Investigation: Mechanism of Injury

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Why me?

› I am an Athletic Trainer

› Athletic trainers are health care professionals who collaborate with physicians to optimize activity and participation of patients and clients.

› Athletic training encompasses the prevention, diagnosis, and intervention of emergency, acute, and chronic medical conditions involving impairment, functional limitations, and disabilities.
This lecture is designed to:

• analyze means of injuries
• assist in those questions that arise in claim handling.
• provide points of view on how an injury occurs, the signs and symptoms present and what these discoveries mean
• review the impact such claims have on the insurance industry.

What we will cover...
Content Objectives

At the end of the presentation the participant will:

• have knowledge of anatomy/body structure
• understand types of bodily injury (BI)
• have knowledge of types of medical procedures and rehabilitation
• understand documentation standards for medical related BI claims.
Anatomy & Injury
Skin & Soft Tissue Injuries
Skin

Anatomy (structure)
› Epidermis (thinner outer layer of skin)
› Dermis (thicker connective tissue layer)
› Hypodermis (subcutaneous layer or Sub-Q)
› Muscle and bone

Physiology (function)
› 1- Protection
› 2- Regulation of body temperature
› 3- Sensation
› 4- Excretion
› 5- Blood reservoir
› 6- Synthesis of Vitamin D (cholecalciferol)
Soft Tissue Injuries

- Trauma that happens to the skin is visually exposed
- Categorized as a skin wound
- Defined as a break in the continuity of the soft parts of body structures caused by a trauma to these tissues
- Mechanical forces include:
  - Friction, scraping, compression, tearing, cutting, penetrating
Abrasions

- Skin scraped against a rough surface
- Several layers of skin are torn loose or totally removed
- Usually more painful than a deeper cut because scraping of skin exposes millions of nerve endings
Incision

- Skin has been sharply cut
- Surgical cut made in skin or flesh
Laceration

- Flesh irregularly torn; cut or tear in the skin
- Minimal bleeding, minimal pain, & no numbness or tingling
- Cuts ≤ 0.25” (6mm) deep and 0.5” (1.3cm) long & have smooth edges → can be treated at home
- Deeper lacerations should be treated by physician (stitches)
Avulsion

- Layers of skin torn off completely or only flap of skin remains
- Same mechanism as laceration, but to extent that tissue is completely ripped from it’s source
- May be considerable bleeding
Puncture Wound

- Penetration of skin by sharp object
  - Nails, tacks, ice picks, knives, teeth, needles
- May be small in diameter and not seem serious
- Do require treatment by physician
- Can become infected easily b/c dirt and germs carried deep in the tissue
Contusion

- A blow compresses or crushes the skin surface and produces bleeding under the skin
- Does not break skin
- Bruising due to injury to blood vessels
- Most mild and respond well to RICE
Blister

Continuous rubbing over the surface of the skin causes a collection of fluid below or within the epidermal layer.
A collection of fluid below or within the epidermal layer that develops from friction.

A) Contusion
B) Laceration
C) Blister
D) Hematoma
A collection of fluid below or within the epidermal layer that develops from friction.

A) Contusion
B) Laceration
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Skeletal System

- 206 bones
- 177 move
- Levers
- 2 parts
Functions of the Skeletal System

› Protect vital organs
› Support soft tissue
› Makes red blood cells (RBCs)
› Reservoir for minerals
› Provide attachments for muscles
› Acts as a system of machines to produce movement
Typical Bony Features

- **Diaphysis**
  - long cylindrical shaft

- **Cortex**
  - hard, dense compact bone forming walls of diaphysis

- **Periosteum**
  - dense, fibrous membrane covering outer surface of diaphysis

- **Endosteum**
  - fibrous membrane that lines the inside of the cortex
Divisions of the Skeleton

› Axial Skeleton
  • skull
  • thorax
  • vertebral column

› Appendicular Skeleton
  • shoulder girdle
  • upper extremities
  • pelvis
  • lower extremities
Head & Spine Injuries

Dr. Peabody took on the most challenging research projects.
Brain (Mid-sagittal View)
Meninges

- Skull
- Dura mater
- Arachnoid
- Pia mater
- Cerebral cortex
- Subarachnoid space
Types of Head Injuries

- Scalp lacerations
- Skull fractures
- Basal Skull fractures
- Concussion
- Post-concussion syndrome
- Cerebral contusions and lacerations
Battle’s Sign & Raccoon Eyes

4/7/2012 - BASILAR SKULL FRACTURE

Fracture of the Occipital Bone
Fracture of the Temporal Bone

Battle’s Sign
Raccoon Eyes
Epidural vs. Subdural Hematomas

Epidural Hematoma

Subdural Hematoma

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Definition of TBI / Concussion

› May result in neuropathological changes
› Acute clinical symptoms largely reflect a functional disturbance rather than a structural injury.
› Results in a graded set of clinical symptoms that may or may not involve LOC
› Resolution of the clinical and cognitive symptoms typically follows a sequential course;
› However, post-concussive symptoms may be prolonged.
Overview of TBI

› What is a traumatic brain injury (TBI)?
  • traumatic biomechanical forces applied to the head, face, neck, or body that affects brain functioning

› Common causes:
  • Falls
  • Motor vehicle accidents
  • Struck by/against an object
  • Assaults / GSW
  • Recreational sports
Overview of TBI

Types of TBI:

- Closed TBI: brain is injured without penetration of the skull
  - Acceleration-deceleration in a single plane
  - Linear
  - Coup / contre-coup injuries
- Open TBI: brain is injured with penetration of the skull (skull Fx)
Coup / Contre-Coup Injury Mechanism

Unilateral Strike

Forward / Backward Movement

http://www.vh.org/adult/patient/neurosurgery/braininjury/03w/hattypesbraininjuries.html

Brain Tissue Deformation Under Lateral Loading

Image Source: The University of Utah: http://sportsnscience.utah.edu/tag/brain/
Spine & Spinal Cord

- Bones - vertebral column
  - 7 Cervical
  - 12 Thoracic
  - 5- Lumbar
  - 5- Sacral

- Discs
  - between vertebra
Etiology of Traumatic SCI

- MVA - most common cause
- Other: falls, violence, sport injuries
- SCI typically occurs from indirect injury from vertebral bones compressing cord
- SCI frequently occur with head injuries
- Cord injury may be caused by direct trauma from knives, bullets, etc.
Classifications of SCI MOI

› Flexion (hyperflexion)
  › Most common because of natural protection position.
  › Generally causes neck to be unstable because stretching of ligaments

› Hyperextension
  › Caused by chin hitting a surface area, such as dashboard or bathtub
  › Usually causes central cord syndrome symptoms
Classifications of SCI MOI

Compression

› Caused by force from above, as hit on head
› Or from below as landing on butt
› Usually affects the lumbar region

Flexion/Rotation

› Most unstable
› Results in tearing of ligamentous structures that normally stabilize the spine
› Usually results in serious neurologic deficits
Intervertebral Disks

Function

- to allow for mobility of the spine and act as shock absorber
- Located between vertebral bodies
- Composed of nucleus pulposus a gelatinous material surrounded by annulus fibrosis - a fibrous coil
Herniated Disc

- Herniated nucleus pulposus, (HNP) slipped disc, ruptured disc
- HNP- annulus becomes weakened/torn and the nucleus pulposus herniates through it.

Risk Factors:
- Standing erect
- Aging changes
- Poor body mechanics
- Overweight
- Trauma
Herniated Disc

› HNP compresses
  • Spinal nerve (sensory or motor component) as it leaves the spinal cord
› Sensory root or nerve usually affected
  • pain, parenthesis, or loss of sensation
› Motor root or nerve may be affected
  • paresis or paralysis
› Radiculopathy-
  • pathology of the nerve root
› Most common site for HNP
  • L4-5 disc - the 5th lumbar nerve root
  • posterior sensory nerve or root compressed
› Classic symptoms-
  • low back sciatica pain
  • pain increases with increase in intrathoracic pressure
Diagnostic Tests

- X-ray
  - identify deformities and narrowing of disk space
- CT/MRI
- Mylogram Nerve conduction studies (EMG)
  - detect electrical activity of skeletal muscles
## Types of Vertebral Fractures

<table>
<thead>
<tr>
<th>Type of Fracture</th>
<th>Column Affected</th>
<th>Stable v. Unstable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression/Wedge Fracture</td>
<td>Anterior only</td>
<td>Stable</td>
</tr>
<tr>
<td>Burst Fracture</td>
<td>Anterior &amp; Middle</td>
<td>Unstable</td>
</tr>
<tr>
<td>Fracture/Dislocation Injury</td>
<td>Anterior, Middle, Posterior</td>
<td>Unstable</td>
</tr>
<tr>
<td>Seat belt fracture</td>
<td>Anterior, Middle, Posterior</td>
<td>Unstable</td>
</tr>
</tbody>
</table>
Wedge Fx
Burst Fracture at L2

L1
L2
L3
L4
L5
Sacrum

Fracture

VirtualMedStudent.com
An indication of a basil skull fracture characterized by bruising behind the ear is known as

A) Battle’s Sign
B) Fluid Aspiration
C) Rhabdomyolysis
D) Wruh’s node
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Appendicular Skeletal Fractures

- Transverse
- Linear
- Oblique Nondisplaced
- Oblique Displaced
- Spiral
- Greenstick
- Comminuted
Clavicle Fractures

Mechanism

• Fall onto shoulder (87%)
• Direct blow (7%)
• Fall onto outstretched hand (6%)

Location of Fx

• Type I - Middle Third (80%)
• Type II - Distal Third (15%)
• Type III - Medial Third (5%)
Shoulder Dislocations

Epidemiology

- Anterior: Most common
- Posterior: Uncommon, 10%, Think Electrocutions & Seizures
- Inferior: Rare, hyperabduction injury
Humeral Fx.

› Proximal
  • Most common
  • elderly, osteoporosis
  • Females 2:1 over males
  • FOOSH
  • MVA

› Mid Shaft
  • MVA
  • FOOSH
  • Fracture pattern depends on stress applied

› Holstein-Lewis Fractures
  • Distal 1/3 fractures
  • May entrap or lacerate radial nerve as the fracture passes through the intermuscular septum
Elbow Dislocations

› Epidemiology
  • 11-28% of injuries to the elbow
  • Posterior dislocations most common
  • Highest incidence - 10-20 years and usually sports injuries

› Mechanism of injury
  • Most common - fall on outstretched hand or elbow resulting in force to unlock the olecranon from the trochlea
  • Posterior dislocation - hyperextension, valgus stress, arm abduction, and forearm supination
  • Anterior dislocation - direct force to the posterior forearm with elbow flexed
Forearm Fractures

- Epidemiology
  - Highest ratio of open to closed than any other fracture except the tibia
  - More common in males than females, most likely secondary MVA, contact sports, altercations, and falls

- Mechanism of Injury
  - Commonly associated with MVA, direct trauma missile projectiles, and falls
Distal Radius Fractures

*Epidemiology*
- Most common fx of UE
- FOOSH
- seen in younger and older pop

*Mechanism of Injury*
- FOOSH - wrist in dorsiflexion
- High energy injuries (ie MVA) result in significantly displaced, highly unstable fractures

*Types*
- Colles’ Fracture
  - Smith Fracture (Reverse Colles)
  - Barton Fracture
  - Radial Styloid Fracture (Chauffeur Fracture)
Hip Dislocations

- Significant trauma, usually MVA
- Posterior: Hip flexion, IR, Add
- Anterior: Extreme ER, Abd/Flex
Femoral Head Fractures

- Concurrent with hip dislocation due to shear injury
- Pipkin Classification
  - I: Fracture inferior to fovea
  - II: Fracture superior to fovea
  - III: Femoral head + acetabulum fracture
  - IV: Femoral head + femoral neck fracture
Femoral Neck Fractures

- **Garden Classification**
  - I Valgus impacted
  - II Non-displaced
  - III Complete: Partially Displaced
  - IV Complete: Fully Displaced

- **Functional Classification**
  - Stable (I/II)
  - Unstable (III/IV)
Classification

- # of parts: Head/Neck, GT, LT, Shaft
- Stable
  - Resists medial & compressive Loads after fixation
- Unstable
  - Collapses into varus or shaft medializes despite anatomic reduction with fixation
- Reverse Obliquity
  - major frx line extends from proximal-medial to distal-lateral through intertroch-subtrochanteric region
Intertrochanteric Hip Fx

Stable

Unstable

Reverse Obliquity
Femoral Shaft Fx

- Type 0 - No comminution
- Type 1 - Insignificant butterfly fragment with transverse or short oblique fracture
- Type 2 - Large butterfly of less than 50% of the bony width, > 50% of cortex intact
- Type 3 - Larger butterfly leaving less than 50% of the cortex in contact
- Type 4 - Segmental comminution
  - Winquist and Hansen 66A, 1984
Knee Dislocations

High association of injuries

• Ligamentous Injury
  • ACL, PCL, Posterolateral Corner
  • LCL, MCL

• Vascular Injury
  • Intimal tear vs. Disruption
  • Obtain ABI’s → (+) → Arteriogram
  • Vascular surgery consult with repair within 8hrs

• Peroneal >> Tibial N. injury
Patella Fractures

History
• MVA, fall onto knee, eccentric loading

Physical Exam
• Ability to perform straight leg raise against gravity (i.e., extensor mechanism still intact?)
• Pain, swelling, contusions, lacerations and/or abrasions at the site of injury
• Palpable defect
Tibial Plateau Fractures

- MVA, fall from height, sporting injuries
- Mechanism and energy of injury plays a major role in determining orthopedic care
- Examine soft tissues, neurologic exam (peroneal N.), vascular exam (esp with medial plateau injuries)
- Be aware for compartment syndrome
- Check for knee ligamentous instability
Schatzker Classification of Plateau Fxs

Lower Energy

Type I
Type II
Type III

Higher Energy

Type IV
Type V
Type VI
Tibial Shaft Fractures

Mechanism of Injury

- Can occur in lower energy, torsion type injury (e.g., skiing)
- More common with higher energy direct force (e.g., car bumper)
- Open fractures of the tibia are more common than in any other long bone
Johner and Wruh’s Classification

Ankle Fractures

History
- Mechanism of injury
- Time elapsed since the injury
- Soft-tissue injury
- Has the patient ambulated on the ankle?
- Patient’s age / bone quality
- Associated injuries
- Comorbidities
  - (DM, smoking)
Classification Systems (Lauge-Hansen)

- Based on cadaveric study
- First word refers to position of foot at time of injury
- Second word refers to force applied to foot relative to tibia at time of injury
Classification Systems (Weber-Danis)

- A: Fibula Fracture distal to mortise
- B: Fibula Fracture at the level of the mortise
- C: Fibula Fracture proximal to mortise
Investigating Falls

- Follow path of energy through body

- Fall Onto Buttocks
  - Pelvic fracture
  - Cocygeal fracture
  - Lumbar compression fracture

- Fall Onto Feet
  - Bilateral heel fractures
  - Compression fractures of vertebrae
  - Bilateral Colles’ fractures
This picture represents which type of injury?

A) Tibial Plateau Fracture
B) Burst Fracture
C) Colle’s Fracture
D) Wedge Fracture
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Claim Analysis & Reporting

“I’m in a paperwork mood, let ‘er rip.”

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Documentation standards for medical related BI claims

- Medical Record Documentation
  - ER records
  - Medical Tx patterns
  - Provider type
  - Tx duration and frequency
  - Pain mgt.
  - SOAP Notes

- Performance Measure

- Baseline Data

- Record of Visits
Review Medical Records / Procedures

› Original Medical Assessment (ER, Occ Med)
› Surgical Tx
› Rehabilitation (outpatient & inpatient procedures: PT, OT, ST)
› FCEs
› IMEs
In Summary

- The body is mechanically modeled as a system of rigid links connected a joints
- Physical principles of kinetic energy, Laws of motion and conservation of energy govern the types of injury sustained by the ridged links and soft tissue structures of the human body
- When assessing an injury scenario follow the path of energy through the body
In Summary

› Identify and assess risks / causation
  • Posture? / Force?
  • Repetition? / Duration?
  • Environment?

› Use information from reports from the scene, ER records, medical treatment patterns, SOAP notes

› Do records match the mechanism?
QUESTIONS?
THANK YOU!

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References


› Medical Billing & Coding: Medical Terminology


› Rast. P. (Fall 2014) Lecture series presented in Anatomical Basis of Activity EXS 2301. Texas Wesleyan University, Fort Worth, TX


› BLS News Release November 19, 2015

References

- NAEMT (2013) PHTLS: Prehospital Trauma Life Support 7th Ed Chapter 4 Kinematics of Trauma, Jones & Bartlett Learning
In the Corporate/Industrial Setting Athletic Trainers:

- possess confidant evaluation skills, and an understanding of orthopedic protocols for acute, chronic and post surgical rehabilitation.
- perform an ergonomic assessment of both static and dynamic activities, establish functional capacity exam standards
- fit employees with proper personal protective equipment (PPE),
- develop a line of communication when dealing with an employee incident
- develop and record an accurate assessment of job duties & instruct employees in proper task performance
- understand established safety issues and OSHA guidelines
- professionally research topics, create a presentation and present material to pertinent parties