

# Trauma

**Trauma-** a physical injury or wound caused by external force or violence

- Leading cause of death for all age groups under the age of 44
- Leading cause of death in children in the United States
- Third leading cause of death in all age groups
- More than 60 million injuries in the US annually
- Over 100,000 people of all ages die from trauma annually in US
- Trauma costs the American public approximately \$400 billion annually
- Motor vehicle accidents are the leading cause of accidental death
- Drinking is a factor in 49% of all fatal MVC
- Most trauma injuries are not accidents, and are preventable with a small amount of planning

**Kinematics of Trauma-** the science of analyzing the mechanism of injury

- Forces involved with the transfer of energy
- Introduces the basic physical concepts that dictate how injuries occur and affect the human body

**Kinetic Energy-**the energy contained in a moving body (object)

$$KE= \text{Mass (M) X Velocity (V)}^2 / 2 \text{ or } 1/2 MV^2$$

**Newton's First Law of Motion-** a body at rest will remain at rest and a body in motion will remain in motion unless acted upon by some outside force.

**Newton's Second Law of Motion-** force equals mass times deceleration or acceleration  
 $F=MA$

**Newton's Third Law of Motion-** for every action, there is an equal and opposite reaction

**Potential Energy-** product of weight, gravity and height

**Mechanism of Injury-** how a person was injured

- By assessing the scene MOI may be determined
- By determining the MOI, The EMT may be able to predict the types of injuries

## BLUNT TRAUMA

- Leading cause of deaths caused by trauma

## Vehicular Collisions

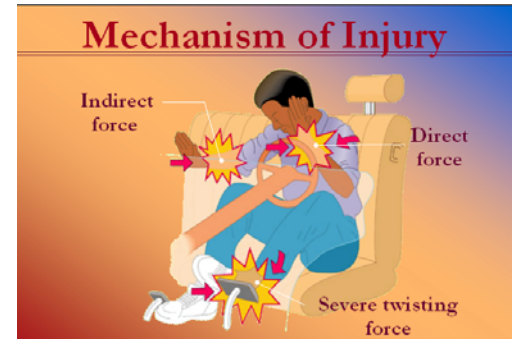
3 types of collisions

- Primary-collision of vehicle against object
- Secondary-collision of passengers against interior of vehicle
- Tertiary-collision of passengers internal organs against the solid structures of the body



## Significant MOI

- Severe deformities to the frontal portion of the vehicle
- Moderate intrusion into the vehicle (passenger compartment)
- Severe damage from the rear
- Collisions involving rotational, rollover, or ejection



## Frontal

- Evaluate for seat belt or air bag injuries
- Check for contact points in the vehicle, bent steering wheel, star burst on windshield, dashboard, etc.

## Down and Under pathway

- Fractures or dislocations of the knee or ankle
- Femur fractures
- Posterior dislocation of the acetabulum

## Up and Over pathway

- Head injuries
- Chest injuries
- Abdominal injuries

## Rear-End Collisions

- Most commonly occurs when vehicle is at a stop
- Commonly caused whiplash injuries, due to neck not being supported by head rest
- Unrestrained passengers will be thrust forward
- If only lap belt worn injuries to abdomen and spine are likely

## Lateral Collisions

- Responsible for the highest incidence of death
- Lateral Whiplash injuries, neck not supported
- Intrusion into the passenger compartment of the vehicle

## Rollover Collisions

- Patient is subjected to forces from all directions
- Patient can impact any part of the vehicle
- More serious because of the multiple violent forces acting on the body
- Best indicator of injury in impact points on the body



## Rotational Collisions

- Forces acting on the body from different directions
- Results in injuries that are a combination of those seen in head on and lateral impact collisions

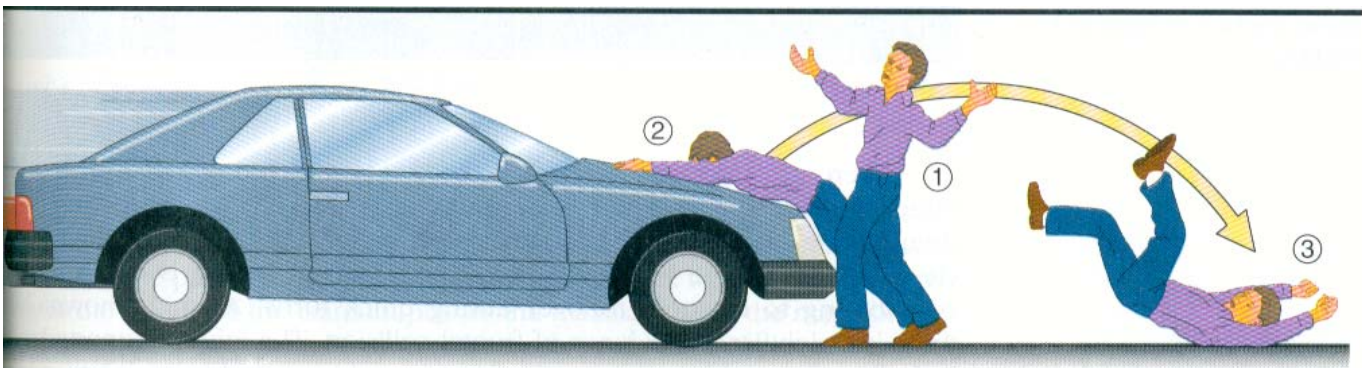
## Ejection

- Likelihood of injury is increased by 300% over non -ejection collisions

## Pedestrian Vs Vehicle Collisions

3 phases of impact

- Frontal vehicle bumper
- Vehicular hood or windshield
- Ground
- In pediatrics the pattern of injury is different. It depends on the size of the child



## Motorcycle Collisions

Frontal Collisions

- Head and chest may impact the handle bars
- Femurs may impact the handlebars

Lateral Collisions

- Crush injuries to the extremities
- Ejection injuries from impacting the ground

Laying the bike down

- Rider moves slower than the bike
- Avulsions, abrasions, bumps



## Falls

- Injury potential is related to the height of the fall
- A fall over 15' or three times the persons height is considered significant
- Consider surface landed on
- Consider body part that impacted first
- Follow the path of energy displacement

## **Blast Injury**

- Caused by rapidly expanding gases Triad of injury
- Primary- direct injury to gas containing organs
- Secondary-flying debris
- Tertiary-individual becomes a missile and is thrown against a solid object

## **Penetration Trauma**

- Second leading cause of death due to trauma
- Low-energy, Medium energy or high energy
- The greater the speed or velocity of the missile the greater the injuries

## **Low Energy Penetrating Trauma**

- Hand driven objects. knives, pencils, ice picks
- Damage produced by sharp edge of the object moving into the body
- Amount of damage produced depends on the movement of the object inside the body
- Determine type and size of object used
- Determine sex of attacker
  - Males-tend to stab with the blade on the thumb side of the hand and with an upward thrust
  - Females-tend to stab with a downward thrust and hold the knife with the blade on the little finger side

## **4 Medium Energy (Velocity) Penetrating Injuries**

- Usually caused by bullets
- Handguns and shotguns
- Can change shape upon entering the body
- Cause cavitation
- Can ricochet within the body
- Identify the weapon caliber and shooting distance

## **High Energy (velocity) Penetrating Trauma**

- Rifles
- More gunpowder means more speed of the bullet which means more kinetic energy
- Larger Temporary cavity
- Large residual permanent cavity
- Damage not only to tissue directly in bullets path, but also to tissue on all sides of the bullet

## **Variables**

- Tumble-bullet tumbles end over end upon impact due to the center of gravity
- Fragmentation- bullet may split apart producing multiple missiles
- Profile-shape of the bullet
- Distance-air resistance slows bullet decreasing velocity

**Cavitation-** energy transfer which occurs when body tissue cells are placed in motion directly away from the site of impact by the energy exchange

Determined by:

- Amount of energy exchanged
- Number of tissue particles impacted
- Density of tissue

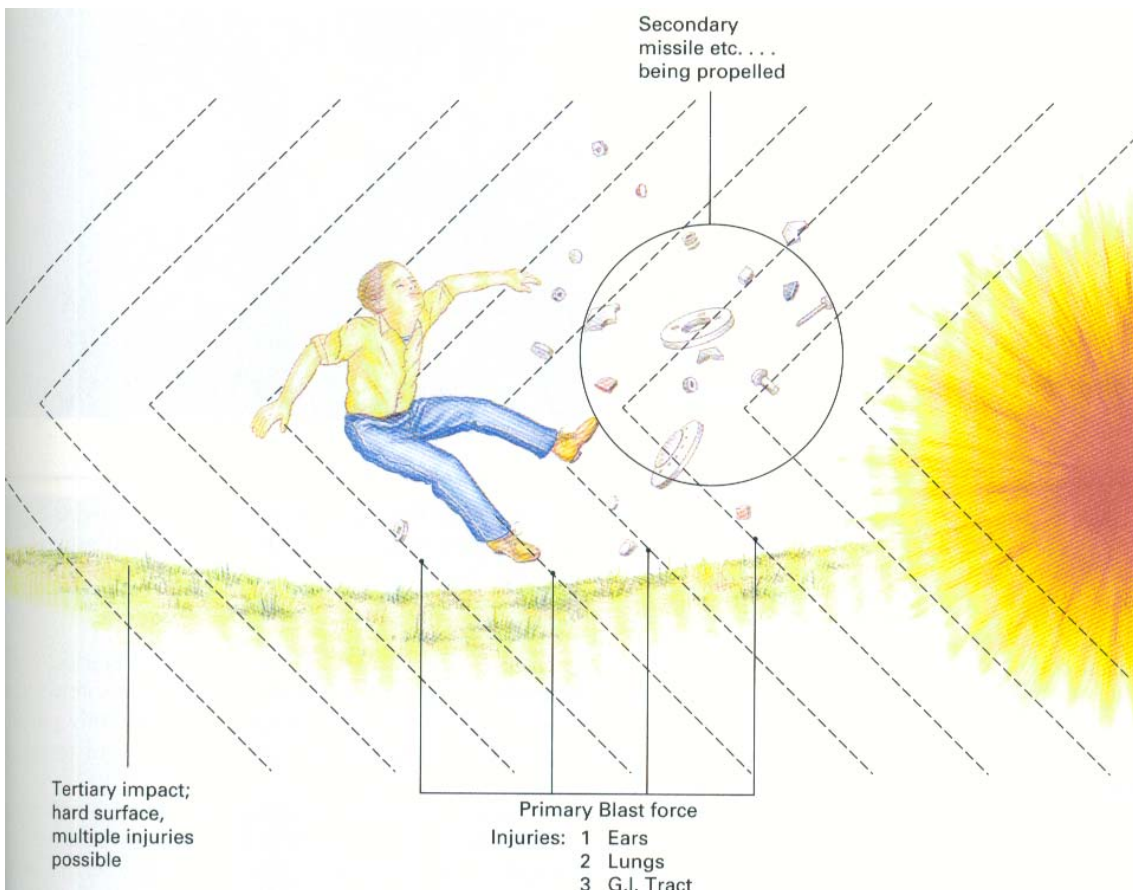
### Entrance vs. Exit Wounds

#### Entrance

- Only true sign is only one wound
- Powder burns around Hints
- Round or oval wound
- Gases beneath skin (close range)
- Burns-(weapons inches from skin)
- Stippling or tattooing (weapon 4-6 inches from skin) Exit
- Usually odd shaped
- Can be larger than entrance wound
- Depends on missile type/profile

**Trauma assessment starts with a story.**

**If you plan for the worst you will never be surprised or disappointed.**



## Rapid Trauma Assessment

INSPECT	Deformities
	Contusions
PALPATE	Abrasions
	Punctures/Penetrations
	Burns
	Tenderness
	Lacerations
	Swelling

