Fracture Classification

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History of Fracture Classification

- 18th & 19th century
  - History based on clinical appearance of limb alone

Colles Fracture Dinner Fork Deformity

20th Century

- Classification based on radiographs of fractures
- Many developed
- Problems
  - Radiographic quality
  - Injury severity

What about CT scans?

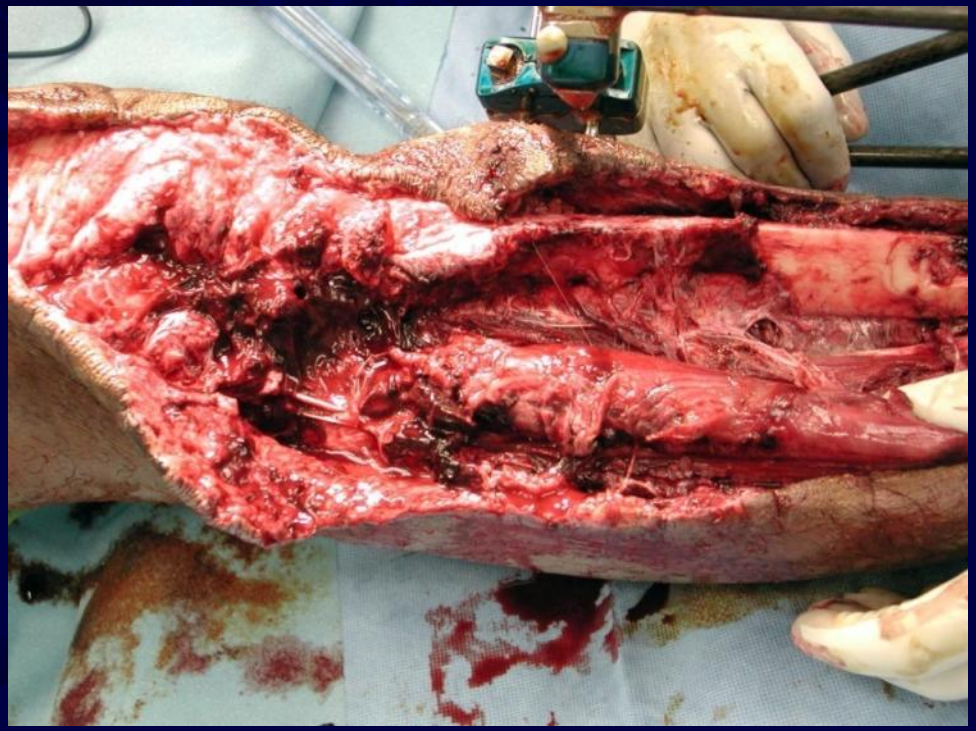
- CT scanning can assist with fracture classification
- Example: Sanders classification of calcaneal fractures

Other Contributing Factors

The Soft Tissues

Fracture appears non complex on radiographs

The real injury



Patient Variables

- Age
- Gender
- Diabetes
- Infection
- Smoking
- Medications
- Underlying physiology

Injury Variables

- Severity
- Energy of Injury
- Morphology of the fracture
- Bone loss
- Blood supply
- Location
- Other injuries

Why Classify?

- As a treatment guide
- To assist with prognosis
- To speak a common language with other surgeons

As a Treatment Guide

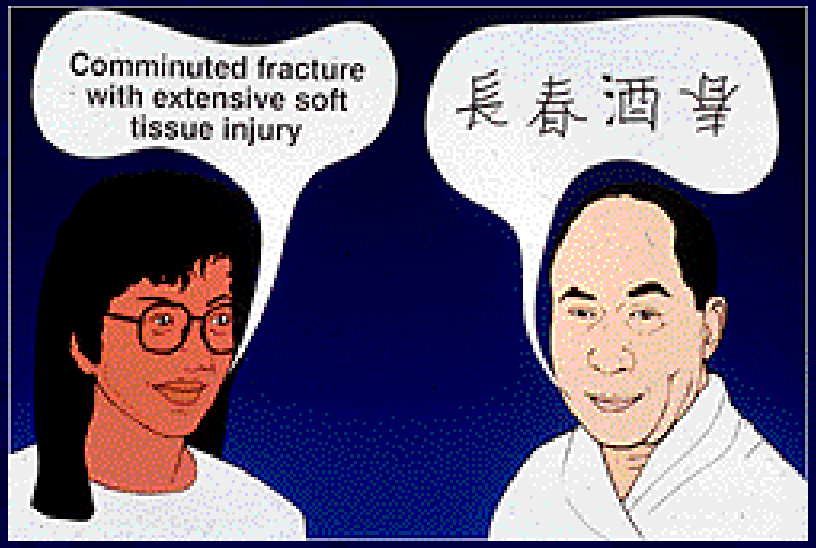
- If the same bone is broken, the surgeon can use a standard treatment
- PROBLEM: fracture personality and variation with equipment and experience

To Assist with Prognosis

- You can tell the patient what to expect with the results
- PROBLEM: Does not consider the soft tissues or other compounding factors

To Speak A Common Language

- This will allow results to be compared
- PROBLEM: Poor interobserver reliability with existing fracture classifications



Interobserver Reliability

Different physicians agree on the classification of a fracture for a particular patient

Intraobserver Reliability

For a given fracture, each physician should produce the same classification

Descriptive Classification Systems

- **Examples**
  - ***Garden:*** **femoral neck**
  - ***Schatzker:*** **Tibial plateau**
  - ***Neer:*** **Proximal Humerus**
  - ***Lauge-Hansen:*** **Ankle**

Literature

- 94 patients with ankle fractures
- 4 observers
- Classify according to Lauge Hansen and Weber
- Evaluated the precision (observer's agreement with each other)

Thomsen et al, JBJS-Br, 1991

Literature

- **Acceptable reliabilty with both systems**
- **Poor precision of staging, especialy PA injuries**
- **Recommend: classification systems should have reliability analysis before used**

Thomsen et al, JBJS-Br, 1991

Literature

- 100 femoral neck fractures
- 8 observers
- Garden's classification

- Classified identical 22/100
- Disagreement b/t displaced and non-displaced in 45
- Conclude poor ability to stage with this system

Frandsen, JBJS-B, 1988

Universal Fracture Classification

OTA Classification

- There has been a need for an organized, systematic fracture classification
- Goal: A comprehensive classification adaptable to the entire skeletal system!
- Answer: OTA Comprehensive Classification of Long Bone Fractures

With a Universal Classification…

You go from x-ray….

To…

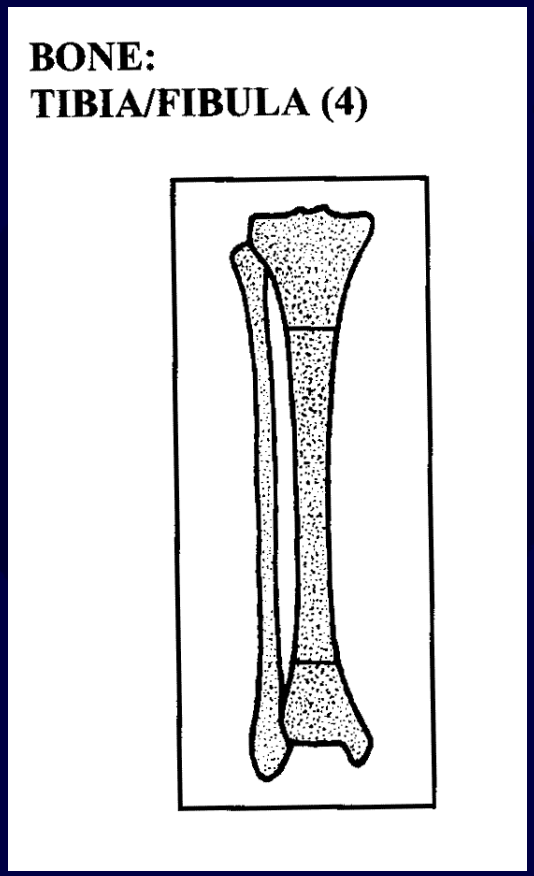
- **Treatment**
- **Implant options**
- **Results**

To Classify a Fracture

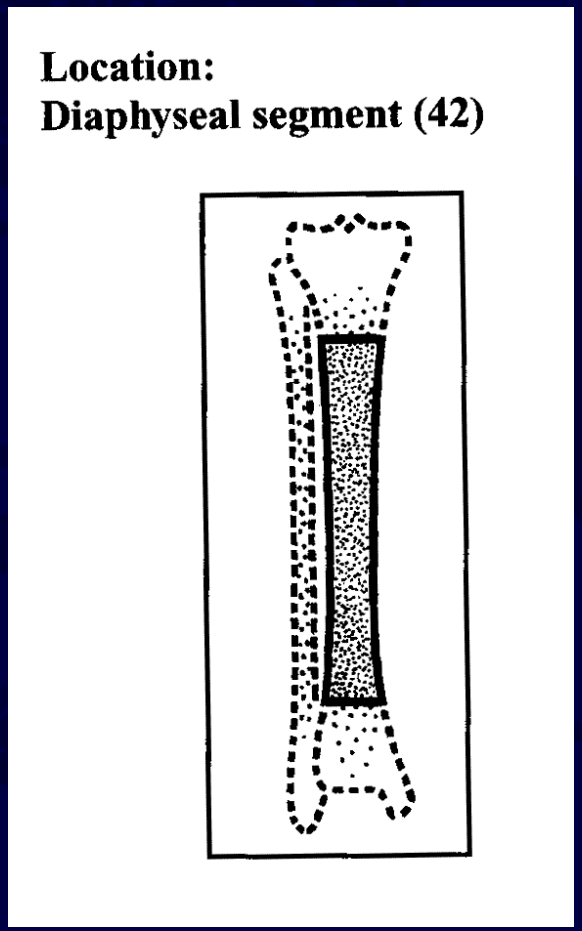
- Which bone?
- Where in the bone is the fracture?
- Which type?
- Which group?
- Which subgroup?

Using the OTA Classification

- Which bone?

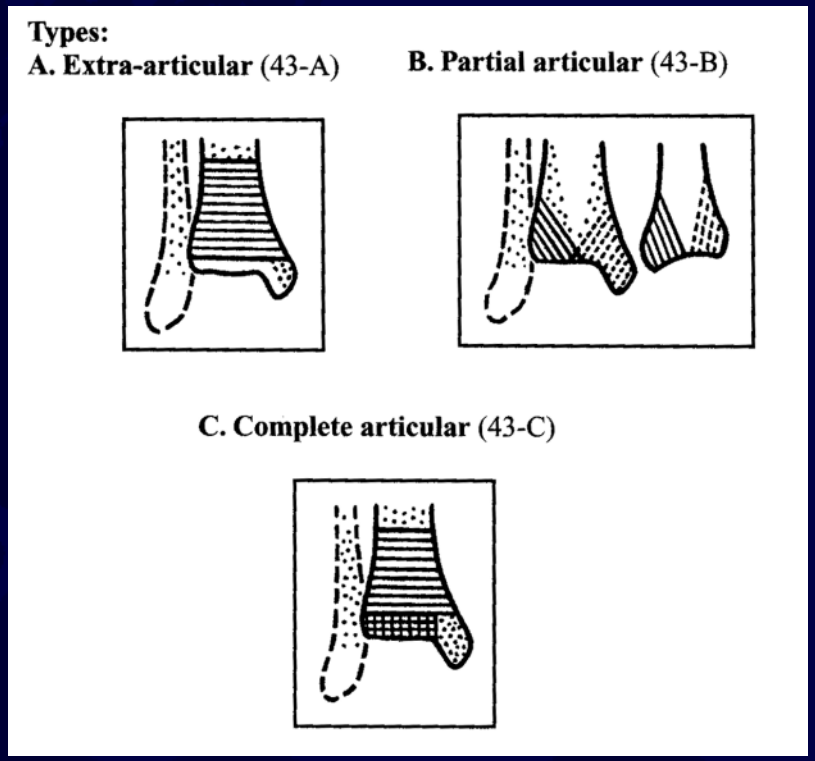


- Where in the bone?



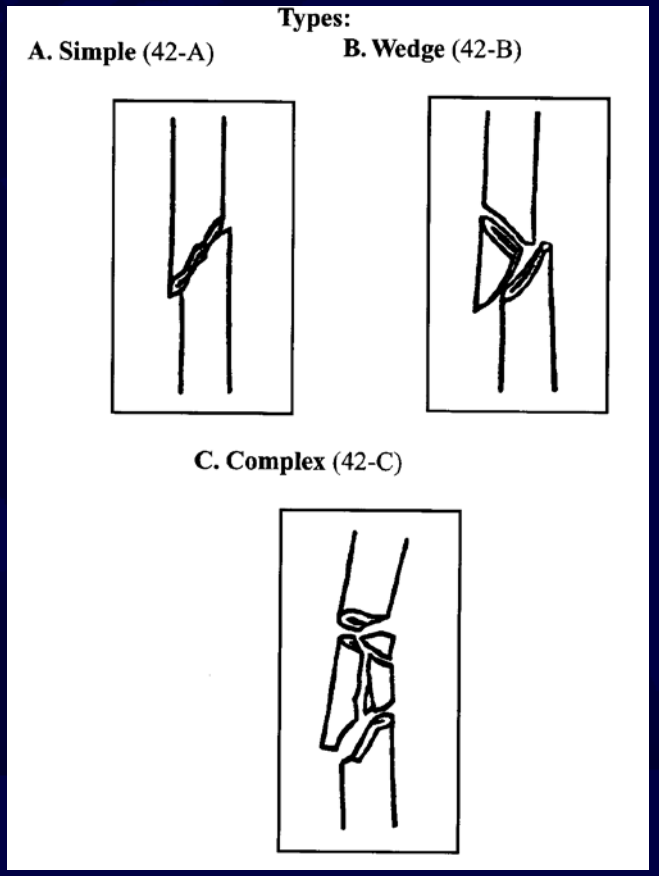
Proximal & Distal Segment Fractures

- Type A
  - Extra-articular
- Type B
  - Partial articular
- Type C
  - Complete disruption of the articular surface from the diaphysis



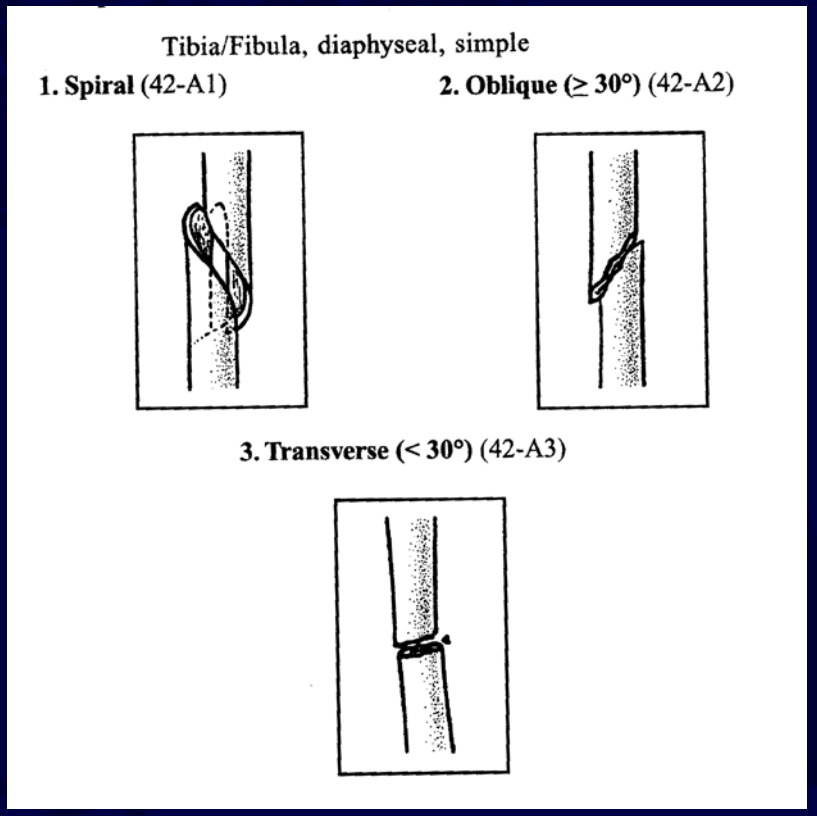
Diaphyseal Fractures

- Type A
  - Simple fractures with two fragments
- Type B
  - Wedge fractures
  - After reduced, length and alignment restored
- Type C
  - Complex fractures with no contact between main fragments



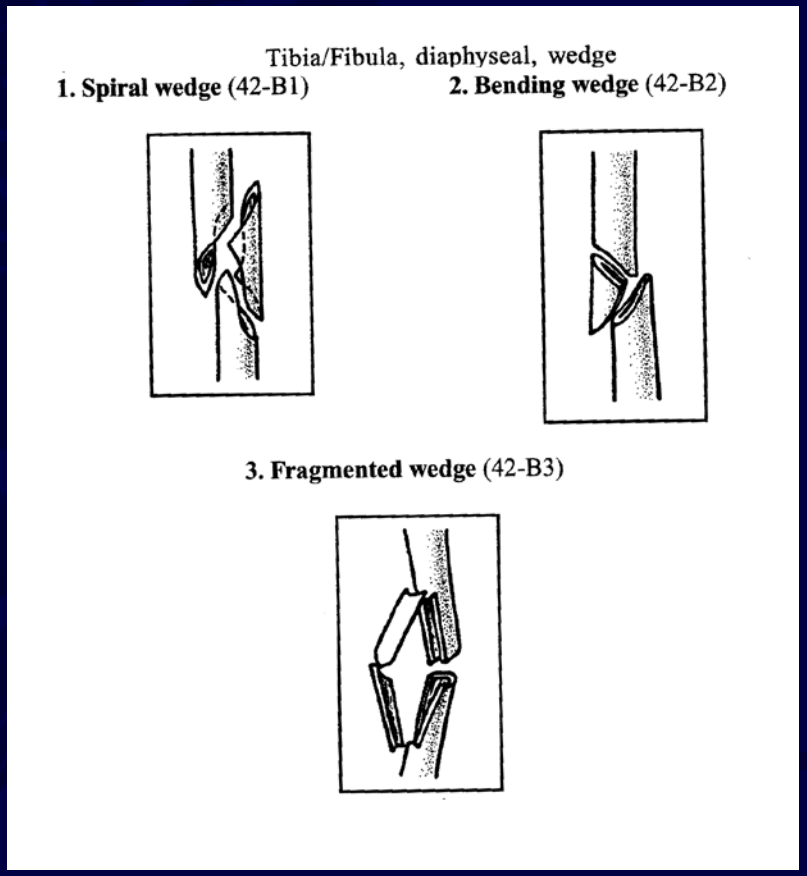
Grouping-Type A

1. Spiral
2. Oblique
3. Transverse



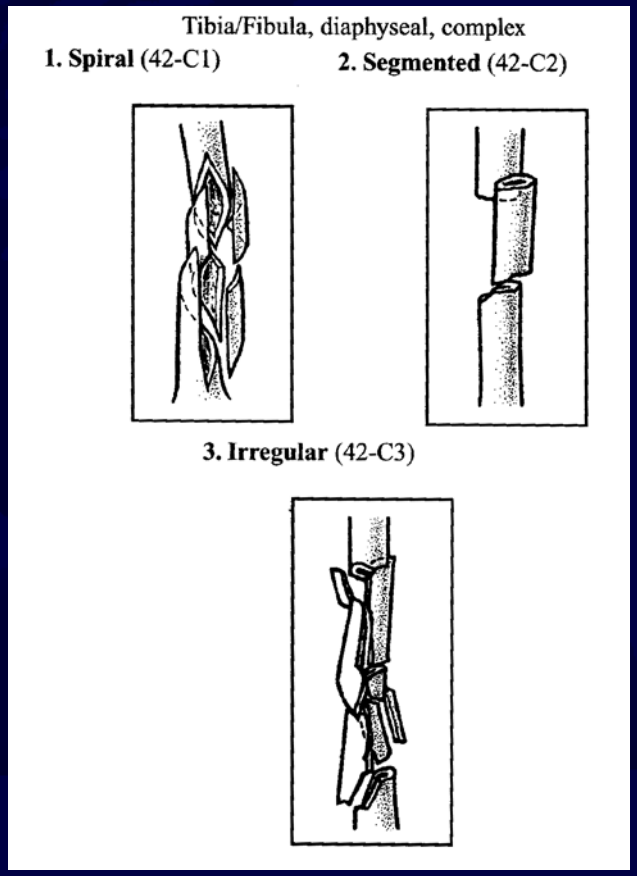
Grouping-Type B

1. Spiral wedge
2. Bending wedge
3. Fragmented wedge



Grouping-Type C

1. Spiral multifragmentary wedge
2. Segmental
3. Irregular



Subgrouping

- Differs from bone to bone
- Depends on key features for any given bone and its classification
- The purpose is to increase the precision of the classification

OTA Classification

- It is an evolving system
- Open for change when appropriate
- Allows consistency in research
- Builds a description of the fracture in an organized, easy to use manner

Classification of Soft Tissue Injury Associated with Fractures

Closed Fractures

- Fracture is not exposed to the environment
- All fractures have some degree of soft tissue injury
- Commonly classified according to the Tscherne classification
- Don’t underestimate the soft tissue injury as this affects treatment and outcome!

Closed Fracture Considerations

- The energy of the injury
- Degree of contamination
- Patient factors
- Additional injuries

Tscherne Classification

- Grade 0
  - Minimal soft tissue injury
  - Indirect injury
- Grade 1
  - Injury from within
  - Superficial contusions or abrasions

Tscherne Classification

- Grade 2
- Direct injury
- More extensive soft tissue injury with muscle contusion, skin abrasions
- More severe bone injury (usually)

Tscherne Classification

- Grade 3
  - Severe injury to soft tisues
  - -degloving with destruction of subcutaneous tissue and muscle
  - Can include a compartment syndrome, vascular injury

Closed tibia fracture
Note periosteal stripping
Compartment syndrome

Literature

- Prospective study
- Tibial shaft fractures treated by intramedullary nail
- Open and closed
- 100 patients

Gaston, JBJS-B, 1999

Literature

What predicts outcome?

Classifications used:

- AO
- Gustilo
- Tscherne
- Winquist-Hansen (comminution)

All x-rays reviewed by single physician

Evaluated outcomes

- Union
- Additional surgery
- Infection

Tscherne classification more predictive of outcome than others

Gaston, JBJS-B, 1999

Open Fractures

- A break in the skin and underlying soft tissue leading into or communicating with the fracture and its hematoma

Open Fractures

- Gustilo-Anderson
- OTA-Open Fracture Classification (OFC)

Open Fractures

- Commonly described by the Gustilo system
- Model is tibia fractures
- Routinely applied to all types of open fractures
- Gustilo emphasis on size of skin injury

Open Fractures

- Gustilo classification used for prognosis
- Fracture healing, infection and amputation rate correlate with the degree of soft tissue injury by Gustilo
- Fractures should be classified in the operating room at the time of initial debridement
  - Evaluate periosteal stripping
  - Consider soft tissue injury

Type I Open Fractures

- Inside-out injury
- Clean wound
- Minimal soft tissue damage
- No significant periosteal stripping

Type II Open Fractures

- Moderate soft tissue damage
- Outside-in mechanism
- Higher energy injury
- Some necrotic muscle, some periosteal stripping

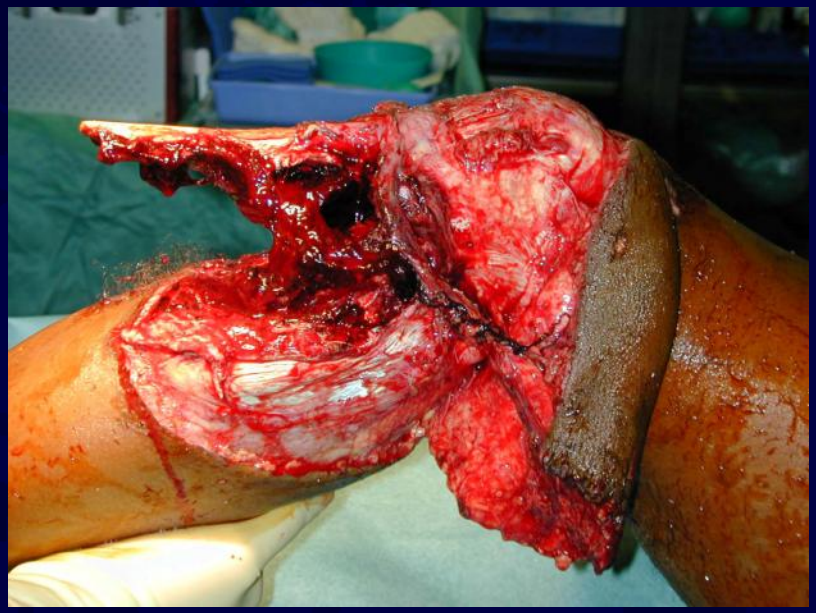
Type IIIA Open Fractures

- High energy
- Outside-in injury
- Extensive muscle devitalization
- Bone coverage with existing soft tissue not problematic

Note Zone of Injury

Type IIIB Open Fractures

- High energy
- Outside in injury
- Extensive muscle devitalization
- Requires a local flap or free flap for bone coverage and soft tissue closure
- Periosteal stripping



Type IIIC Open Fractures

- High energy
- Increased risk of amputation and infection
- Major vascular injury requiring repair

Literature on Open Fracture Classification

- 245 surgeons
- 12 cases of open tibia fractures
- Videos used
- Various levels of training (residents to trauma attendings)

Brumback et al, JBJS-A, 1994

Literature on Open Fracture Classification

- Interobserver agreement poor
  - Range 42-94% for each fracture
- Least experienced- 59% agreement
- Orthopaedic Trauma Fellowship trained- 66% agreement

Brumback et al, JBJS-A, 1994

New Lecture on the OTA Open Fracture Classification:

- **For questions or comments, please send to ota@ota.org**

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