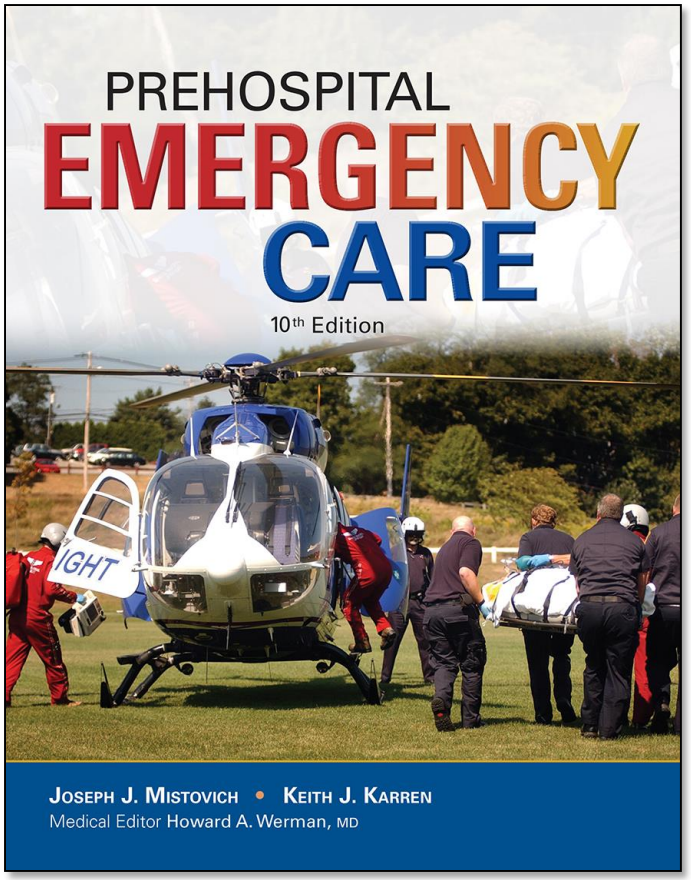
PREHOSPITAL EMERGENCY CARE

TENTH EDITION



CHAPTER 27

Trauma Overview: The Trauma Patient and the Trauma System

Learning Readiness

- EMS Education Standards, text p. 750

Learning Readiness Objectives

- Please refer to page 750 of your text to view the objectives for this chapter.

Learning Readiness Key Terms

- Please refer to page 750 of your text to view the key terms for this chapter.

Setting the Stage

- Overview of Lesson Topics
  - The Kinetics of Trauma
  - Mechanisms of Injury
  - The Multisystem Trauma Patient
  - The Golden Period
  - The Trauma System
  - Golden Principles of Out-of-Hospital Trauma Care

Case Study Introduction

EMTs Nina Segall and Scotty Lindquist respond to a report of a person shot in a hunting accident. After a 15-minute response to the remote area, they meet state police on the scene. Police confirm that it was a hunting accident and all weapons have been secured. The patient, a 27-year-old man, was accidentally shot by another hunter with a high-velocity rifle.

Case Study Introduction

As the EMTs size up the scene, they see a police officer holding direct pressure on the patient's thigh. The patient is lying supine on the ground, and seems combative and confused. He is pale and sweating, despite the cool temperatures.

Case Study

- What are the priorities in managing this patient?
- What information will help the EMTs determine the extent of the patient's injuries?

Introduction

- Trauma is the leading cause of death among those aged 1 to 44 years and the fourth leading cause of death among all ages.
- Recognizing the extent of injury is critical to making decisions to giving trauma patients the best chances of survival.

The Kinetics of Trauma

- The mechanism of injury (MOI) is how a person is injured.
- Kinetic energy is the energy contained in a moving body.
- The science of analyzing mechanisms of injury is the kinetics of trauma.

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The Kinetics of Trauma

- Understanding kinetics of trauma helps predict injury patterns.
- Predictors of injury are the patient's physiological indicators, the anatomy of the injury, and MOI.

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The Kinetics of Trauma

- Kinetic energy

$$\frac{\text{Mass} \times \text{velocity}^2}{2}$$

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The Kinetics of Trauma

- Kinetic energy
  - Velocity is the more significant factory in determining the amount of kinetic energy.
  - Estimate the speed of the objects involved.
    - Motor vehicle collisions
    - Penetrating trauma

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The Kinetics of Trauma

- Acceleration and deceleration
  - A body at rest will remain at rest, and a body in motion will remain in motion, unless acted upon by an outside force.
  - A faster change of speed (acceleration or deceleration) results in more force exerted.

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The Kinetics of Trauma

- Energy travels in a straight line unless it meets interference.
- Interference with the travel of kinetic energy can cause it to change direction and form.

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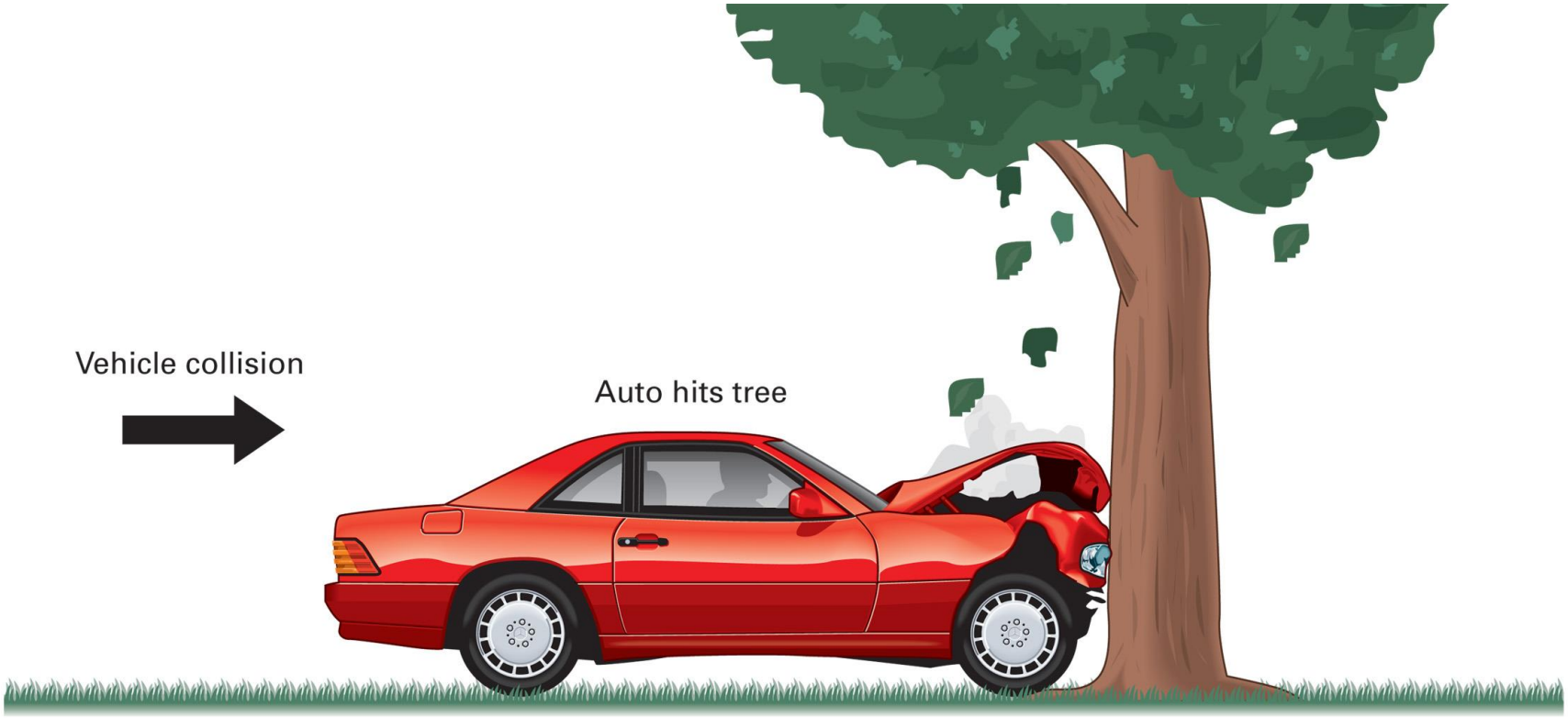
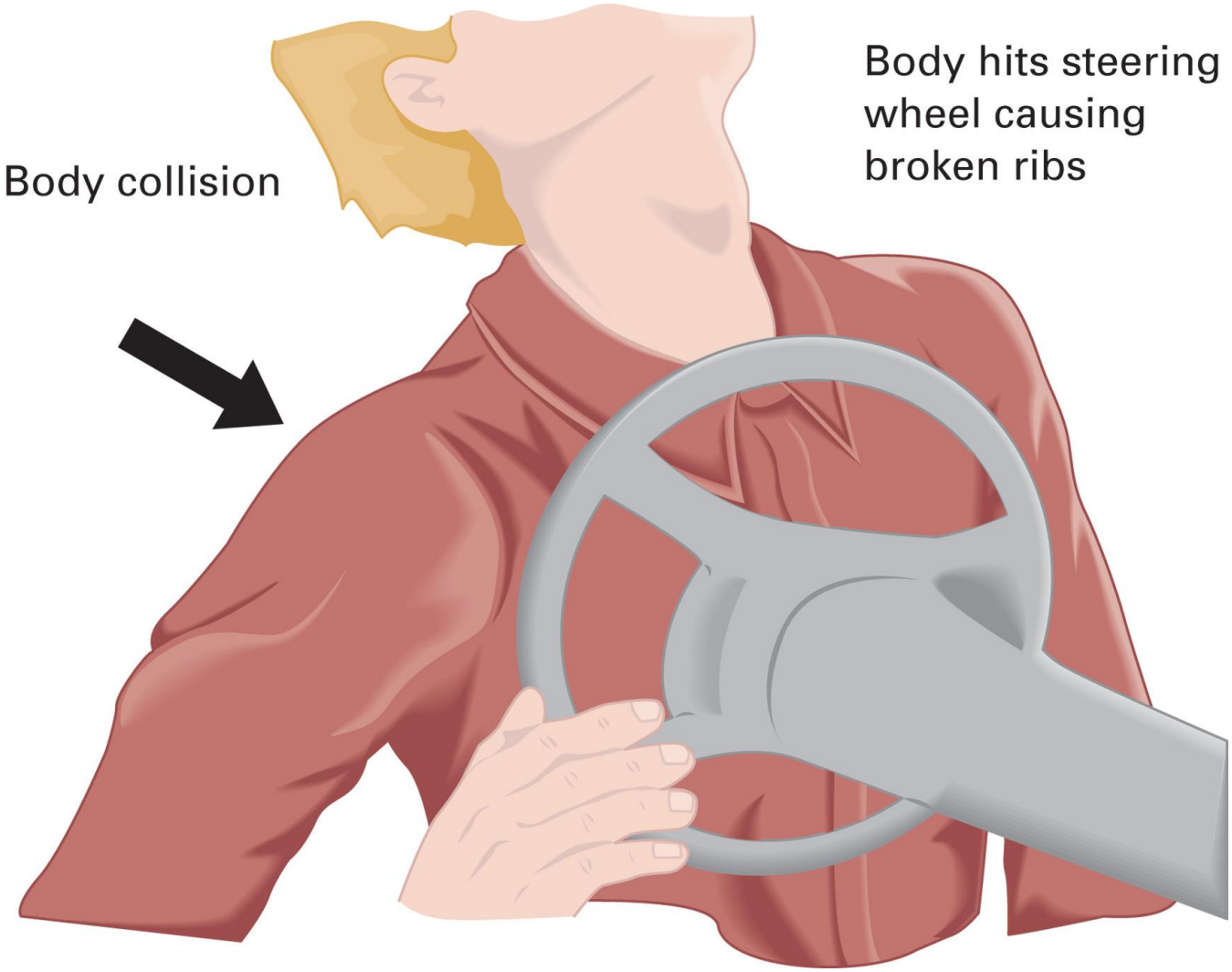
The Kinetics of Trauma

- Three types of impacts in a vehicle collision
  - Energy is absorbed in each impact.
  - There can be multiple impacts of each type.
    - Vehicle collision
    - Body collision
    - Organ collision

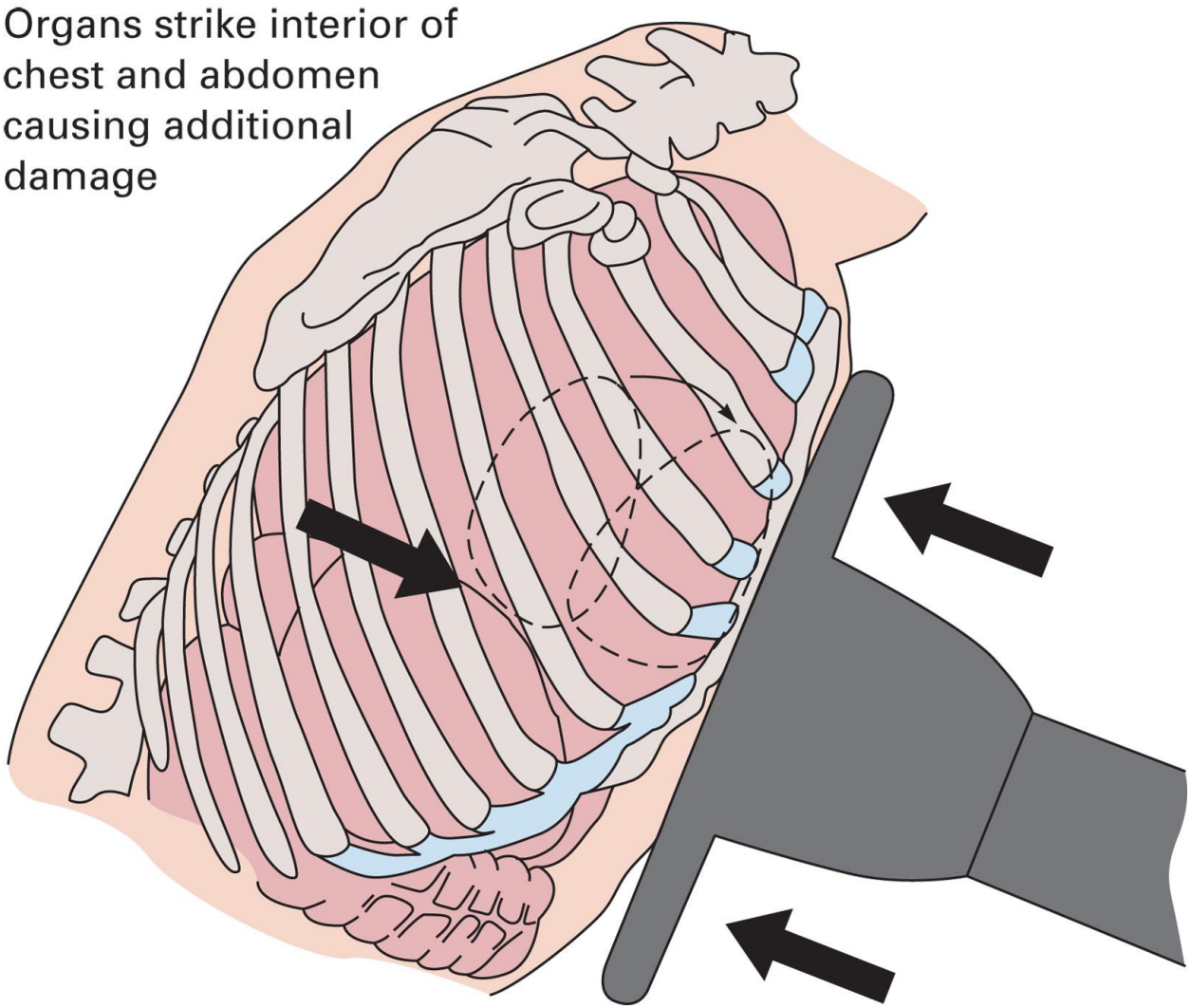
Vehicle collision. The vehicle strikes an object.



Body collision. The occupant continues forward and strikes the inside of the automobile.



Organ collision. The organs continue to move forward and strike the inside of the skull, chest, or abdomen.



Click on the factor that most significantly determines the amount of kinetic energy involved in a vehicle collision.

A. The center of gravity of the vehicle

B. The mass of the vehicle the patient is in

C. The mass of the vehicle that strikes the patient's vehicle

D. The combined speed of the two vehicles

Mechanisms of Injury

- MOI provides a suspicion of injury; not an accurate indicator of injury.
- You must assess the patient for indictors of injury.

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Mechanisms of Injury

- Common MOIs include:
  - Vehicle collisions
  - Falls
  - Penetrating injuries (gunshots, stabbings)
  - Explosions

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Mechanisms of Injury

- Vehicle collisions
  - Have a high suspicion of injury when there is:
    - Evidence of high speed collision
    - Death of another vehicle occupant
    - Altered mental status

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Mechanisms of Injury

- Vehicle collisions
  - Have a high suspicion of injury when there is:
    - Intrusion larger than 12 inches at occupant site; larger than 18 inches at any site
    - Ejection

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Mechanisms of Injury

- Vehicle collisions
  - Each type of motor vehicle collision has a predictable pattern of injuries associated with it.

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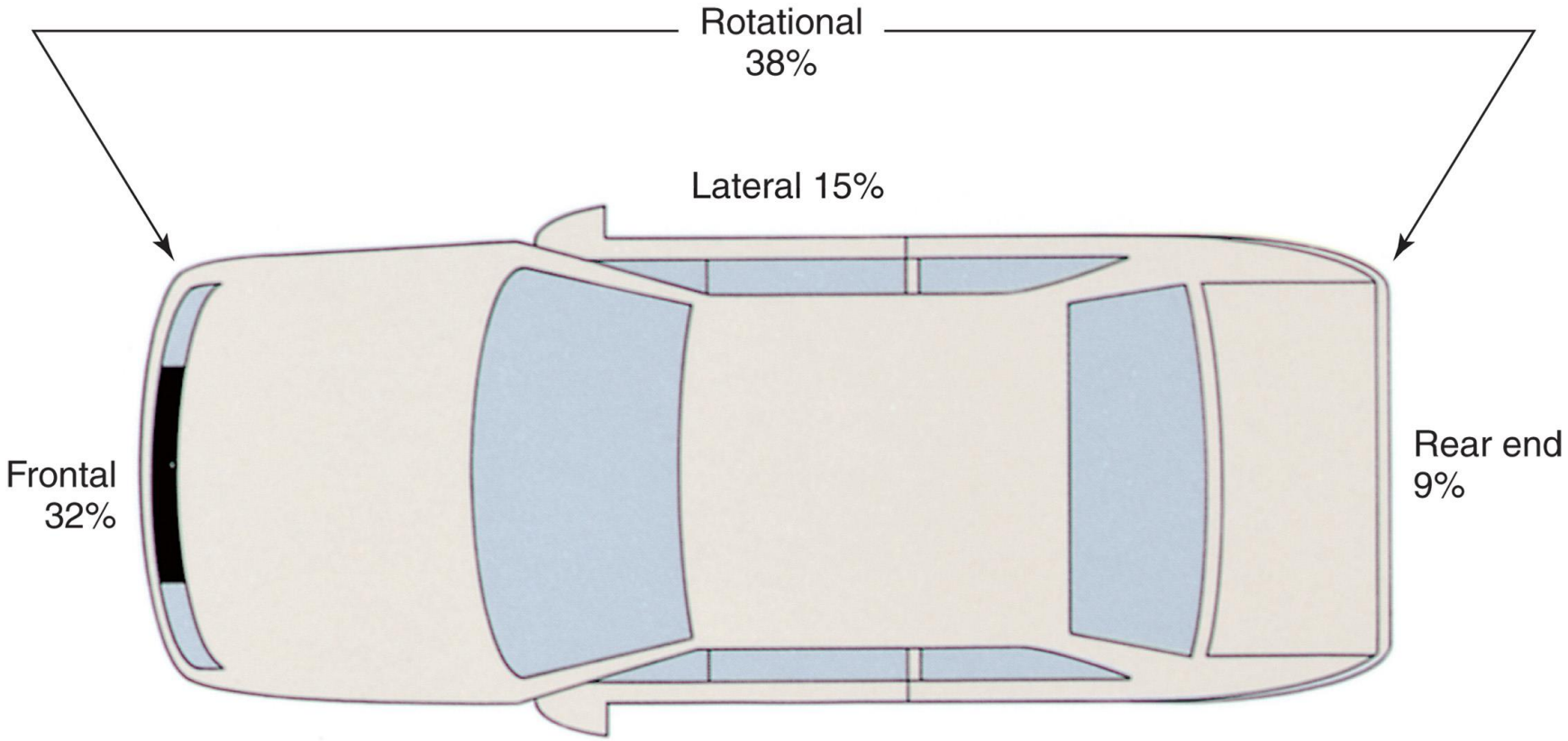
Types of impacts in motor vehicle trauma and their incidence of frequency in urban areas (by percentage).



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Mechanisms of Injury

- Frontal impact
  - The occupant is traveling at the same speed as the vehicle.

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Frontal impact. (© Kevin Link)

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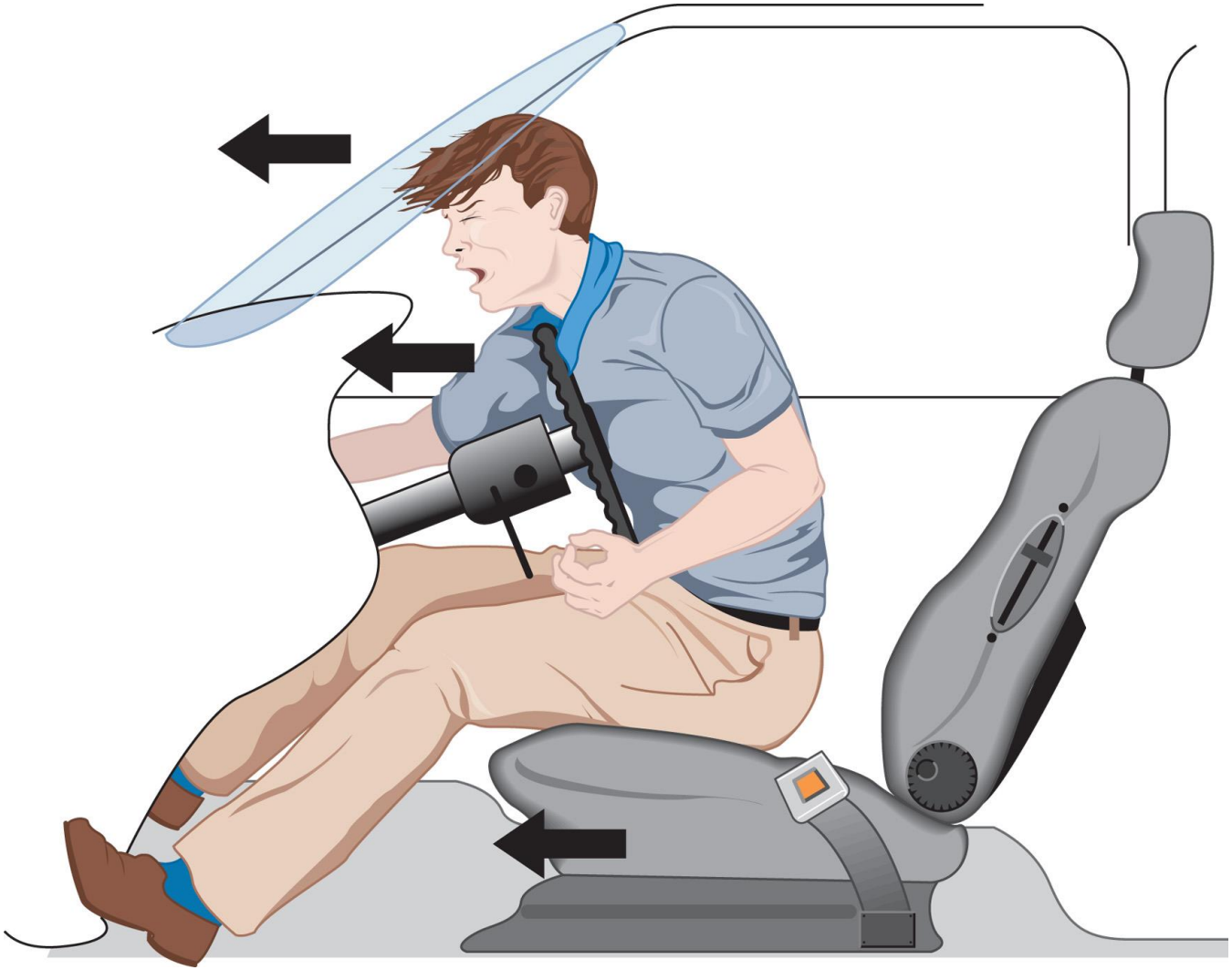
In a frontal collision, the occupant continues to move forward at the same speed the vehicle was moving.



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Mechanisms of Injury

- Frontal impact
  - With an up-and-over pathway look for injuries to the abdomen, chest, face, head, and neck.

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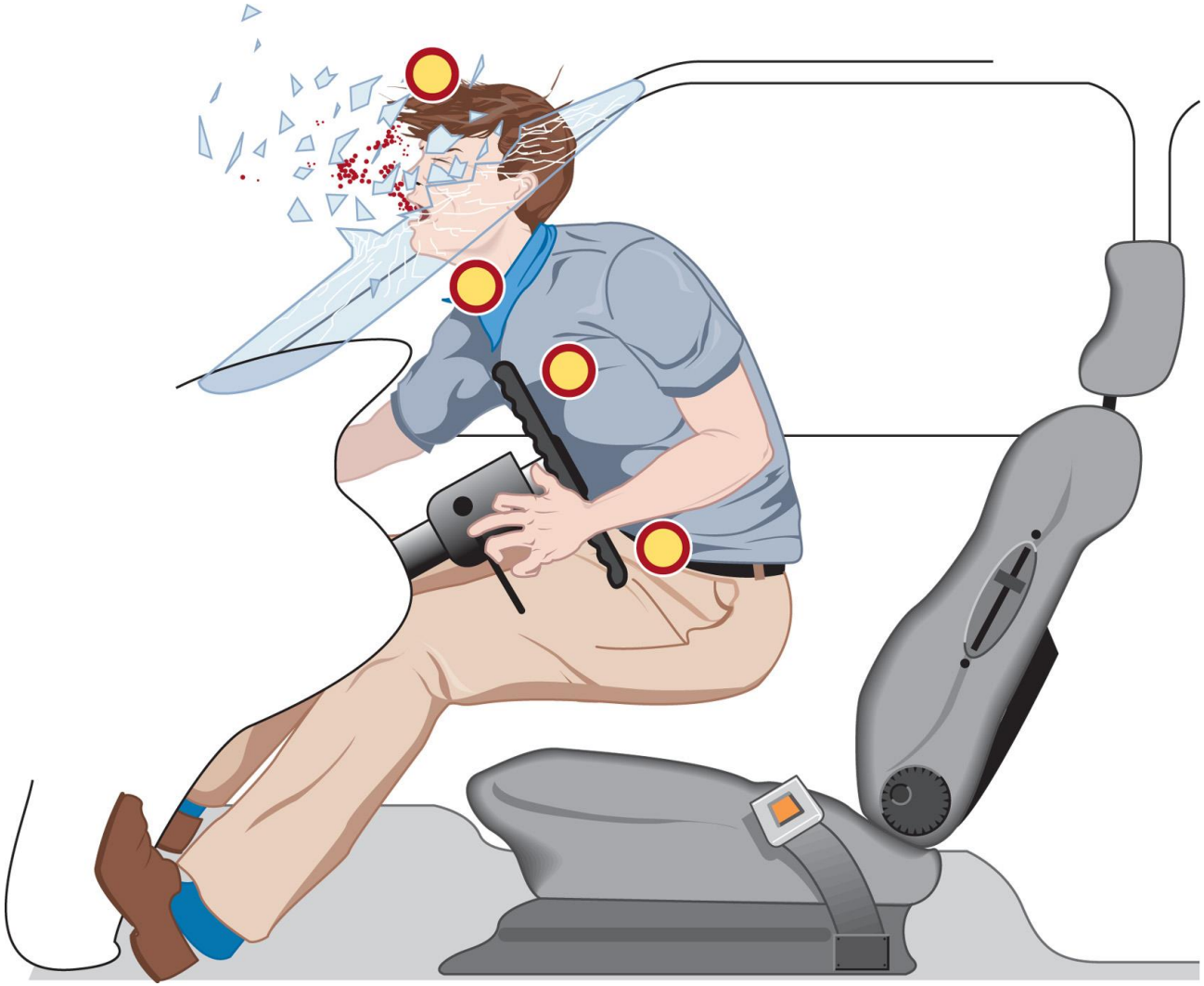
The up-and-over pathway causes impact to the head, neck, chest, and abdomen.



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A deformed steering wheel indicates possible chest or abdominal injury. (© Kevin Link)

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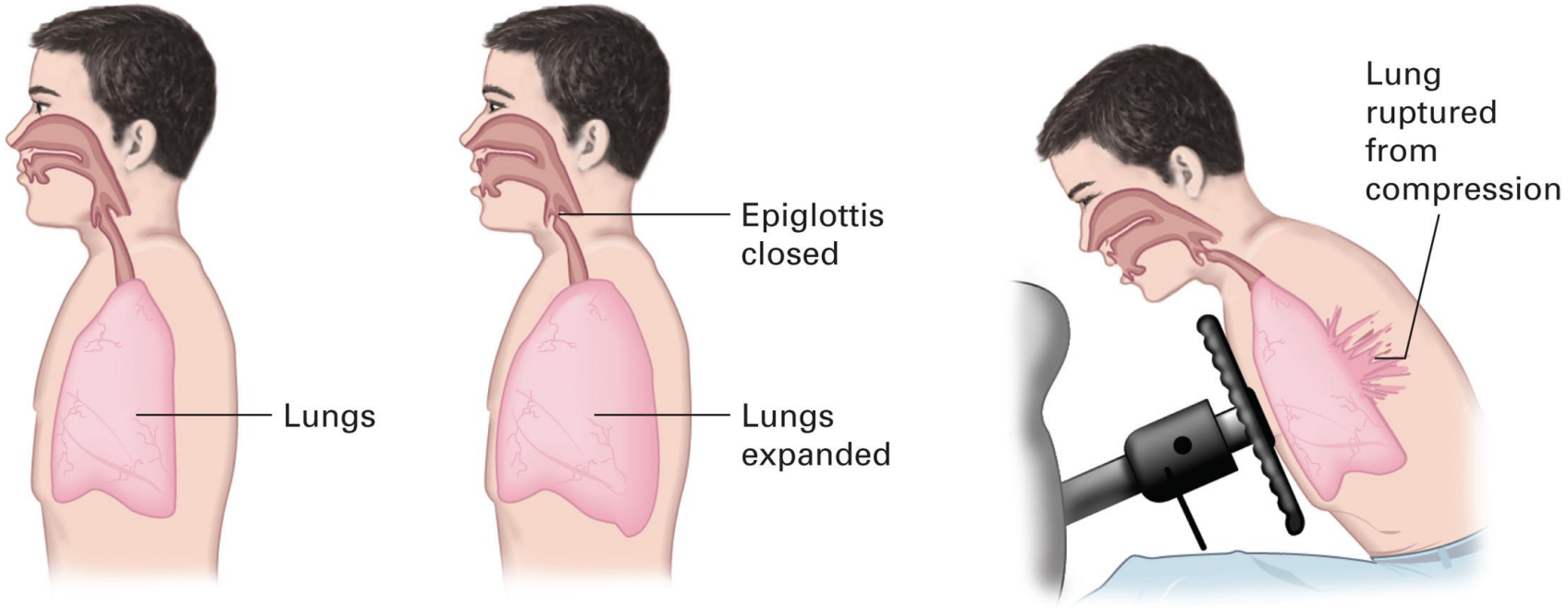
The “paper bag” syndrome results from compression of the chest against the steering column.



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Impact marks or cracking to the windshield indicates a possible head injury.

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Mechanisms of Injury

- Frontal impact
  - With a down-and-under pathway look for injuries to the knees, femurs, hips, acetabulum, and spine.

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The down-and-under pathway causes impact to the knees, femurs, hips, acetabulum, and spine.

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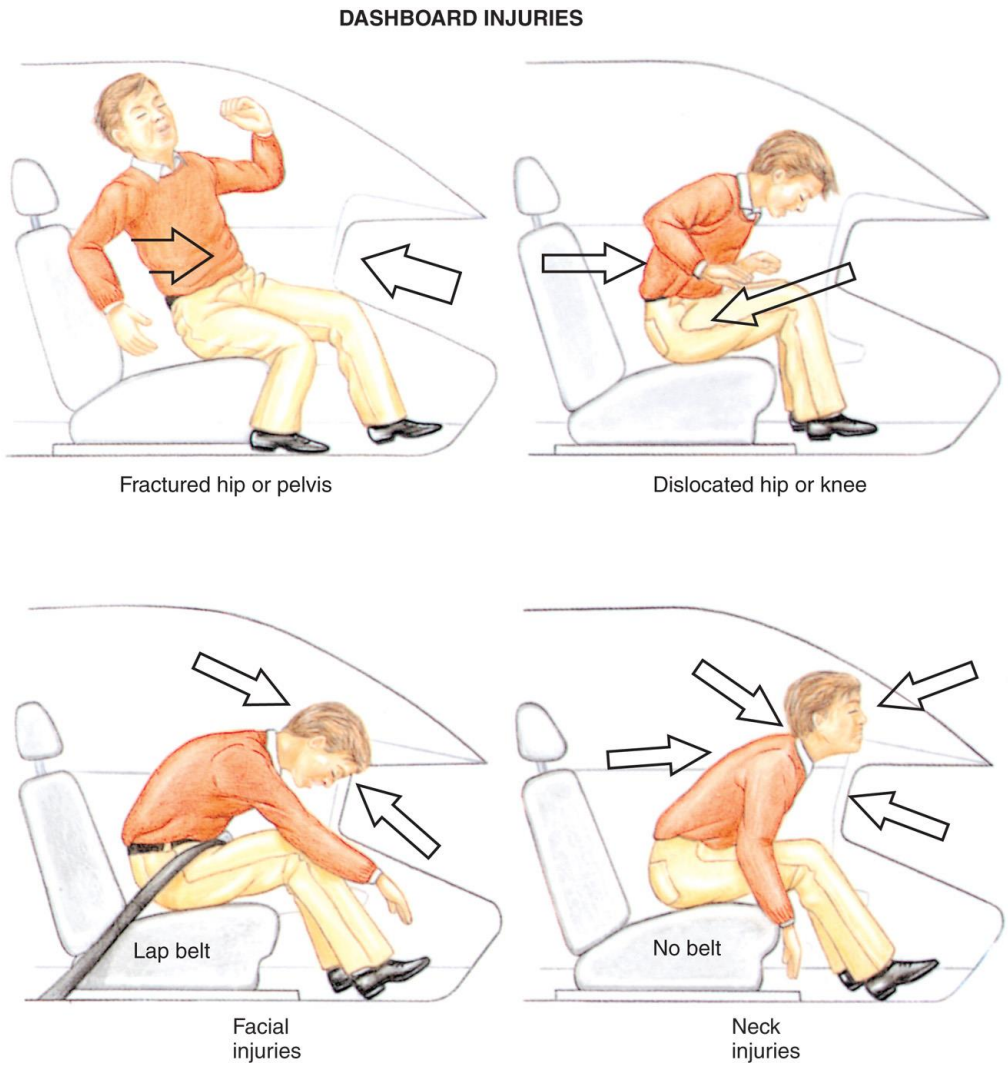
Examples of mechanisms of injury associated with frontal impact.



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Mechanisms of Injury

- Rear impact
  - Initially, the head and neck are whipped back.
  - A properly adjusted headrest and seat belts reduce injury.
  - Subsequent injury can follow an up-and-over or down-and-under pathway.

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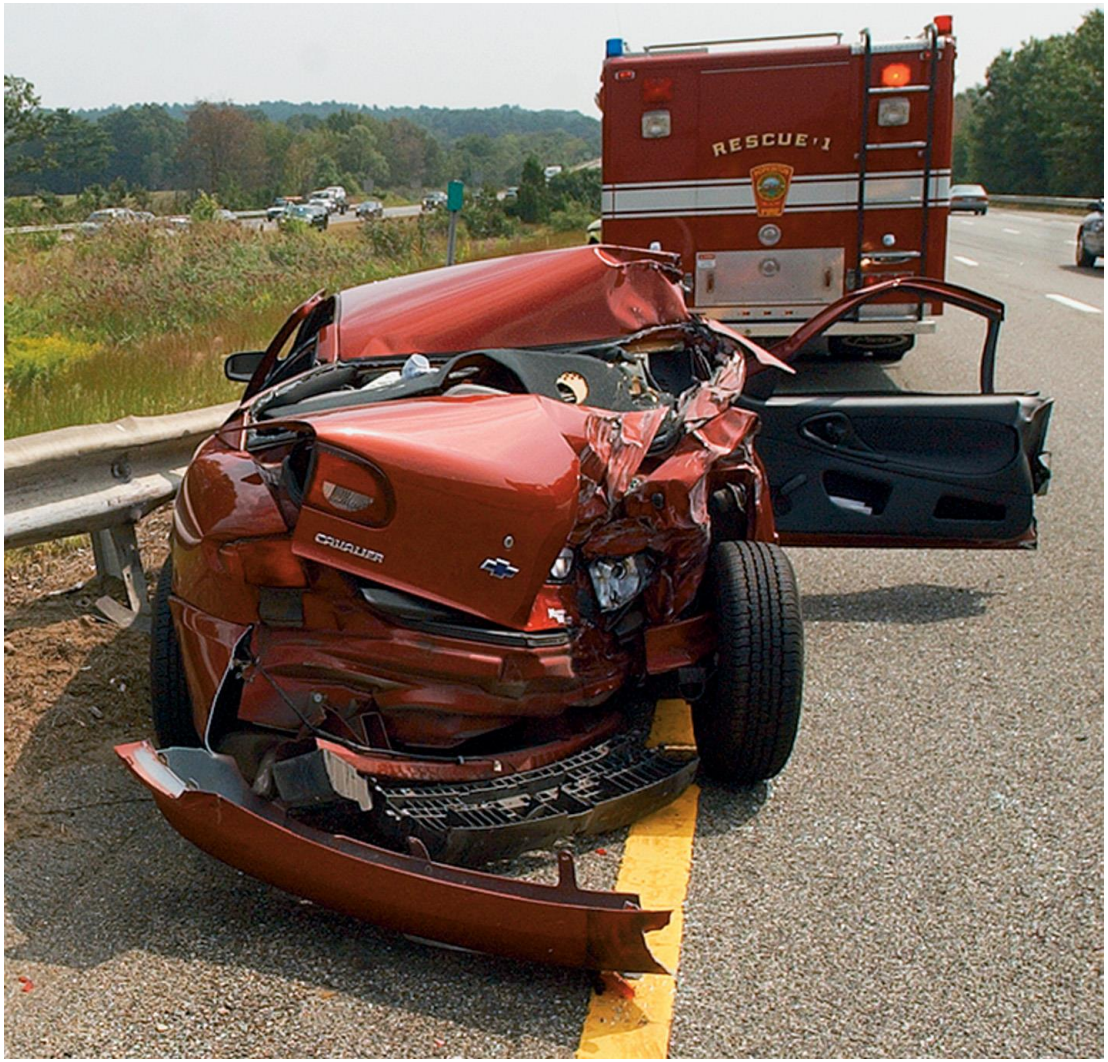
Rear impact. (© Mark C. Ide)



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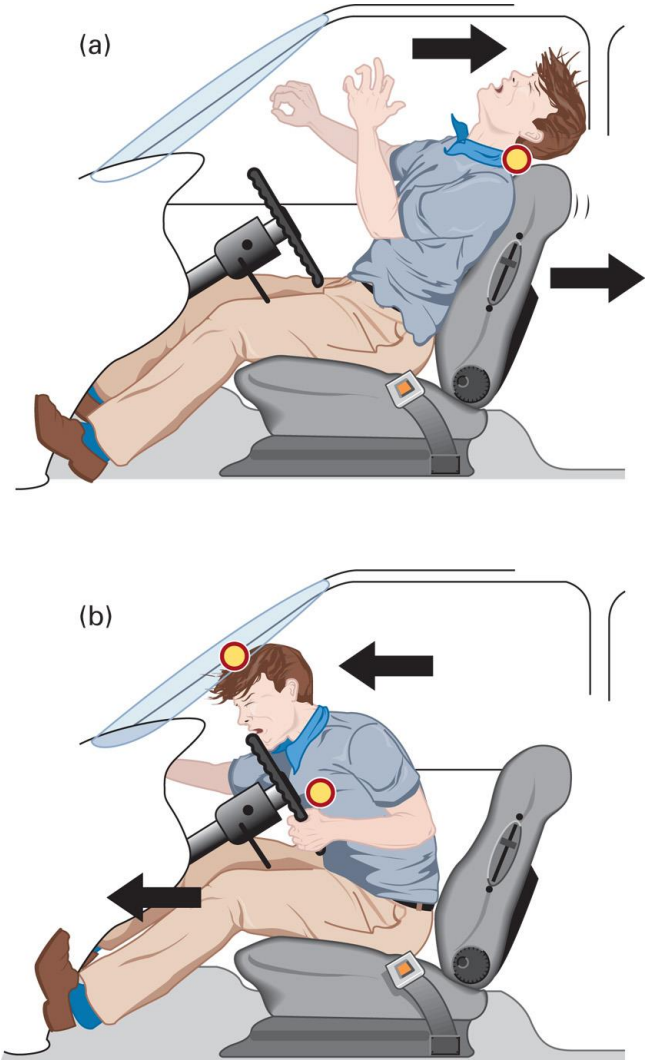
(a) In a rear impact with an unrestrained occupant, initial movement is backward, causing potential neck injury.
(b) The occupant then moves forward, causing impact to the head and chest.



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Mechanisms of Injury

- Lateral impact
  - There may be injuries the the head, neck, chest, abdomen, pelvis, and extremities.
  - Assess whether the patient bore the brunt of the impact.

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Lateral impact. (© Kevin Link)

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Lateral impact causes impact to the head, shoulder, lateral chest, lateral abdomen, lateral pelvis, and femur.

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Mechanisms of Injury

- Rotational or rollover crash
  - Injury patterns are less predictable.
  - In rollovers there are multiple impacts and changes in direction.
  - Multisystem trauma is common.
  - Ejection is common with rollover; crushing injuries to ejected occupants are common.

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Rotational impact. (© Kevin Link)

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Rollover impacts. (© Daniel Limmer)

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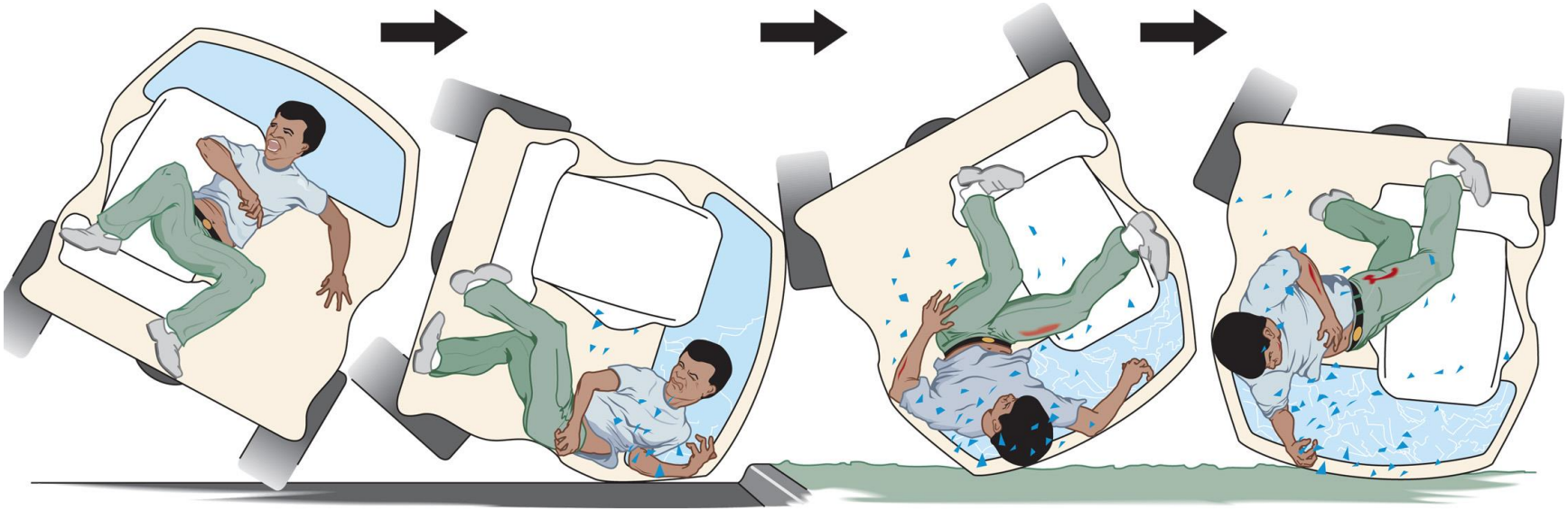
In a rollover of an unrestrained occupant, impact to the body is difficult to predict and commonly results in multiple system injury.



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Mechanisms of Injury

- Vehicle-pedestrian
  - Extent of injury depends on:
    - Vehicle speed
    - What part of the body is hit
    - How far the pedestrian was thrown
    - The surface the pedestrian landed on
    - The body part that first struck the ground

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Mechanisms of Injury

- Vehicle-pedestrian
  - Injury patterns are different in children and adults.
    - Different size and body weight distribution
    - Reaction upon impending impact

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Mechanisms of Injury

- The benefits of restraints outweigh the risks, but they are associated with certain injuries that must be suspected.
- Injury is more likely if lap belts and shoulder straps are not positioned properly.
- Air bags are not designed for multiple collisions.

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Seat belt injuries to the upper chest. (© Edward T. Dickinson, MD)

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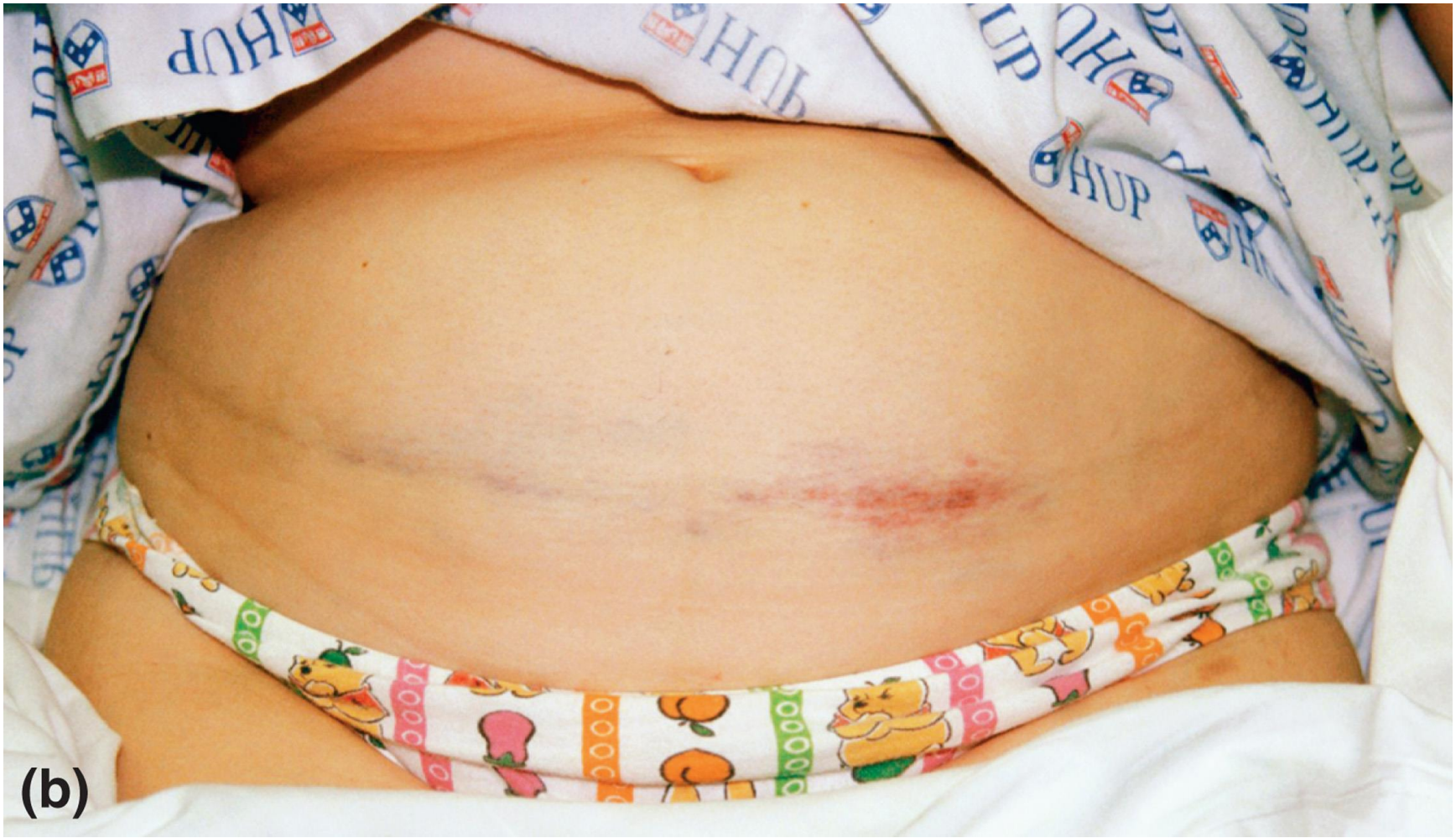
Seat belt injuries to the abdomen. (© Edward T. Dickinson, MD)



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Mechanisms of Injury

- Considerations for infants and children
  - The head and neck are not secured.
  - The head snaps forward, straining the neck.
  - Spinal cord injury can occur, even without injury to the vertebrae.

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Mechanisms of Injury

- Considerations for infants and children
  - Care seats should be placed in the backseat of the vehicle only.
  - The car seat should face backward, reclined at a 45-degree angle.

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Mechanisms of Injury

- Motorcycle collisions
  - Helmet use is a significant factor in reducing morbidity and mortality.
  - Impacts may be head-on or angular, and may involve ejection.
  - Laying the bike down can result in severe abrasions and burns.

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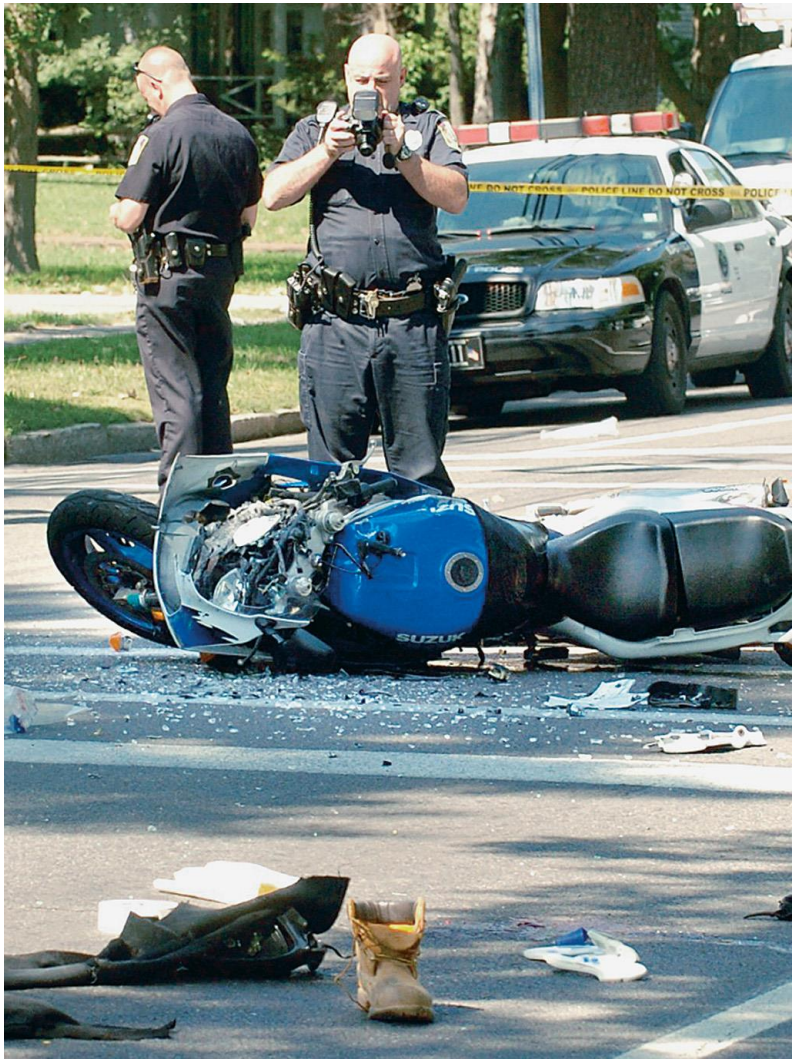
Motorcycle collisions can result in multisystem trauma from multiple impacts to the rider. (© CW McKean/Syracuse Newspapers/The Image Works)



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Soft tissue injury to the forehead.

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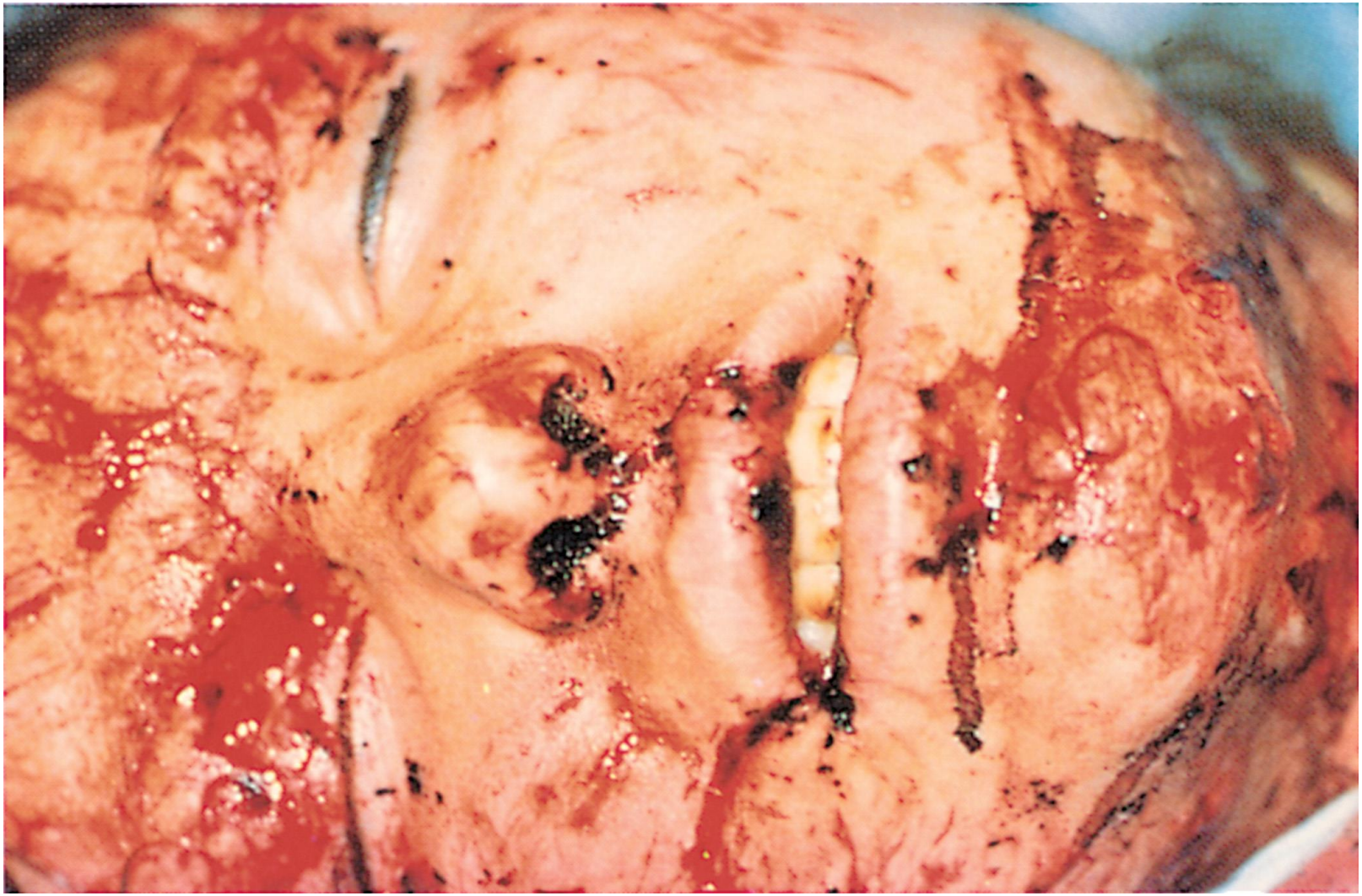
Soft tissue injury to the face.



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Mechanisms of Injury

- All-terrain vehicles
  - Vehicles are unstable and easily tipped.
  - Collisions are similar to motorcycle collisions.

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All-terrain vehicles (ATVs) can cause multiple injuries from the combination of speed and instability.

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Mechanisms of Injury

- Falls
  - The most common mechanism of injury
  - Severity of trauma depends on several factors.
    - Distance
    - Surface
    - Body part impacted first

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Mechanisms of Injury

- Falls
  - A severe fall is:
    - >20 feet in an adult
    - >10 feet or two to three times the height in a child

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Mechanisms of Injury

- Falls
  - Feet-first falls
    - Injuries to lower extremities
    - Injuries to spine
    - Injury to internal organs
    - Wrist and elbow injuries may occur.

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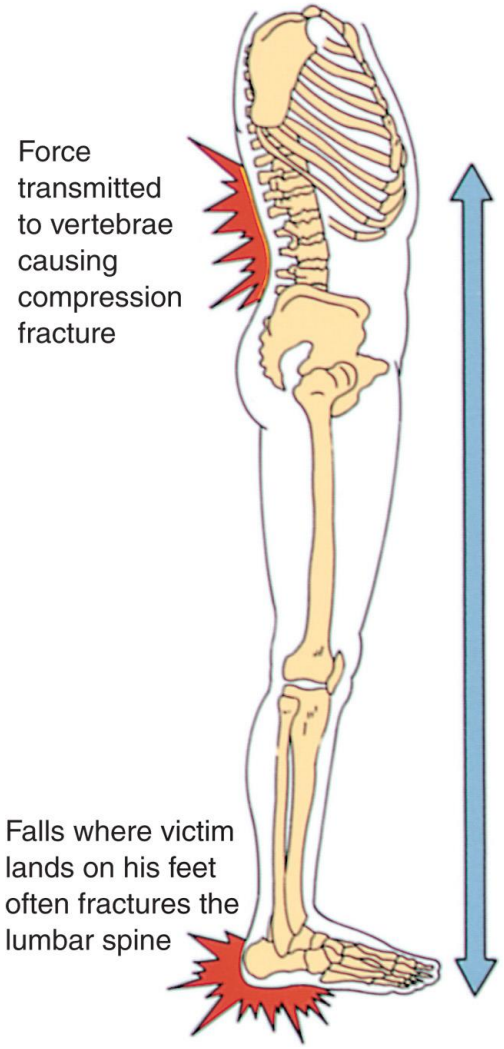
In falls the energy of impact is transmitted up the skeletal system.



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Mechanisms of Injury

- Falls
  - Head-first falls
    - Upper extremity injuries
    - Head and neck injuries
    - Chest, spine, and pelvis injuries may occur.

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Mechanisms of Injury

- Penetrating injuries
  - Kinetic energy predicts the amount of damage.
  - Low, medium, or high velocity

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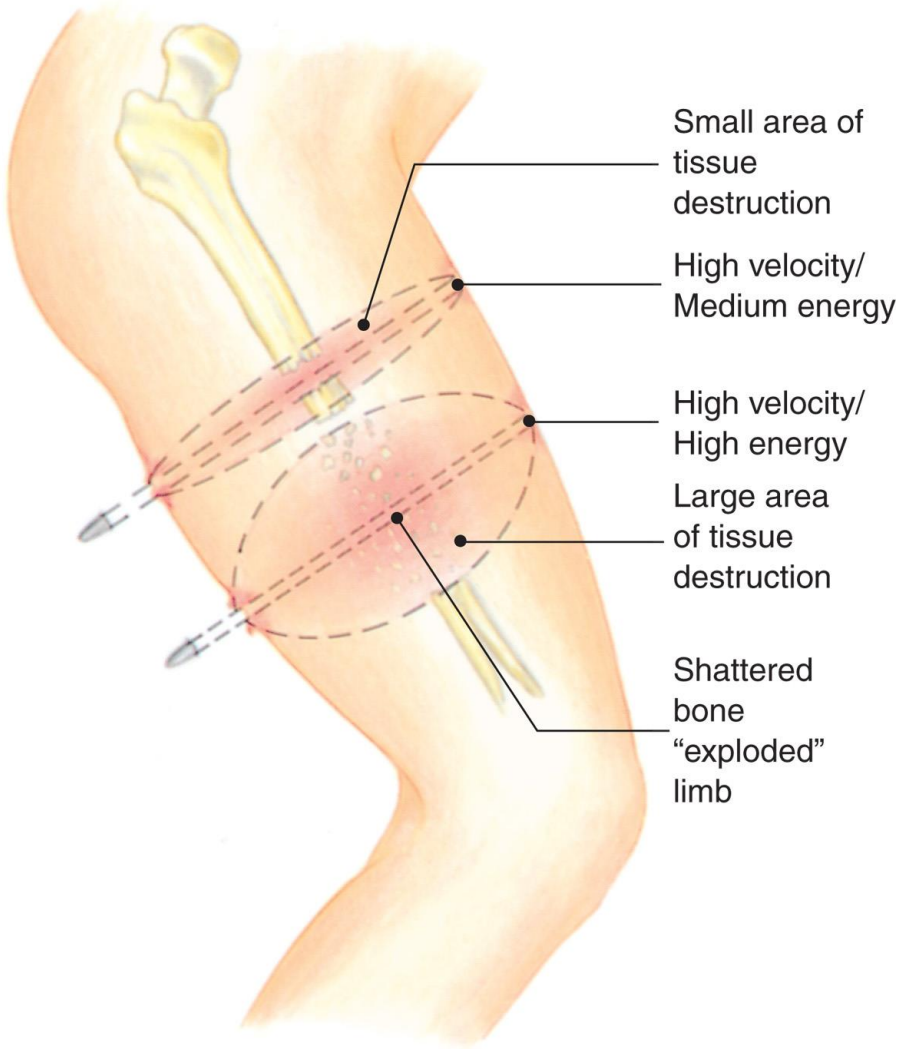
The severity of injury caused by penetrating trauma is related to the velocity of the penetrating object.



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Mechanisms of Injury

- Low velocity
  - Knife or similar object
  - Can include defensive slash wounds
  - The length of the object provides clues to injury.

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Mechanisms of Injury

- Medium- and high-velocity injuries
  - Includes pellets and bullets
  - Shotguns and handguns are generally medium-velocity.
  - High velocity weapons include rifles.

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Mechanisms of Injury

- Medium- and high-velocity injuries
  - Damage is determined by the trajectory and the dissipation of energy.
  - Dissipation of energy is affected by:
    - Drag
    - Profile
    - Cavitation
    - Fragmentation

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Mechanisms of Injury

- Gunshot wounds
  - 90% of fatal wounds involve the head, thorax, and abdomen.

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Mechanisms of Injury

- Gunshot wounds
  - Head wounds
    - Result in severe compression of brain tissue as energy is dissipated within the fixed container of the skull
    - Facial wounds can result in airway problems.

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Mechanisms of Injury

- Gunshot wounds
  - Chest wounds
    - May occur in conjunction with abdominal injuries
    - Pneumothorax
    - Rib fractures
    - Injuries to the heart and great vessels

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Mechanisms of Injury

- Gunshot wounds
  - Abdomen
    - May occur in conjunction with chest injury
    - Can involve the solid or hollow organs, as well as bony structures

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Mechanisms of Injury

- Gunshot wounds
  - Extremities
    - Injury to bone, muscle, blood vessels, and nerves
    - Bony fragments become secondary projectiles.
    - Severe circulatory compromise can occur.

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Mechanisms of Injury

- Blast injuries
  - Occur from explosions
  - Each of the phases of an explosion causes specific types of injury.

An explosion releases tremendous amounts of heat energy, generating a pressure wave, blast wind, and projection of debris. (Reproduced from Bombing Injury Patterns and Care, Office of Public Health Preparedness and Response. www.CDC.gov)

Blast injuries can cause injury with the initial blast, when the patient is struck by debris, or by the patient being thrown from the site of the blast.

(a) Explosion
Instantaneous combustion of the explosive agent creates superheated gases. The resulting pressure blows the bomb casing apart.

(b) Pressure Wave/Primary Injury
Air molecules slam into one another, creating a pressure wave moving outward from the blast center, causing pressure injuries.

(c) Blast Wave/Secondary Injury
Instantaneous combustion of the explosive agent creates superheated gases. The resulting pressure blows the bomb casing apart. Pieces of the bomb become projectiles that cause injuries by impacting the victim.

(d) Victim Displacement/Tertiary Injury
The blast wind may propel the victim to the ground or against objects, causing further injuries.

Case Study

Nina and Scotty ensure that the patient has an open airway and is breathing adequately, and apply oxygen by nonrebreather mask as the police officer continues to apply direct pressure. Nina detects a weak, thready radial pulse that she estimates to be greater than 100 per minute.

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Case Study

She performs a rapid secondary assessment, during which she finds an entry wound to the front of the thigh, and an exit wound posteriorly.

Meanwhile, Scotty is preparing a long backboard so they can prepare the patient for transport.

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Case Study

- What factors should the EMTs consider in determining where the patient should be transported?

The Multisystem Trauma Patient

- Most trauma patients have a simple or single injury.
- Multisystem trauma has a high incidence of morbidity and mortality.
- Managing immediate life threats and expeditious transport are the appropriate care.

Helicopters are commonly used in EMS transport. (© Austin/Travis County STAR Flight)

Loading a patient at the rear of the helicopter. (© Mark Foster)

The Golden Period and Platinum Ten Minutes

- The best chances of survival from trauma occurs when intervention takes place as quickly as possible.
- The goal is for EMS providers to limit scene time to 10 minutes with severely injured patients.

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The Golden Period and Platinum Ten Minutes

- Within the 10-minute scene time, you must assess the patient, manage immediate life threats, and prepare the patient for transport.

TABLE 27-1 Indications for On-Scene Time of 10 Minutes or Less and Rapid Transport

- Airway occlusion or difficulty in maintaining a patent airway
- Respiratory rate <10 or >29/minute
- Inadequate tidal volume
- Hypoxia (SpO_2 <95%)
- Respiratory distress, failure, or arrest
- Suspected skull fracture
- Flail chest
- Suspected pneumothorax, hemothorax, or tension pneumothorax
- Pelvic fracture
- Two or more proximal long-bone fractures
- Crushed or mangled extremity
- Uncontrolled external hemorrhage
- Suspected internal hemorrhage
- Signs and symptoms of shock

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TABLE 27-1 Indications for On-Scene Time of 10 Minutes or Less and Rapid Transport

- Significant external blood loss with controlled hemorrhage
- Glasgow Coma Scale score 14 or less
- Altered mental status
- Seizure activity
- Sensory or motor deficit
- Any penetrating trauma to the head, neck, anterior or posterior chest or abdomen, and above the elbow or knee
- Amputation of an extremity proximal to the finger
- Trauma in a patient with significant medical history (myocardial infarction, chronic obstructive pulmonary disease, congestive heart failure), >55 years of age, hypothermia, burns, or pregnancy
- Multisystem trauma
- Open or depressed skull fracture
- Suspected brain injury
- Paralysis

The Trauma System

- The trauma system exists to provide immediate surgical intervention for critically injured trauma patients.
- Different levels of trauma centers have different levels of capability.

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A St. Louis Fire Department ambulance pulls up at the Charles F. Knight Emergency and Trauma Center.

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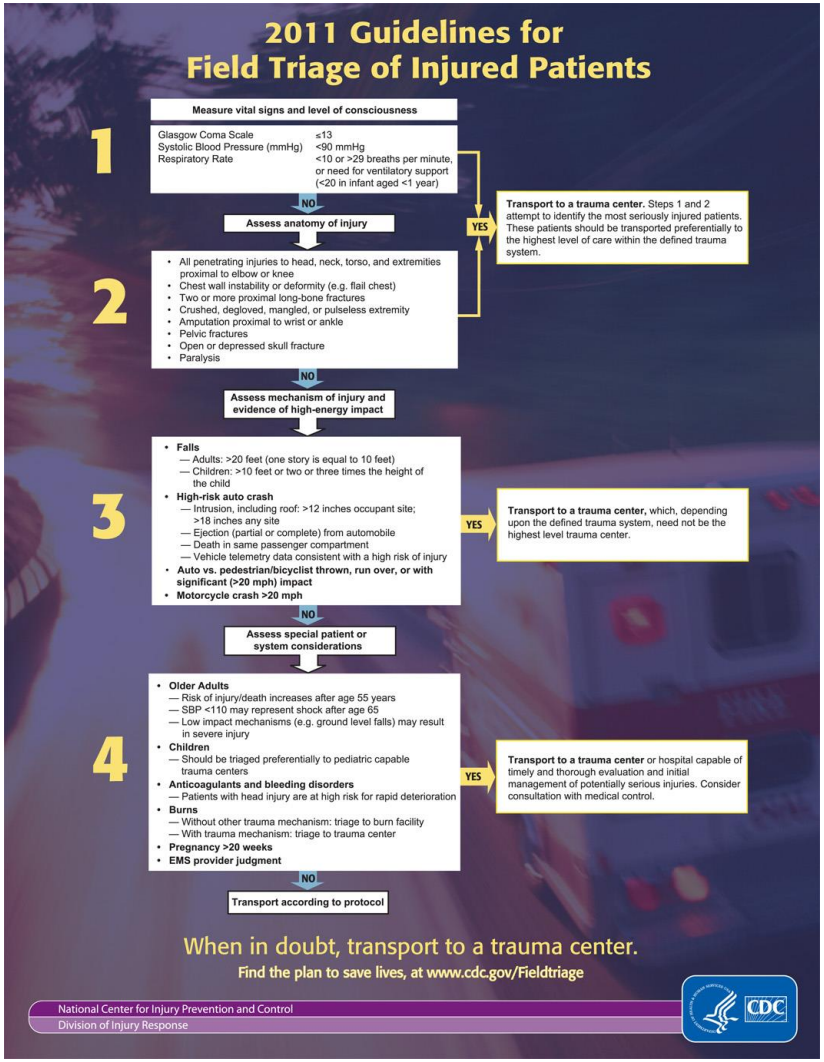
The Trauma System

- Level I – Regional Trauma Center
- Level II – Area Trauma Center
- Level III – Community Trauma Center
- Level IV – Trauma Facility

Guidelines for Field Triage of Injured Patients.



Golden Principles of Prehospital Trauma Care

- Ensure the safety of EMS personnel, patients, and bystanders.
- Quickly determine the need for additional resources.
- Determine the mechanism of injury and kinematics involved.

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Golden Principles of Prehospital Trauma Care

- Perform a primary assessment to identify and manage immediate life threats.
- Establish spinal stabilization for suspected vertebral or spinal cord injury.
- Establish and maintain a patent airway.

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Golden Principles of Prehospital Trauma Care

- Maintain adequate oxygenation.
- Provide positive pressure ventilation for inadequate respiratory rate or tidal volume.
- Control external hemorrhage.

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Golden Principles of Prehospital Trauma Care

- Treat for shock.
- Consider PASG, if indicated.
- Maintain manual spinal stabilization until the patient is immobilized.

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Golden Principles of Prehospital Trauma Care

- Transport critically injured patients within 10 minutes to the appropriate trauma facility.
- Obtain a history.
- Perform and secondary assessment and manage other injuries.

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Golden Principles of Prehospital Trauma Care

- Special considerations
  - Your personal safety is the highest priority.
  - Airway management and adequate ventilation and oxygenation are key elements of trauma management.
  - Stop significant bleeding.

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Golden Principles of Prehospital Trauma Care

- Special considerations
  - Use a systematic approach to assessment.
  - Rapid transport is essential to survival of severely injured patients.
  - A backboard serves to splint fractures in unstable trauma patients.

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Golden Principles of Prehospital Trauma Care

- Special considerations
  - Do not develop tunnel vision and become focused on dramatic injuries or dramatic patients.

Case Study Conclusion

Nina consults with medical direction concerning their destination for the patient. There is a community trauma center 20 minutes away, and a regional trauma center 70 minutes away.

Medical direction advises transport to the community trauma center, where the patient will receive initial stabilization. It is likely that the patient will be transferred to the regional trauma center for definitive treatment.

Lesson Summary

- Assessing the MOI helps predict potential injuries.
- Mass and velocity are the determinants of kinetic energy.
- Trauma may be blunt or penetrating.

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Lesson Summary

- Trauma systems exist to allow rapid surgical intervention for severely injured patients.
- Trauma triage criteria help determine which patients should be transported to a trauma center.