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## WAR WOUNDS: SOME HISTORY, MECHANISMS AND PATHOLOGY

MR JOHN BEAVIS FRCS DMCC

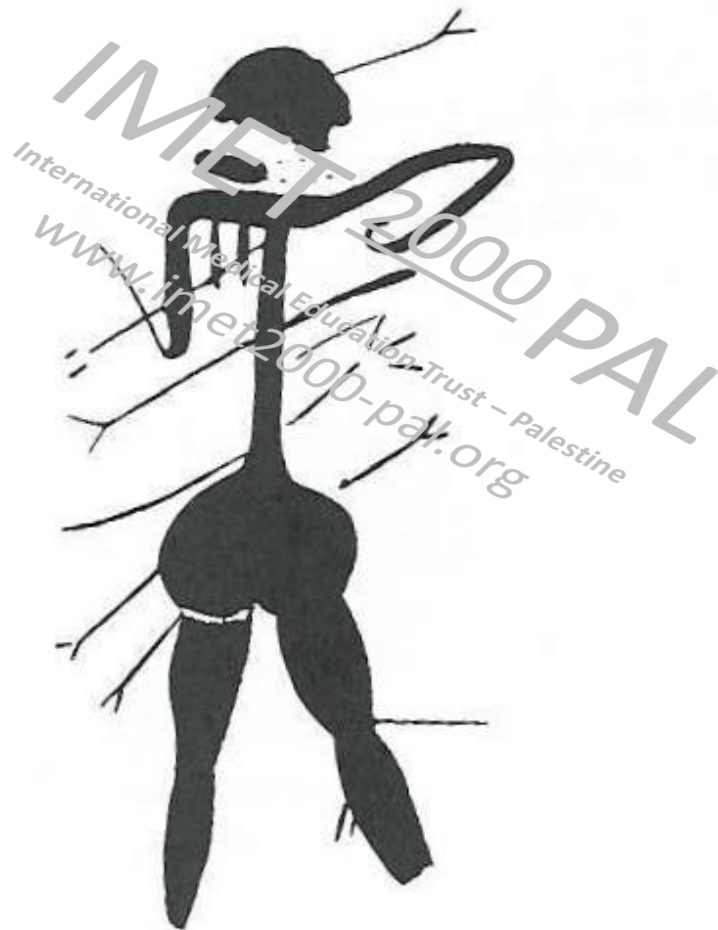
CONSULTANT TRAUMA SURGEON

PAST SENIOR LECTURER UNIVERSITY COLLEGE LONDON

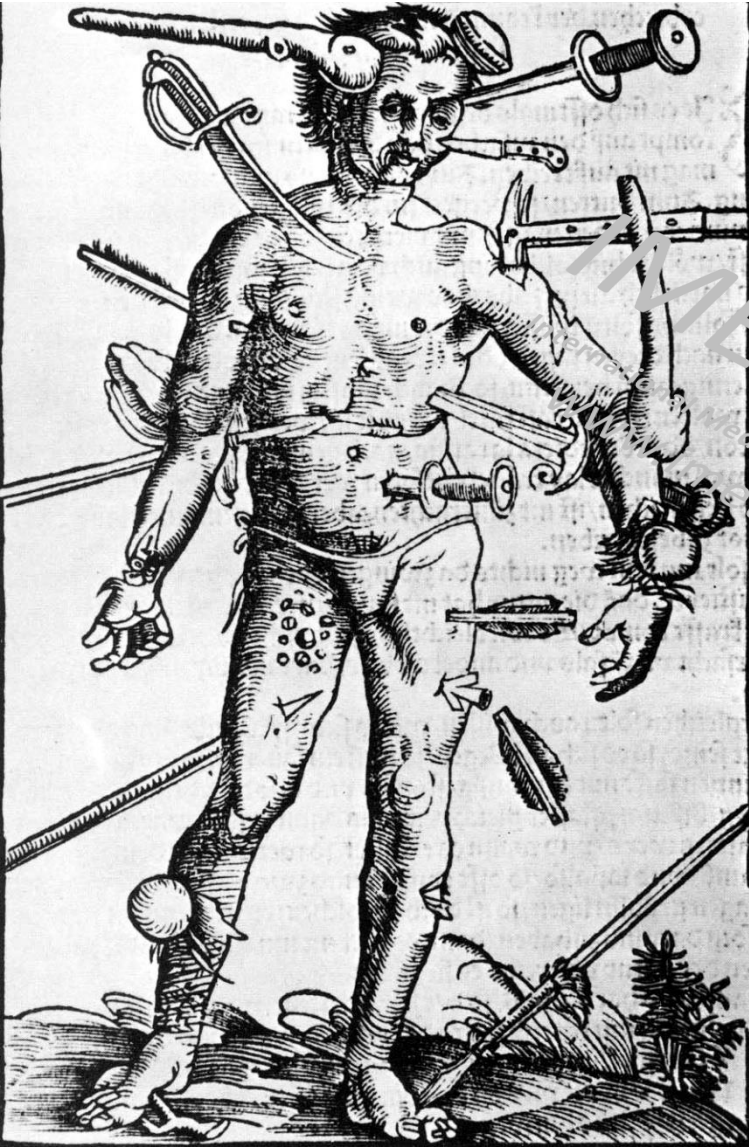
PAST HUNTERIAN PROFESSOR

ROYAL COLLEGE OF SURGEONS OF ENGLAND

# Cave Dweller Painting In France At Least 25,000 Years Old



# LOW ENERGY WOUNDS



# HIGH ENERGY WOUNDS

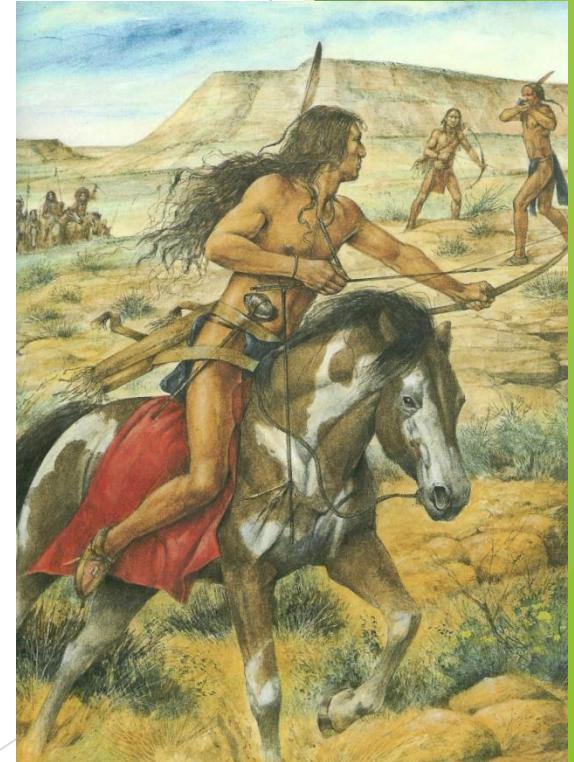
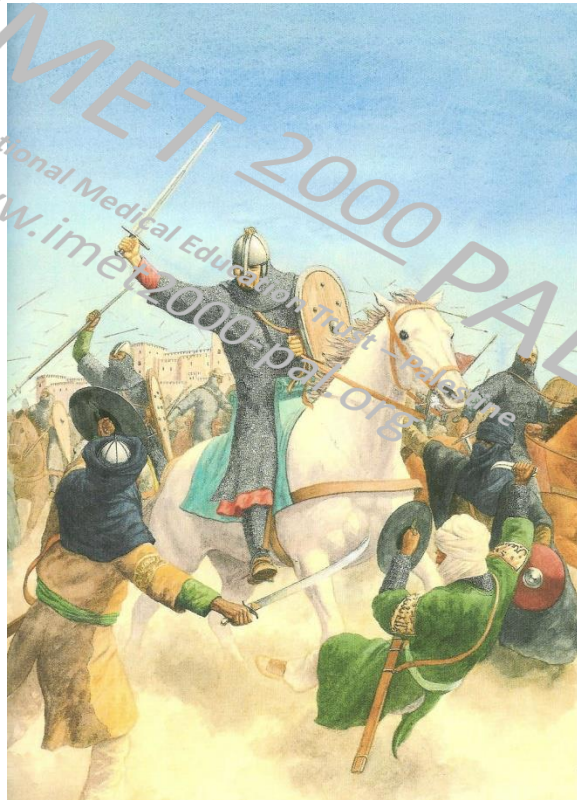
# History of war injuries

## LOW AND HIGH ENERGY WOUNDS

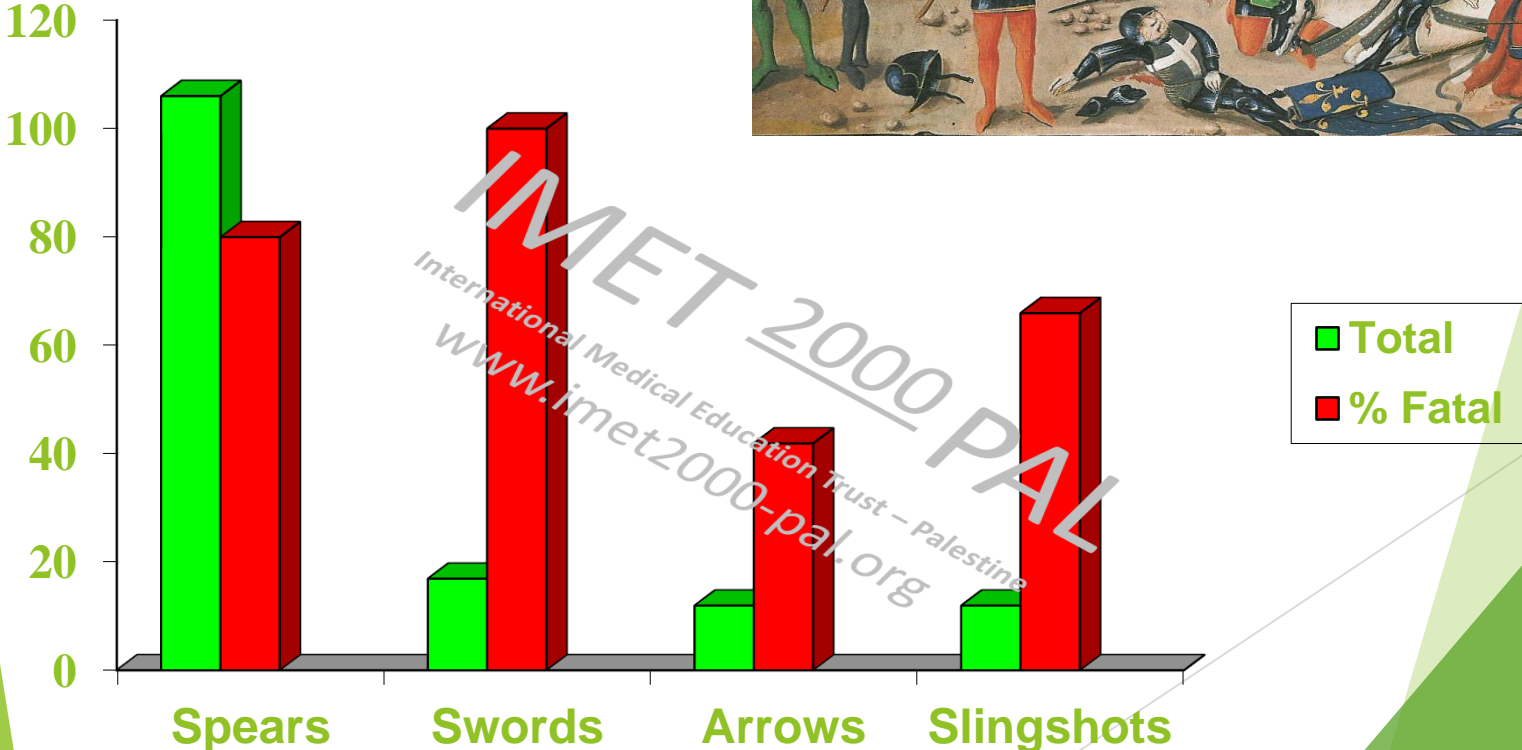
- ▶ Sharp/blunt weapons personally delivered by hand and contact
- ▶ Projectiles -- stones, arrows
- ▶ Explosive Discharge Projectiles -- bullets, shell fragments, mines
- ▶ Explosive --- blast injuries

# LOW ENERGY MISSILES

- ▶ Sharp/blunt weapons personally delivered
- ▶ Projectiles -- stones, arrows



# STUDY OF TROJAN WARS IN HOMER'S ILIAD BY FROLICH



# LOW ENERGY PENETRATING WOUNDS

DESPITE VITAL SITE OF  
INJURY THEY CAN BE  
TREATED -----

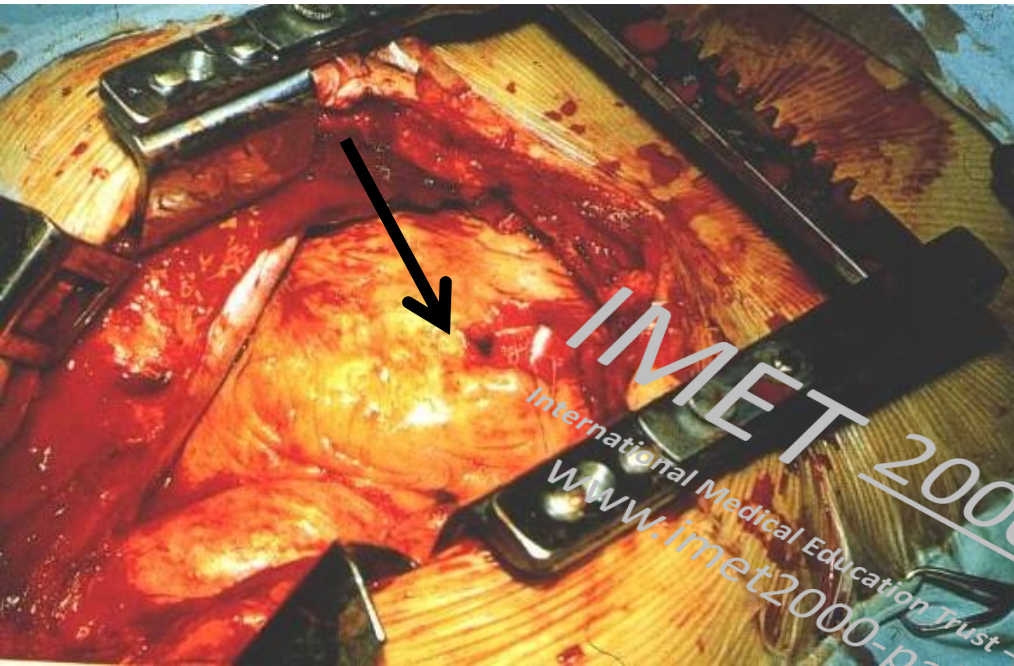


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----- IF THE VITAL ORGANS  
ARE  
NOT DAMAGED  
TOO MUCH BECAUSE  
THE DAMAGE IS  
LOCALISED TO THE  
TRACK OF THE INJURY!



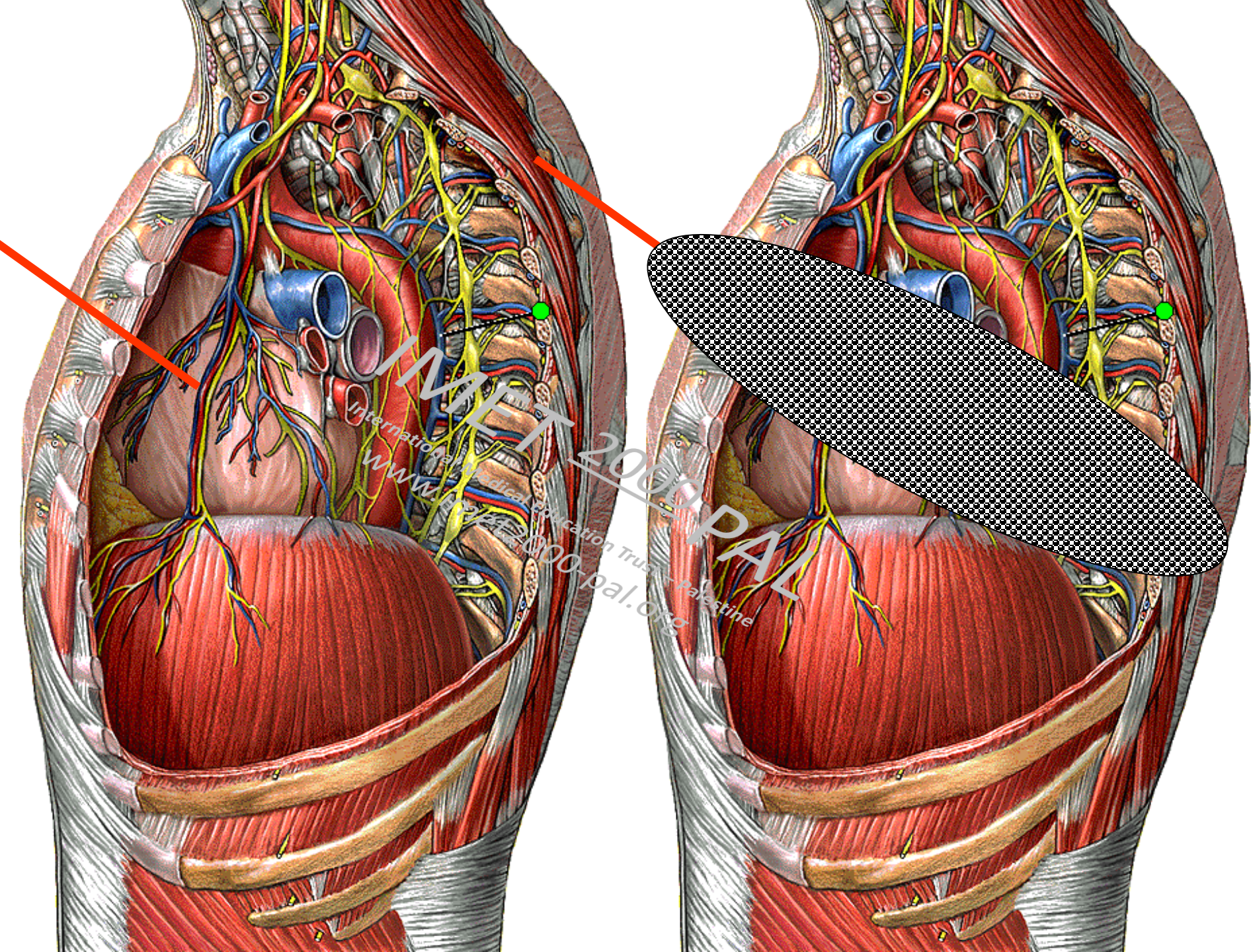
# LOW ENERGY WOUNDS ARE MUCH DIFFERENT TO HIGH ENERGY WOUNDS



1. A SINGLE LOW ENERGY knife wound of the heart which was sutured and patient survived. 6 in days in hospital

2. A SINGLE HIGH ENERGY bullet wound of the arm -- massive blood loss and infection. Patient nearly died of complications. 8 weeks in hospital





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# BUT WHAT MAKES A MISSILE HIGH ENERGY? ANSWER: SIZE AND VELOCITY

WHEN THE OBJECT STOPS THE ENERGY HAS TO GO SOMEWHERE!!

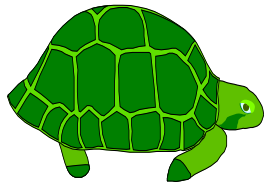


Fig. 14. From bottom to top, the intact round, a cutaway showing the internal construction, and the bullet as it appeared after striking a multi-layer aluminum can shown for a bullet fired from a Soviet AK74 (left), an M16 bullet fired from an M16A1 (middle), and an M855 bullet fired from an M16A2 or an M249 Squad Automatic Weapon (SAR) (right).  
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# MODERN RIFLE VELOCITY OF HIGH ENERGY BULLET 2009 VERSUS MUSKET BALL 1805





**OVER THE CENTURIES  
MAN'S ABILITY TO MAKE  
GUNS MORE POWERFUL  
HAS BEEN MUCH GREATER  
THAN HIS ABILITY  
TO MAKE PEACE**

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# SOME CAUSES OF HIGH ENERGY MISSILE WOUNDS



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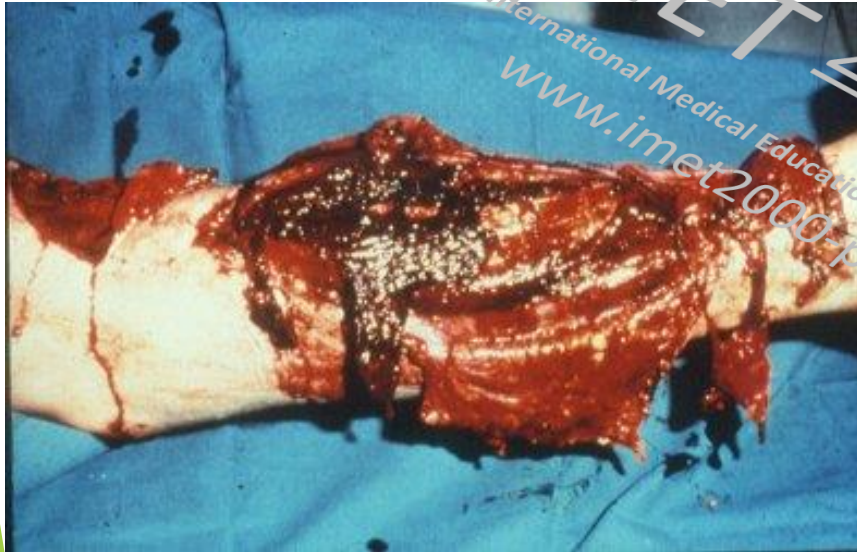
Fig. 1-17. A 20-mm cannon shell at the moment of detonation



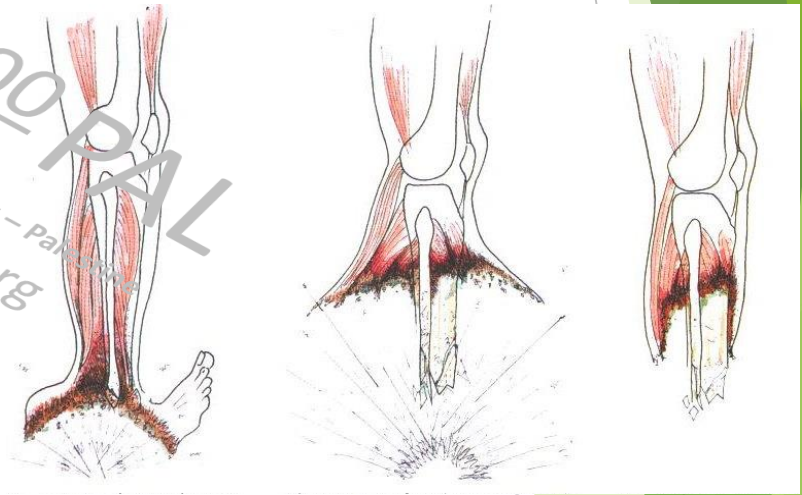
# HIGH ENERGY WOUNDS 1

## THE DAMAGE GOES WELL OUTSIDE THE INITIAL TRACK OF THE MISSILE

- ▶ Projectiles -- explosive discharge, bullets shell fragments.
- ▶ Explosive -- mines,



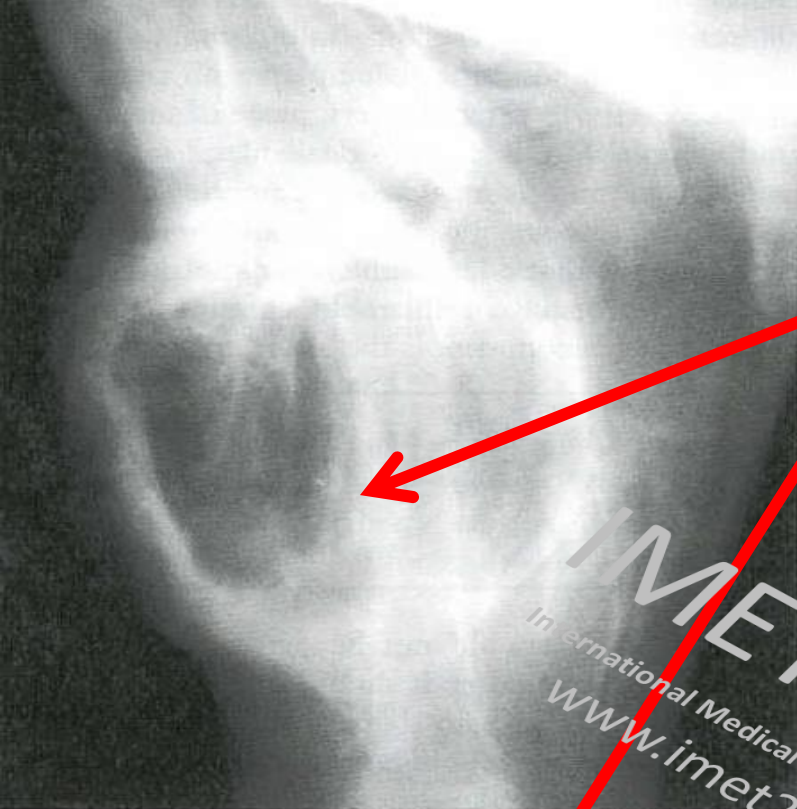
**HIGH ENERGY GUN SHOT**



**DIAGRAM OF MINE INJURY**

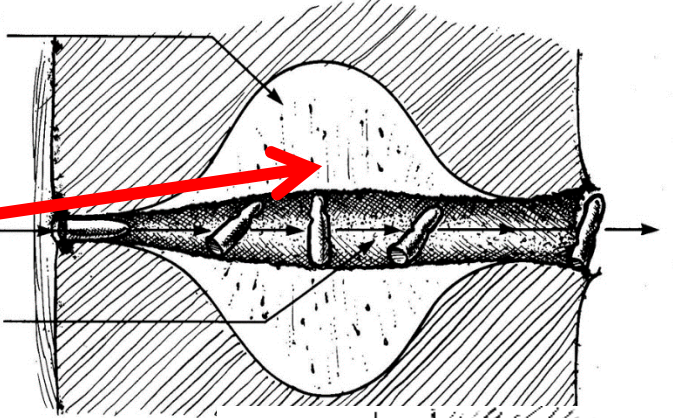


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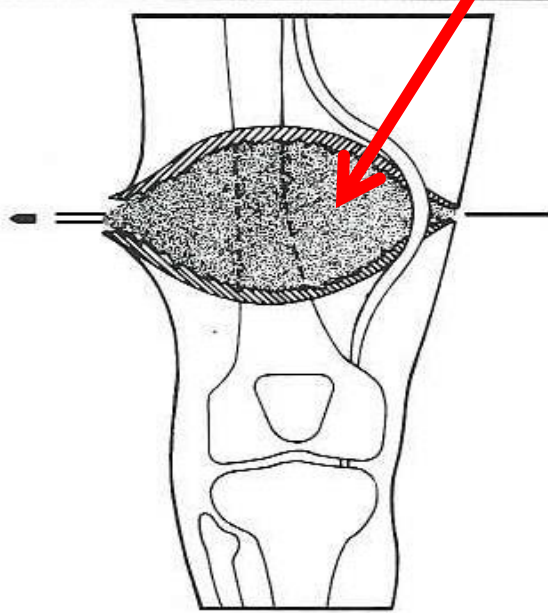
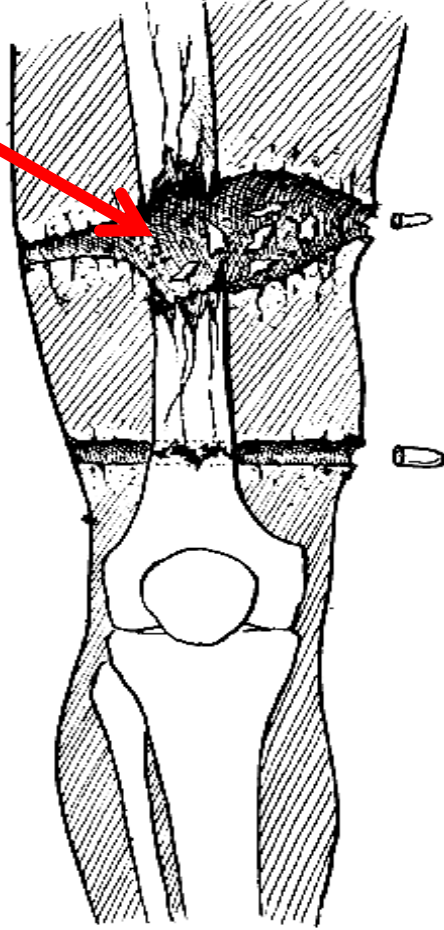
Privremena šupljina

Stalna šupljina



High Energy

Low Energy



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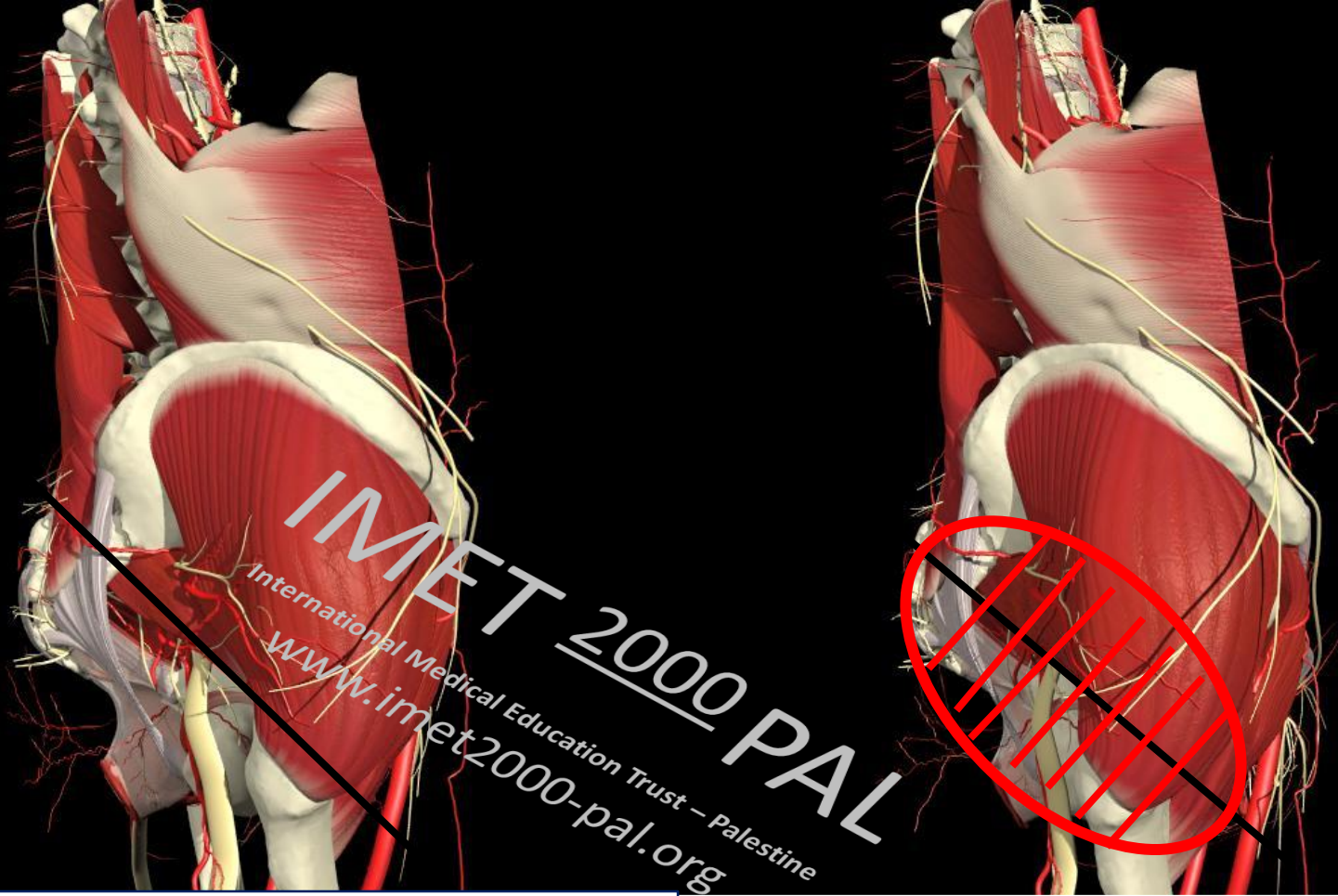


**Small entrance wound  
From high energy  
Bullet wound**

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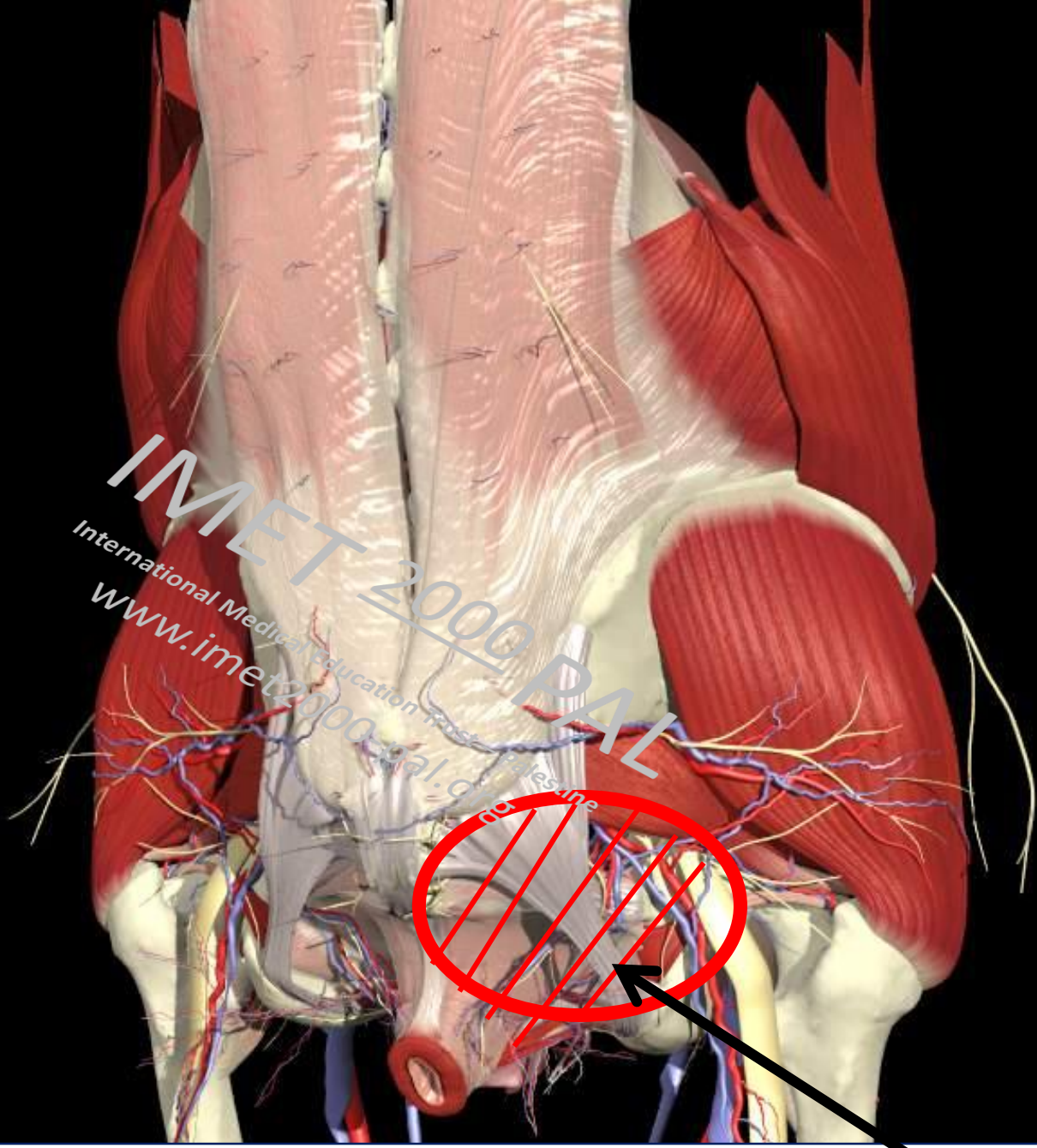


**Large exit wound.  
What has  
happened internally?**



**LOW ENERGY**

**HIGH ENERGY**



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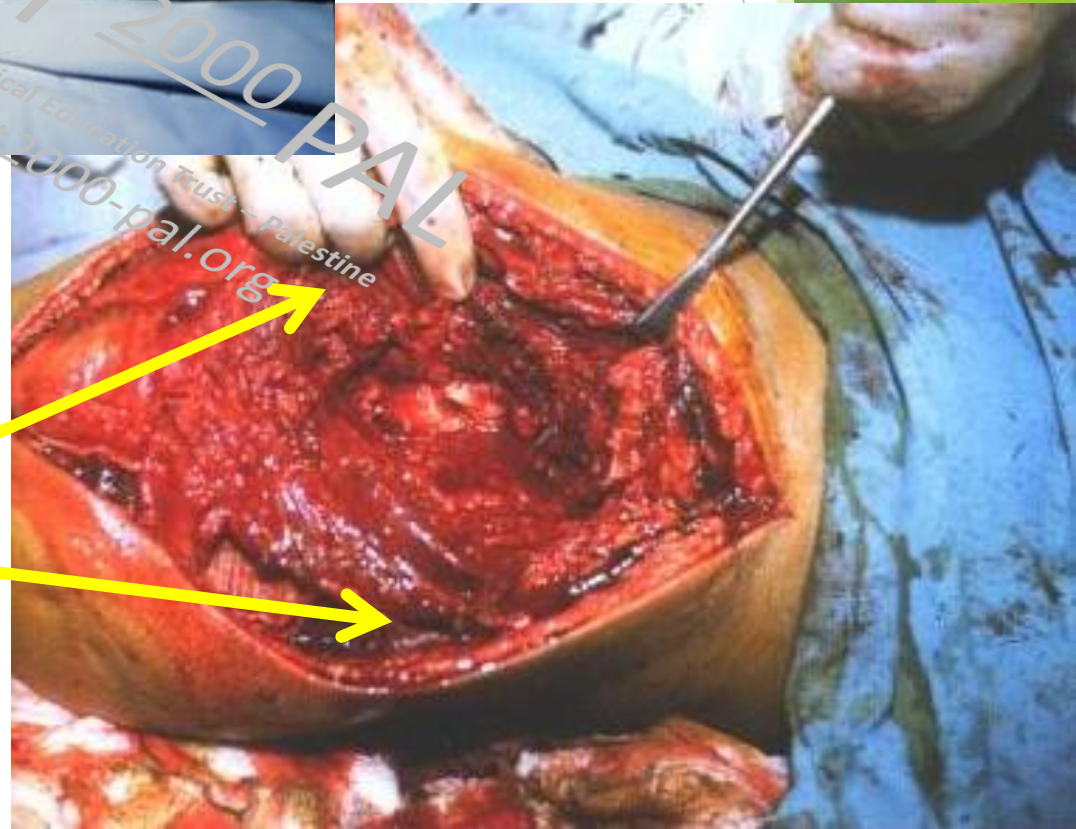
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**HIGH ENERGY GUN  
SHOT WOUND**



**SMALL ENTRY  
WOUND**



**MASSIVE TISSUE  
DESTRUCTION**

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**HIGH ENERGY MORTAR**

**SHELL FRAGMENT**

**LOWER SPEED THAN A**

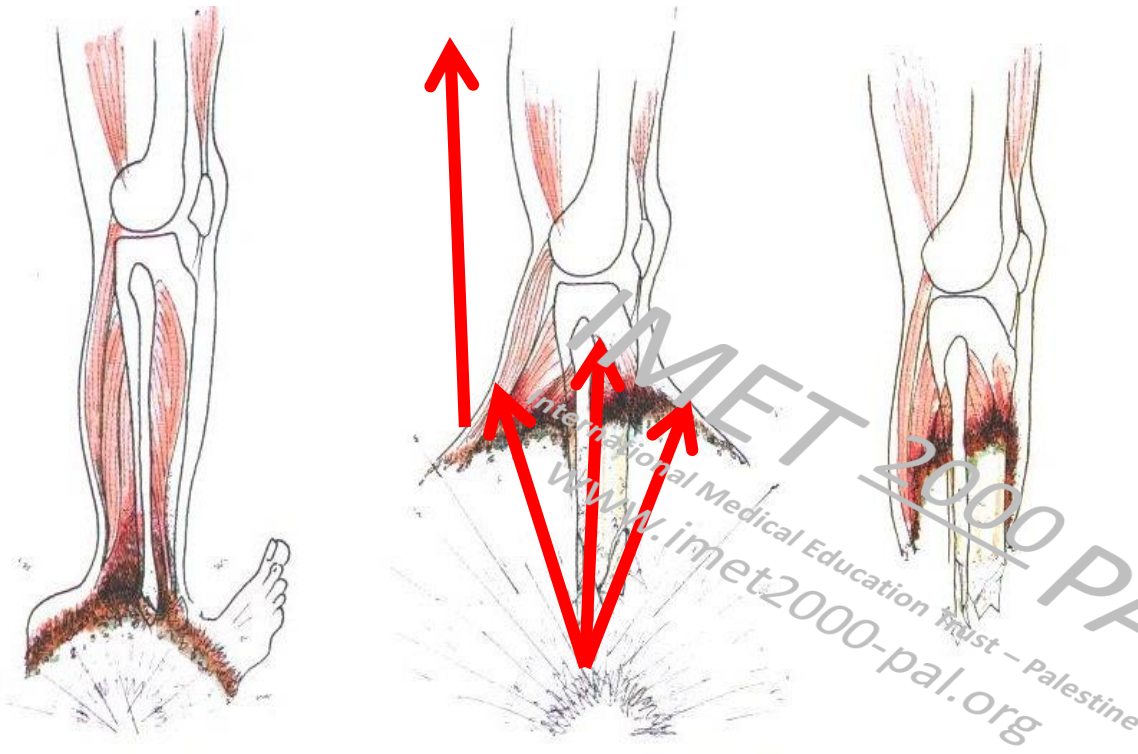
**BULLET BUT HEAVIER**

**CAN ONLY BE TREATED BY  
WIDE EXCISION OF DEAD  
TISSUE AND EVENTUAL  
GRAFTING**

**LEAVE THE WOUND OPEN  
UNTIL YOU ARE CERTAIN THE  
INFECTION/DEAD MATERIAL  
ARE REMOVED.**

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# MINE INJURIES



**HIGH ENERGY PARTICLES ARE  
DRIVEN UP WELL INTO THE  
HEALTHY TISSUES AND  
MAY BE CONCEALED**



**SARAJEVO 1994  
LOOKING FOR WOOD  
FOR HIS FAMILY**

# MINE INJURIES

▶ COMMON CAUSE OF AMPUTATION AND MANY ARE BILATERAL

▶ OFTEN IN WOMEN AND CHILDREN

▶ MULTIPLE INJURIES ESPECIALLY PERINEAL

▶ ANTI-PERSONAL ARE USUALLY UPPER LIMB



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# HIGH ENERGY WOUNDS 2

- ▶ Explosive -- blast injuries



MULTIPLE HIGH ENERGY MISSILES

MULTIPLE ORGAN HIGH ENERGY AND LOW ENERGY BLAST INJURIES

BURNS AND SMOKE INHALATION

EFFECTS OF BEING PROJECTED

CRUSHING INJURIES

TREATMENT DELAY WHEN TRAPPED

# BLAST SHOCK WAVE

## HIGH ENERGY

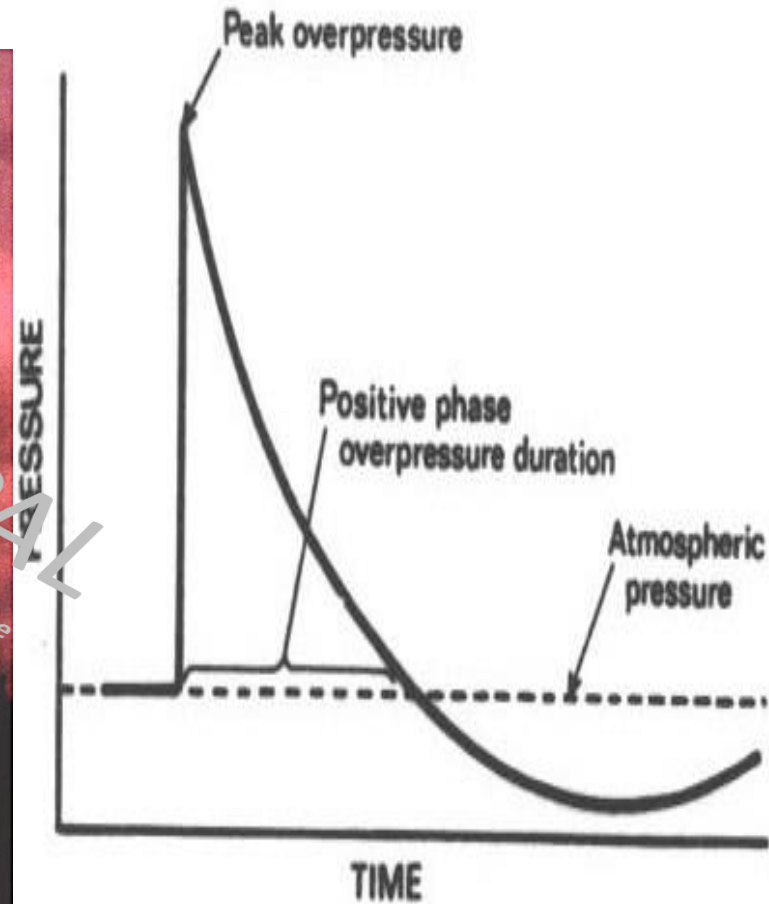
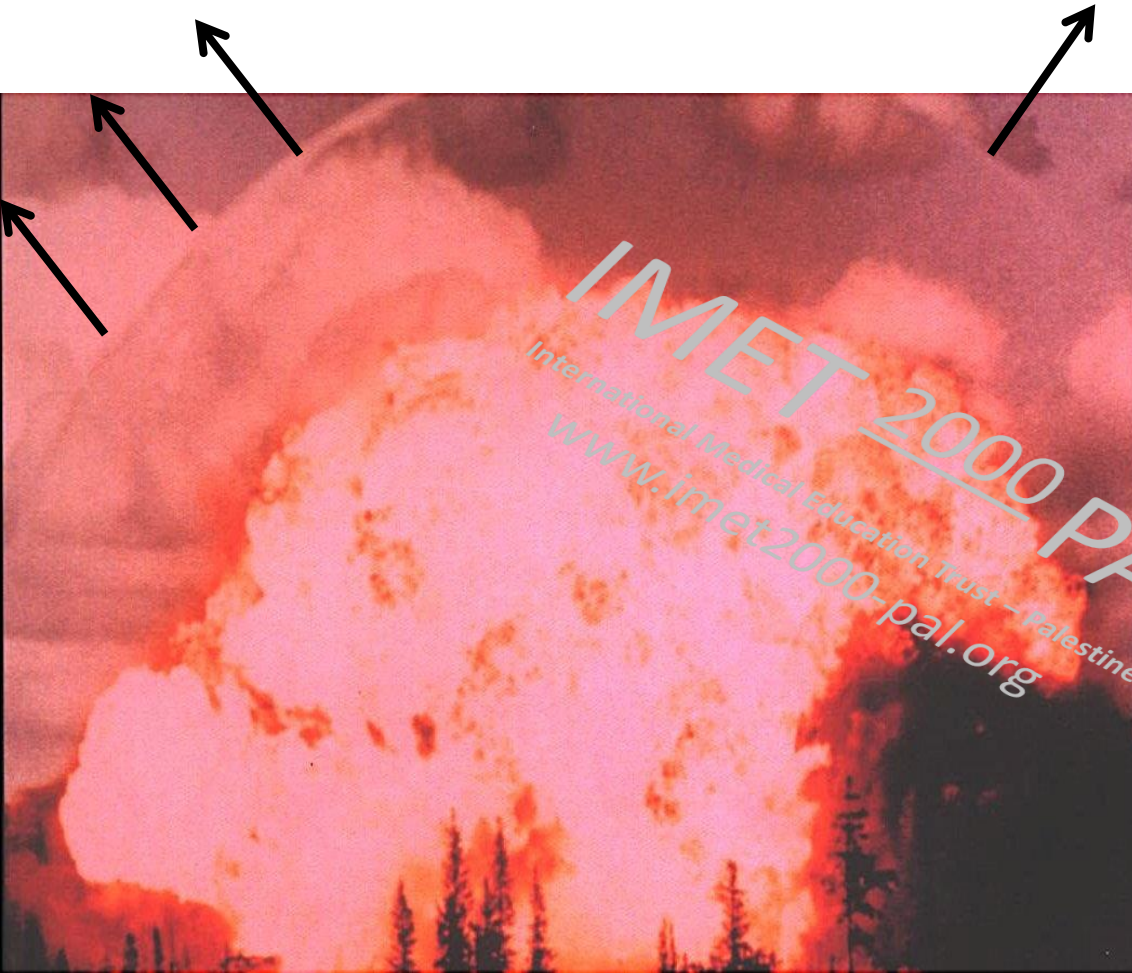
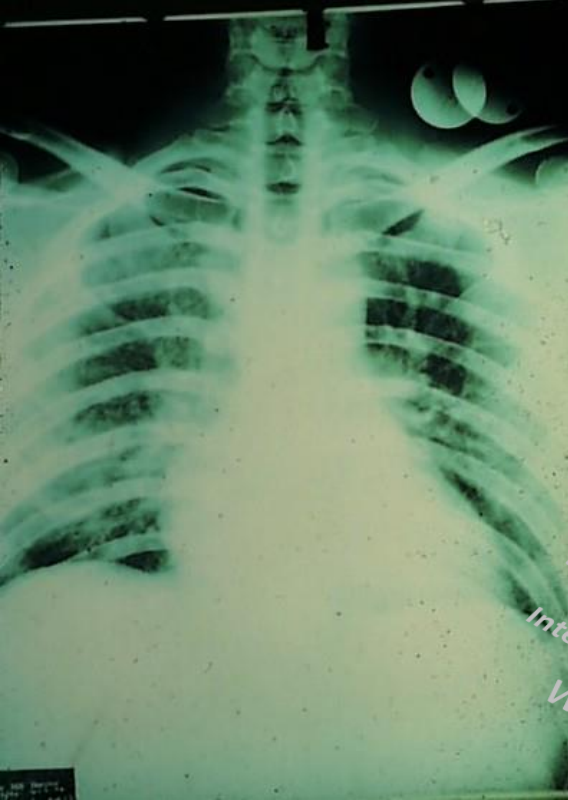
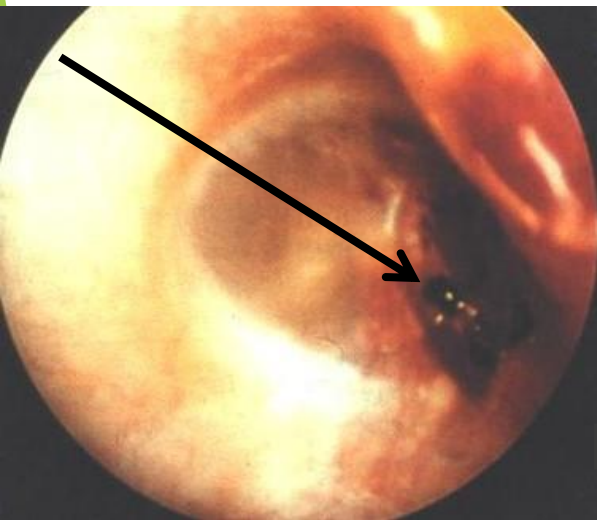
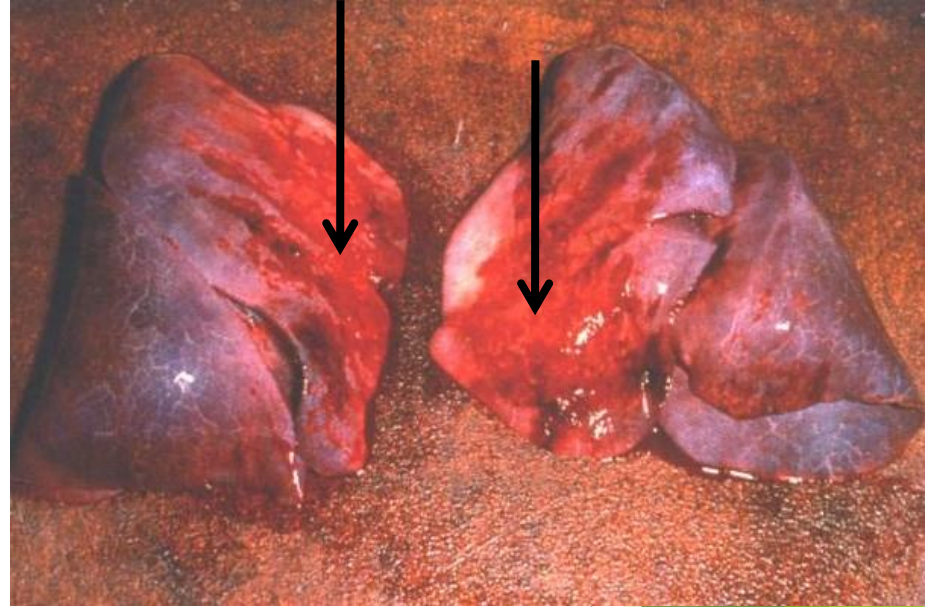


Fig 1. Idealised blast overpressure waveform.



**Blast lung at 12 hours. Notice the areas of haemorrhage**



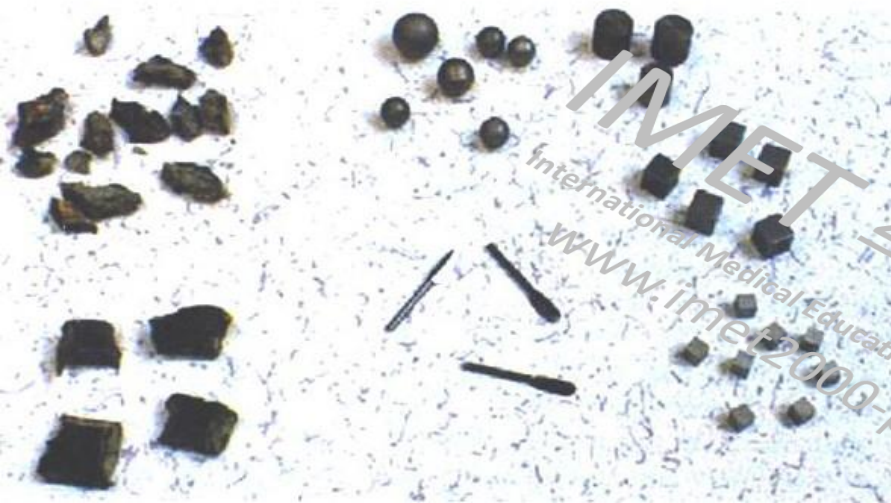
**Blast Ear drum**



**Blast with left lobe of liver destroyed**

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# **MULTIPLE HIGH AND LOW ENERGY TYPES OF FRAGMENTATION FROM SHELL/BOMB EXPLOSION**



**POSTMORTEM STUDIES ALWAYS SHOW  
PRESENCE OF SHRAPNEL**

OVER PAST TEN YEARS VERY SEVERE HIGH ENERGY INJURIES HAVE BEEN NOTICED WITH GROSS BLASTING BUT NO EVIDENCE OF FRAGMENTS IN WOUNDS



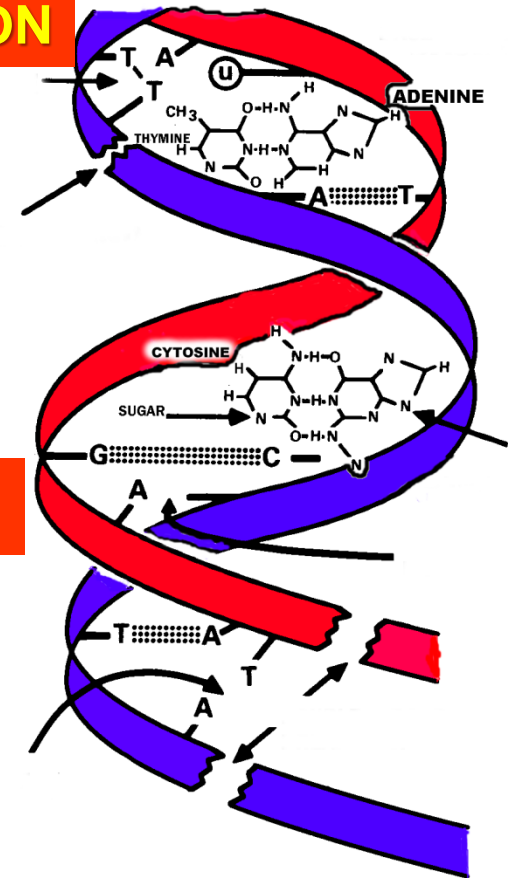
- Wounds demonstrate very severe local blast effect
- These weapons are very high energy explosives encased in metal containers which vaporise on explosion and deeply penetrate tissues and enter the blood stream
- Tissues from 2006 Gaza victims contain high concentrations of carbon aluminium copper and tungsten *Dr. Carmela Vaccaio at University Parma*

# VERY HIGH ENERGY WEAPONS DENSE INERT METAL EXPLOSIVES D.I.M.E.

**IONIZING  
RADIATION**

- ▶ No collateral damage and primarily anti- personal.  
People are damaged and not buildings so less evidence remains.
- ▶ May have long term effects of carcinogenic and second generation genetic deformities

**HEAVY METAL**



**CHEMICAL WEAPONS**



## PHOSPHORUS BURNS OXYGEN IS BAD



# SUMMARY OF WAR WOUNDS

- ▶ The classification HIGH AND LOW ENERGY serves us well to plan treatment
- ▶ Weapons continue to be developed and anatomical injury is now only part of the problem with carcinogenic and genetic complications likely.

