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

- *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 reliability with both systems
• Poor precision of staging, especially 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?
  BONE: TIBIA/FIBULA (4)

- Where in the bone?
  Location: Diaphyseal segment (42)
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

- Tibia/Fibula, diaphyseal, complex
  1. Spiral (42-C1)
  2. Segmented (42-C2)
  3. Irregular (42-C3)
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 tissues
  – 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:
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