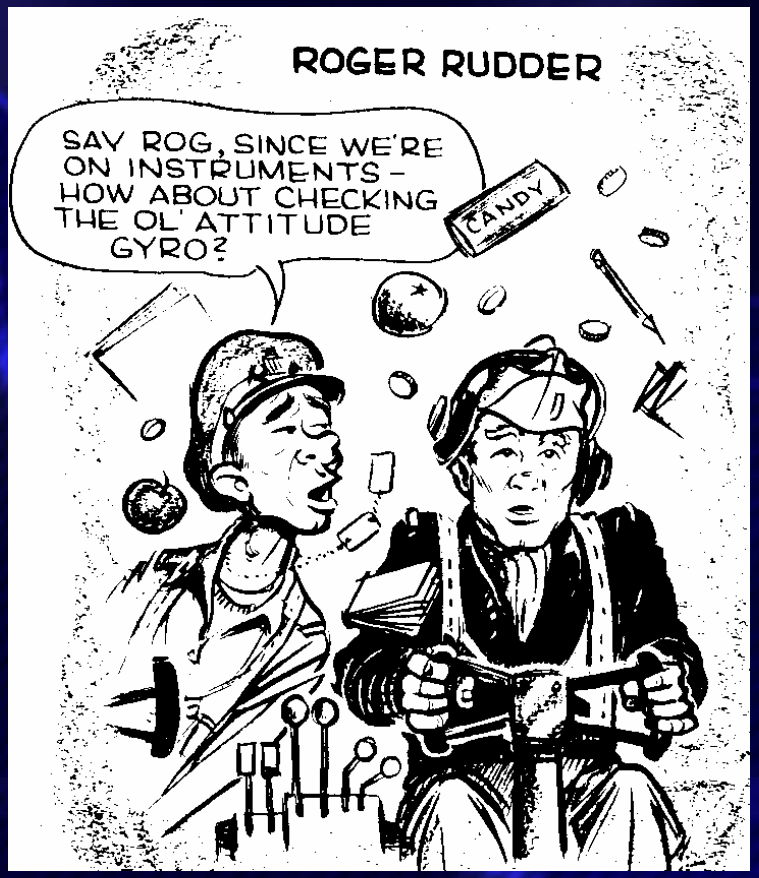


- **Labs**
- **CBC**
- **T & C**
- **SMA - 20 , amylase**
- **PT / PTT**
- **U / A**
- **ABG**
- **X - Ray**
- **Skull , Facial**
- **C - Spine**
- **CXR**
- **ABD**
- **Extremity**

Hospital Assessment

- **Procedures**
- **Large bore lines**
- **EKG**
- **DPL**
- **Monitoring**
- **Oxymetry**
- **ICP Bolt**
- **Mini - Lap**
- **Open Chest**
-

Hospital Assessment



- **Special Diagnostics**
- **CT**
- **IVP**
- **Cysto**
- **DPL**
- **Arteriogram**
- **Ultrasound**
- **Echocardiogram**
- **Fetal monitoring**

Wisdom

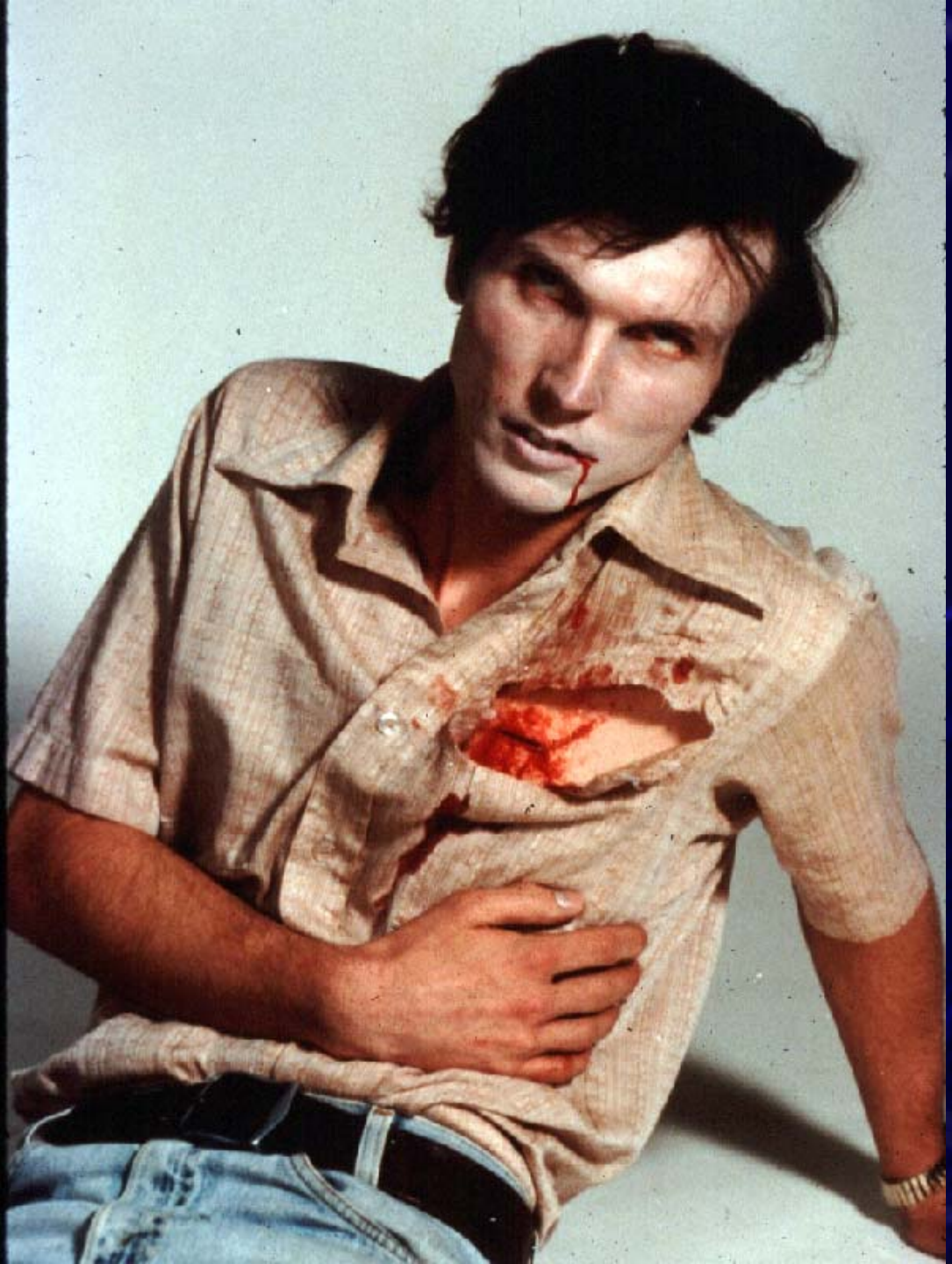
- **GSW are multi - system events**
- **GSW to the head cause C - Spine injuries**
- **Point A - to - point B is not always a straight line ! ! !**
- **GSW patients have other concomitant problems :**
- **Drugs**
- **ETOH**
- **HIV , Hepatitis B , etc.**
- **Medical , pregnancy**
- **Surgical**
- **May not speak the truth**
- **GSW are high risk to all involved**

Wisdom

- **Think ballistic injury with all forms of trauma**
- **Rapid deceleration and stop can be a ballistic injury**
- **A fall is a ballistic injury**
- **Ballistic injury can be occult just like other penetrating events**

Summary

- **The OR is the CURE ! ! !**
- **Rapid assessment , treatment , and transport**
- **Do not by - pass a smaller hospital with a surgically unstable patient , they can help you stabilize the patient**
- **Activate all resources as soon as the need noted**
- **Use Incident Command**
- **Notify receiving hospital ASAP ! ! !**



Summary

- **Plan Ahead**
- **Know available resources**
- **Expect the un- expected**
- **Be prepared for the worst**
- **Oxygen and fluid , and fluid , and fluid !**
- **Serial ABC's**