FRACTURE CLASSIFICATION

Lonnie Froberg MD, Ph.D
Odense University Hospital
Why classified?

AO classification system

Interactive interobserver agreement study

How reliable and accurate is the AO classification system?
Why?

- Common mode of communication
- Comparison and prognosis assessment tool
- Treatment recommendation
Ideal fracture classification system

- Reliable
- Reproducible
- All-inclusive
- Logical
- Clinically useful

Martin et al. J Orthop Trauma 1997
Classification systems – local

- Lauge – Hansen – malleol
- Garden – collum femoris
- Schatzker – tibiaplateau
- Older – distale radius
- Neer – proximale humerus
- Evans – pertrochantære
- Sanders – calcaneus
Classification system – all-inclusive

- AO (Arbeitsgemeinschaft für Osteosynthesefragen)
AO classification

Localization
- Bone  1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type  A,B,C
- Group  1,2,3
- Subgroup
AO classification - bone

Localization
• Bone 1, 2, 3, 4
• Segment 1, 2, 3 (4)

Morphology
• Type A, B, C
• Group 1, 2, 3
• Subgroup
AO classification - segment

Segment
1 proximal end segment
2 diaphyseal segment
3 distal end segment

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
AO classification - type

Diaphyseal fractures

Type

A Simple
B Wedge
C Complex

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
AO classification - group

Diaphyseal fractures

Group

A1 Spiral
A2 Oblique
A3 Transverse

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
AO classification - group

Diaphyseal fractures

Group

B1 Spiral
B2 Bending
B3 Multifragmentary

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
AO classification - group

Diaphyseal fractures

Group

C1 Spiral
C2 Segmental
C3 Irregular

Localization
• Bone 1,2,3,4
• Segment 1,2,3 (4)

Morphology
• Type A,B,C
• Group 1,2,3
• Subgroup
AO classification - subgroup

Diaphyseal fractures

Subgroup

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
Articular fractures

Type

A Extraarticular
B Partial articular
C Complete articular

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
AO classification - group

Articular fractures

Group

A1 Simple
A2 Wedge
A3 Complex

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
Articular fractures

Group
B1 Lateral sagittal
B2 Medial sagittal
B3 Coronal
B1 Pure split
B2 Pure depression
B3 Split-depression

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
AO classification - group

Articular fractures

Group

C1 Articular simple
metaphyseal simple

C2 Articular simple
metaphyseal complex

C3 Articular complex

Localization
- Bone 1,2,3,4
- Segment 1,2,3 (4)

Morphology
- Type A,B,C
- Group 1,2,3
- Subgroup
Localization
- Bone
- Segment

Morphology
- Type
- Group
Localization

- Bone
- Segment

Segment

1 proximal end segment
2 diaphyseal segment
3 distal end segment
Diaphyseal fractures

Type

A Simple
B Wedge
C Complex
Localization
- Bone 3
- Segment 2

Morphology

Right:
- Type C
- Group 3

Left:
- Type A
- Group 2

C: Complex 3: "Irregulær"
Localization
- Bone  3
- Segment 2

Morphology

Right:
- Type  C
- Group  3

Left:
- Type  A
- Group  2

A: Simpel
2: Oblique
How reliable and accurate is the AO classification system?

- Stavanger University Hospital, 2008
- Long-bone fractures
- Excluded: Patients >16 years, pathologic, around implants
- n=949 fractures
- 26 surgeons

Meling et al. J Trauma Acute Care Surg 2012
How reliable and accurate is the AO classification system?

- Bone, segment, type and group
- Re-classified 1 year later
- Intra- and interobserver reliability
  - Proportion of agreement
  - Kappa

Meling et al. J Trauma Acute Care Surg 2012
<table>
<thead>
<tr>
<th>Kappa value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.20</td>
<td>Poor</td>
</tr>
<tr>
<td>0.20-0.39</td>
<td>Slight</td>
</tr>
<tr>
<td>0.40-0.59</td>
<td>Moderate</td>
</tr>
<tr>
<td>0.60-0.79</td>
<td>Substantial</td>
</tr>
<tr>
<td>&gt;0.80</td>
<td>Excellent</td>
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</table>

Landis and Koch. Biometrics 1977
## Intraobserver reliability

<table>
<thead>
<tr>
<th>AO sign</th>
<th>Proportion of agreement (%)</th>
<th>Kappa (95% CI)</th>
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<tbody>
<tr>
<td>Bone</td>
<td>100</td>
<td>1.00</td>
</tr>
<tr>
<td>Bone+segment</td>
<td>96</td>
<td>0.95 (0.93-0.97)</td>
</tr>
<tr>
<td>Bone+segment+type</td>
<td>86</td>
<td>0.84 (0.81-0.87)</td>
</tr>
<tr>
<td>Bone+segment+type+group</td>
<td>69</td>
<td>0.67 (0.63-0.70)</td>
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Meling et al. J Trauma Acute Care Surg 2012
### Interobserver reliability

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<td>Bone+segment+type</td>
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<td>0.87 (0.84-0.90)</td>
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<td>69</td>
<td>0.67 (0.62-0.71)</td>
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How reliable and accurate is the AO classification system?

- Reliability and accuracy
  - Substantial to excellent

- Coding and orthopedic experience
  - No influence

- Type C more difficult than A and B

- Least frequent fracture more difficult

Meling et al. J Trauma Acute Care Surg 2012
Take home message

- Fracture classification
  - Common mode of communication
  - Comparison and prognosis assessment tool
  - Treatment recommendation
AO classification system
- Not perfect
- Reliable
- Reproducible
- Logical
- Clinically useful (?)