Kinematics of Trauma

Chapter 21
Kinematics of Trauma

- Injuries are the leading cause of death among children and young adults.
- Kinematics introduces the basic physical concepts that dictate how injuries occur and affect the human body.
Energy and Trauma

• Work
  – Force acting over distance

• Kinetic energy
  – Energy of moving object

• Potential energy
  – Product of weight, gravity, and height
Traumatic Injuries

• Blunt trauma
  – Caused by a force to the body
  – Injuries do not penetrate soft tissue or organs

• Penetrating trauma
  – Caused by objects such as knives and bullets
  – Injuries pierce the surface of the body
Mechanism of Injury (MOI)

- MOI is the way in which traumatic injuries occur.
- Different MOIs produce many types of injuries.
  - Isolated to one body system
  - Injuries to many body systems
Vehicular Crashes and MOI

• By assessing the crash, the MOI may be determined.

• By determining the MOI, you may be able to predict the types of injuries that may have happened at the time of impact.
Vehicular Collisions

• Three types of crashes
  – Collision of car against another car or object
  – Collision of passenger(s) against interior of car
  – Collision of passenger’s internal organs against the solid structures of the body
Significant MOI

- Severe deformities to the frontal part of the vehicle
- Moderate intrusion from a T-bone accident
- Severe damage from the rear
- Collisions in which rotation is involved
Types of Motor Vehicle Collisions

- Frontal
- Lateral
- Rear-end
- Rollovers
- Spins
Frontal Collisions

• Evaluate seat belts and airbags.
• Remember that supplemental restraint systems cannot prevent all injuries.
  – You should still suspect that serious injuries have occurred.
• Check for contact points.
• Steering wheels can also cause chest injuries, especially if no airbag is present.
Rear-End Collisions

- Commonly cause whiplash-type injuries
- Unrestrained passengers will be thrust forward into the dashboard.
- Back seat passengers wearing only lap belts might have a higher incidence of lumbar and thoracic spine injury.
Lateral Collisions

- Responsible for the highest incidence of deaths.
- Lateral whiplash injury is the result.
- There may be intrusion into the passenger compartment.
Rollover Crashes

- Injury patterns differ if patients are unrestrained.
- The most unpredictable injuries are to unrestrained passengers.
- Ejection is the most common life-threatening injury.
Spins

- Vehicle is put into rotational motion.
- Vehicle often strikes a fixed object, combining forces of rotation with lateral impact.
Car-Versus-Pedestrian Collisions

• Often cause serious injuries to body systems
• Evaluate MOI to determine:
  – Whether patient was thrown and how far.
  – Whether patient was struck and pulled under car.
• Presume injury to the spinal cord and maintain immobilization.
Falls

- Injury potential is related to the height of the fall.
- A fall either 15' or three times the person’s height is considered significant.
- Suspect internal injuries from a significant fall.
Considerations for Falls

• The height of the fall
• The surface struck
• The part of the body that hit first, followed by the path of energy displacement
• Always consider syncope or other medical conditions as an underlying cause.
Penetrating Trauma

- Second largest cause of death in the United States after blunt trauma
- Penetration can be low-energy, or medium- or high-velocity.
- The greater the speed of penetration, the greater the injuries.
Low-Energy Penetrating Trauma

- Caused accidentally by an object or intentionally with a weapon
- Injury caused by the sharp edges of the object moving through the body
Medium-Velocity and High-Velocity Penetrating Trauma

• Usually caused by bullets
• Bullets can change shape and ricochet within the body.
• Pressure waves cause cavitation.
• If possible, identify weapon caliber and shooting distance.
High-Velocity Penetrating Trauma
Newton’s Laws

• Objects at rest tend to stay at rest, and objects in motion tend to stay in motion, unless they are acted upon by some force.

• Force (F) equals Mass (M) times Acceleration (A)

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F = MA
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• For every action, there is an equal and opposite reaction.
Injuries to the Head

- Bruising or tearing of the brain
- Bleeding or swelling inside the skull is often life threatening.
- Some patients may not have signs and symptoms.
Injuries to the Neck

- Tearing or swelling of trachea can cause life-threatening airway problems.
- Injury to large blood vessels in the neck may produce swelling that prevents blood flow to the brain.
- Open wounds to neck vein bleed heavily or allow air to enter the circulatory system.
Injuries to the Chest

• Broken ribs may interfere with chest’s ability to expand normally.
• Large vessels may tear, causing massive bleeding.
Pneumothorax

- Air collecting between lung tissue and chest wall
- Compression of lung tissue interferes with oxygen exchange.
- May also interfere with the functioning of the heart (tension pneumothorax)
Abdominal Injuries

- Solid organs can tear, lacerate, or fracture, causing serious bleeding and death.
- Hollow organs can leak digestive fluids.
- Trauma patients who complain of abdominal pain may have abdominal bleeding.
Mutisystem Trauma Patient

- A patient whose injuries involve more than one body system