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at Hartford Hospital

# Orthopedic Emergencies-
## LONG BONE FRACTURES

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*BJI/ Hartford Hospital*

## No Conflict

I have no commercial conflicts with this presentation.



## Kevin Ware

## Long bone fractures are attention getters…




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## Long bone fractures relatively rare in Sport-

- Important to recognize the issues that can prolong recovery



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## Agenda- 30 min

**•Discuss long bone fractures and identify potential complications that may occur**
**•Understand the prognosis of long bone fractures**
**•Recommendations for return to participation for long bone fractures**



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## Agenda

- Discuss fractures and what would make them possible emergencies
- Discuss the major long bone fractures cases and relevance to sport
- Review their prognosis and return to sport potential/timing



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## Implications of long bone fractures

## WHY ARE LONG BONE FRACTURES EMERGENCIES?

- Blood Loss
- Neurovascular damage
- Fat embolism

- Long term loss of function



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## Physiologic events after long bone fractures and injuries

- Local
  - Immediate
  - Early
  - delayed
- Sytemic
  - Immediate
  - early

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## Immediate Potentail Complications

- **Systemic** immediate Complication
  - hypovolemic shock
- **Local** immediate complication
  - Injury to major vessels.
  - -Injury to muscles and tendons.
  - -Injury to joints.
  - -Injury to nerves.

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## Early Potential Complications

**Local**

- Bleeding /shock
- Compartment syndrome.
- Infection if open

**Systemic**

- Hypovolemic shock
- ARDS
- Fat embolism syndrome
- Deep vein thrombosis
- Pulmonary Embolism
- Crush syndrome
- Septicemia

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## Late complications- loss of function

- Imperfect union of the fracture (Deformity)
- Delayed union
- Non union
- Mal union

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## Bleeding-

**Can occur from**

- fracture site
- Arterial injury



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## Blood Loss from fracture site

- Femur ➢ 1000-1500 cc
- Tibia ➢ 500-1000 cc
- Humerus ➢ 250 – 500 cc
- Clavicle ➢ 100-250 cc

Categories of Hemorrhagic Shock

| | Class I | Class II | Class III | Class IV |
|---|---|---|---|---|
| Blood Loss % | < 750 ml < 15 % | 750-1500 ml (15-30 %) | 1500-2000 ml (30-40 %) | > 2000 ml > 40 % |
| HR (b/min) | Normal or minimally ↑ | > 100 | > 120 | > 140 |
| Ventilatory R (breath/min) | Normal | 20 – 30 | 30 – 40 | > 35 |
| SBP | Normal | Normal | Decreased | Greatly Decreased |
| Urine Output (ml/hr) | Normal | 20 – 30 | 5 – 15 | Minimal |



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## BLOOD VESSELS : VASCULAR INJURY

**specific fractures**

- Clavicle.
- Supracondylar region of the elbow
- Femoral shaft-
- Around the knee

**artery**

- subclavian artery
- brachial artery
- femoral artery .
- popliteal artery

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## NERVE INJURY

- Nerve can damage in 3 ways:
- • Compressed.
- • Contused.
- • Stretched.

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## Adult Respiratory Distress

known as :Shock lung or wet lung.

- fluid overload.
- Edema and electrolyte retention 2nd to trauma contributes to it.
- Treatment is by oxygen and ventilation.

## Fat Embolism Syndrome

- Mechanical blockage of blood vessels by circulating fat particles .
- Occurs following
  - Long bone fracture,
  - pelvic fracture

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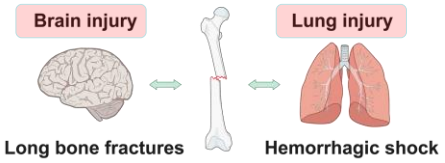
## Lungs and Brain especially susceptible to 2nd hit…




- Vulnerable blood-brain barrier and pulmonary endothelium

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## Etiology Of Decompensation

- Linked to Inflammatory Cascade
  - Initiated by trauma
- Pt in Hypermetabolic state
  - Cytokine Storm
  - Elevated IL-10 & IL-6
    - IL-6: Pro-inflammatory
    - IL-10: Anti-inflammatory
- Risk of MOF (Multiple Organ Failure)

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## FES

**Signs and symptoms**

- appear 12-72 hours post injury
  - Change in mental status
  - Respiratory distress
  - Petechial of skin & mucosa.

**Diagnostics:**

- No specific labs test
  - Fat globules may be detected in blood, urine or
  - sputum
  - PO2 drops to < 50 mm HG
  - Chest X Ray with diffuse "snowstorm" effect

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## Deep Venous Thrombosis & Pulmonary Embolism

- Formation of fibrin leads to development of a thrombus (fibrin **clot**)
  - Embolus can enter pulmonary circulation
  - perfusion distal to the embolus can be partially or completely occluded.

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## Deep Vein Thrombosis and Pulmonary Embolism

- DVT:
- Clinical manifestations
  - Unilateral swelling of thigh/lower leg
  - Discomfort in leg
  - Erythema
  - Warmth
  - Tenderness

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## DVT and PE Investigation

**Deep Venous Thrombosis**

- Contrast venography
- Doppler Ultrasonogram

**Pulmonary Embolism**

- Pulmonary Angiogram
- CT scan

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## Crush Injuries

- traumatic rhabdomyolysis.
- compression of extremities
  - causes muscle swelling
  - neurological disturbances in the affected areas
- characterized by major shock and renal failure after a crush injury to skeletal muscle

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## COMPARTMENT SYNDROME- RISK FACTORS

A condition in which the circulation and function of tissues within a closed space compromised by an increased pressure within that space.

**Internal Factors**

- Bleeding
  - Swelling/edema
- Training

**External Force**

- Tight cast
- Tight dressing
- Prolonged compression
- Crush injuries

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## acute compartment syndrome

**Conditions that precipitate**

- fracture.
- crush injuries.
  - bruised muscle. E.g. football player is hit in the leg with another player's helmet.
- Reestablished blood flow
- Anabolic steroid use. Taking steroids is a possible factor in compartment syndrome.



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## All fractures have the same effects

- bleeding
- Release of local mediators
- Initiation of the inflammatory response



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## Soccer , football players at higher risk of compartment syndrome

Acute tibia fractures in football, soccer players more likely to develop acute compartment syndrome
Wind T. J Orthop Trauma. 2011.



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## Bone healing problem

**Delayed Union**

No healing after 4 months

**Nonunion**

No healing after 6 months

**Malunion**

Heals out of alignment

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## Emergency Medical Care

- Perform a primary assessment.
- Stabilize the patient's ABCs.
- Perform a rapid scan or focus on a specific injury.
- Follow standard precautions.
- Suspect internal bleeding.

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## Splinting (1 of 7)

- A splint is a flexible or rigid device that is used to protect and maintain the position of an injured extremity.
  - Splint all fractures, dislocations, and sprains before moving the patient, unless he or she is in immediate danger.
  - Splinting reduces pain and makes it easier to transfer and transport the patient.

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## Splinting (2 of 7)

- Splinting will help to prevent:
  - Further damage to muscles, the spinal cord, peripheral nerves, and blood vessels
  - Laceration of the skin
  - Restriction of distal blood flow
  - Excessive bleeding of the tissues
  - Increased pain
  - Paralysis of extremities

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## Splinting (4 of 7)

- General principles of splinting
  - Remove clothing from the area.
  - Note and record the patient's neurovascular status.
  - Cover all wounds with a dry, sterile dressing.
  - Do not move the patient before splinting an extremity, unless there is danger.

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## Splinting (5 of 7)

- General principles of splinting (cont'd)
  - Pad all rigid splints.
  - Maintain manual stabilization.
  - If you encounter resistance, splint the limb in its deformed position.
  - Stabilize all suspected spinal injuries in a neutral, in-line position.
  - When in doubt, splint.

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## Splinting (6 of 7)

- General principles of in-line traction splinting
  - Act of pulling on a body structure in the direction of its normal alignment
  - Goals of in-line traction:
    - To stabilize the fracture fragments
    - To align the limb sufficiently
    - To avoid potential neurovascular compromise

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## Splinting (7 of 7)

- In-line traction splinting (cont'd)
  - Imagine where the uninjured limb would lie, and pull gently along the line of that imaginary limb until the injured limb is in approximately that position.

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## Transportation

- Very few, if any, musculoskeletal injuries justify the use of excessive speed during transport.
  - A patient with a pulseless limb must be given a higher priority.
  - If the treatment facility is an hour or more away, transport by helicopter or immediate ground transportation.

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## You can help reduce the risk or duration of long-term disability by

- Preventing further injury
- Reducing the risk of wound infection
- Minimizing pain by the use of cold and analgesia
- Transporting patients to an appropriate medical facility

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## Pelvic fractures

**Avulsion fractures common**

- Not dangerous

courtesy of Dr Andrew Ho, Radiopaedia.org, rID: 28884



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## Pelvic fractures- non avulsion



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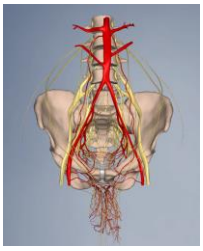
## Pelvis

**Very vascular**

**Can bleed**





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## Pelvis

**Decelerates around object**

Horse
Bicycle
Motorcycle
Fall
( sled)



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## Pelvic ring disruption—mortal

- Potential for Severe hemorrhage with mortality of 50–60%
- Hallmark for survival: rapid recognition and control of retroperitoneal hemorrhage

**Smith W, Williams A, Agudelo J et al.** Early predictors of mortality in hemodynamically unstable pelvis fractures. *J Orthop Trauma.* 2007 Jan;21(1):31-7.

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## Femur fractures


Boston Bruins Schedule Standings Stats Video Odds Fantasy Tickets

Chris Kelly: Retirement 'Furthest Thing From My Mind' After Broken Leg

by Zack Cox on Thu, Nov 19, 2015 at 1:04PM

Bruins winger Chris Kelly trips and fractures his femur

*He did not leave the game under his own power.*



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## Clinical Presentation

**Physical exam findings**

- Shortening of the thigh
- Swelling
- Deformity
- Severe pain
-



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## Physical examination

- Palpation of the pelvis, hip, and knee
- Circumferential examination of soft-tissue
- Assessment of distal neurologic and vascular integrity
- Rule out of compartment syndrome of the calf and thigh
- Examination for thromboembolitic disease
- Examination for concomitant injuries
- Quaternary survey: all other bone palpated for tenderness (see first, second, and third phases of ATLS)



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## Associated injuries

**Table 4: Specific knee injuries with respect to femoral fractures**

| IDK pattern | No. |
|---|---|
| ACL + PCL + MCL + MM | 2 |
| ACL + LCL + LM | 4 |
| ACL + MCL + MM | 3 |
| ACL + MCL | 1 |
| ACL + PCL | 1 |
| MCL + MM | 1 |
| Mixed chondral contusions | 12 |
| Isolated chondral contusions | 5 |
| PCL (isolated) | 1 |
| ACL (isolated) | 1 |

ACL is the most common associated injury in femoral fracture followed by MCL



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## Rehabilitation and Postoperative Management

- Postoperatively, active range motion of surrounding joints is encouraged.
- weight bearing is typically as tolerated



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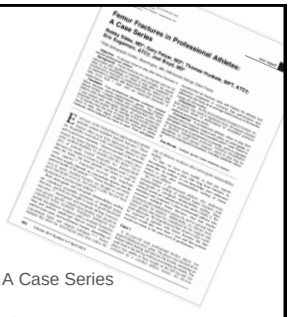
## Femur Fractures

- Functional recovery after long-bone fractures usually depends on concomitant injuries and the general health of the patient.
- Femur fractures are rarely seen in sports.




- 1 year return to sport

Femur Fractures in Professional Athletes: A Case Series
Sikka et al

Journal of Athletic Training 2015;50(4):442–448 doi: 10.4085/1062-6050-49.5.10



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- Functional limitations that impaired outcomes after femur fractures included hip-abductor weakness, quadri- ceps femoris muscle weakness, and anterior knee pain



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## Soft Tissue- 26 yo struck by boat w femur /acet

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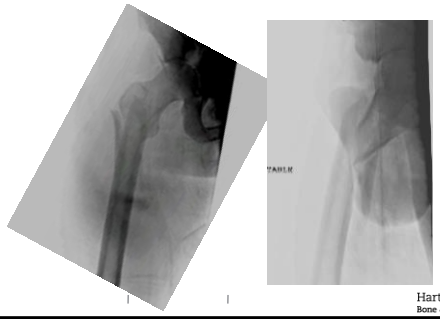

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## Locking plate subcutaneously as ex fix

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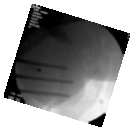

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## Return to OR when swelling down

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## Tibia

- Typically occurs w high energy injuries
- Can occur direct contact w foot planted
  - Theisman
  - Ware





## Prognosis- tibia

- 91.5% of patients with tibial shaft fractures treated surgically returned to sports, only 75% in different studies) returned to the same level of play.
  - Surgery was associated with some complications, including knee pain after surgery, compartment syndrome, infection and blood clots.
- 66.7% treated nonsurgically returned to sports.
  - time required to return was much greater for nonsurgically-treated fractures.
  - Displacement of the fracture can occur with nonoperative treatment.

Robertson GAJ and Wood AM. Return to Sport After Tibial Shaft Fractures: A Systematic Review. *Sports Health*. Published online August 18, 2015

## Injuries of the Clavicle and Scapula (1 of 3)

Source: © Shea, MD/Custom Medical Stock Photo

- The clavicle is one of the most commonly fractured bones in the body.
  - Occur most often in children
  - pain in the shoulder
  - will hold the arm across the front of the body.

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## Injuries of the Clavicle and Scapula (3 of 3)

- These fractures can be splinted effectively with a sling and swathe.

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## Clavicle

- Clavicle fractures comprises up to 10% of all sport-related fractures,[7,8] with around 30% of all clavicle fractures occurring during sport.[8]
- Currently, most patients are able to return to manual work after fracture consolidation at average of 16 weeks.
- study results demonstrate that high-end athletes can safely return to at-risk sports much sooner than the average delays seen with non-athletes.

Hebert-Davies J, Agel J. BMJ Open Sport Exerc Med 2018;**4**:e000371. doi:10.1136/bmjsem-2018-000371



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## Dislocations of the Shoulder

- The humeral head most commonly dislocates anteriorly.
- Shoulder dislocations are very painful.
  - Stabilization is difficult because any attempt to bring the arm in toward the chest wall produces pain.
  - Splint the joint in whatever position is more comfortable for the patient.

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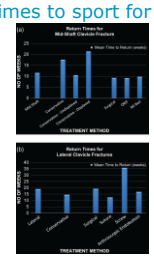
## Fig. 3 (a) Return Times to sport for mid-shaft clavicle fractures; (b) return times to sport for lateral clavicle ...




British Medical Bulletin, Volume 119, Issue 1, 09 September 2016, Pages 111–128, https://doi.org/10.1093/bmb/ldw029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## Fractures of the Humerus

- Occur either proximally, in the midshaft, or distally at the elbow
- Consider applying traction to realign the fracture fragments before splinting them.
  - Splint the arm with a sling and swathe.

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## In non contact siyuations usually due to muscle imbalance

**imbalance exists between**

- the internal rotators
  - latissimus dorsi,
  - pectoralis major,
  - subscapularis
- external rotators
  - (rotator cuff).

- the rotational torque force on the humerus during the acceleration phase of overhead throwing is sufficient to cause a spontaneous fracture.



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## 24 yo pitcher- fractures humerus during game



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## postop



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## After hardware removal



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## Humerus – return to sport

- Proximal humerus
  - Older population- 53 yrs
  - Most avoided return to overhead sports
- Humerus shaft
  - 12-16 weeks

Return to sports after plate fixation of humeral head fractures 65 cases with minimum 24-month follow-up Ahrens et al. BMC Musculoskeletal Disorders (2017) 18:173 DOI 10.1186/s12891-017-1532-2



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## Prognosis

- Return to sport after long bone fractures often season ending injury
- Typical return to sport- minimum 16 weeks
  - Significantly affected by injury to
    - Nerves
    - Muscle



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## Summary

- Long bone fractures can be possible medical emergencies- recognition important
- major long bone fractures relatively rare in sport
- Long bone fractures have a good prognosis but return to sport can be prolonged



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