Pathomechanics and Pathoanatomy of Ankle Fractures: A New Concept

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Knowing the precise mechanism of ankle fracture helps surgeons
1. assess the extent of soft-tissue injury/sequence of injury based on the fracture pattern on radiographs;
2. determine which forces to apply to obtain and maintain reduction of an ankle fracture subluxation or dislocation.

Problems with the Lauge-Hansen supination-external rotation (SE) mechanism
1. When an individual sustains an injury with the foot supinated, the foot rotates internally rather than externally.
2. Although reversing the deforming forces should achieve fracture reduction, placing the foot in a supinated rather than pronated position during surgery reduces fracture.
3. No studies have successfully reproduced stage-4 SE fracture.

Our study in 23 cadaver ankles
1. revealed the pronation-external rotation (PE) mechanism causes both short oblique (Lauge-Hansen SE) and high fibular fractures;
2. showed that the fracture type is affected by the associated abduction moment;
3. is the first study to show that a short oblique fracture of the distal end of the fibula can occur with the foot in the pronated position prior to medial injury.

Clinical relevance
1. Most ankle fractures, with the exception of “supination-adduction” fractures, occur in the pronated position.
2. A more direct classification system based on injury-producing loads is as follows:
   • external rotation fracture (a low oblique fibular fracture at the level of the syndesmosis, with the lateral injury occurring first)
   • external rotation-abduction fracture (the fibular fracture is reversed and sometimes comminuted above the level of the syndesmosis, with the medial injury occurring first)
3. Because both types of ankle fracture occur in the pronated position, description of the foot position is superfluous. Fracture types can be described by associated injury loads alone.


Other ankle fracture mechanisms

1. Supination-adduction fracture
   - Stage 1: avulsion fracture of lateral ligaments—a type of structural failure of the lateral ankle ligament complex
   - Stage 2: should be regarded as distal tibia fracture (AO/OTA 43-B2.2)

2. Pronation-abduction fracture
   - actually reproduced not by a pure pronation-abduction mechanism but rather by pronation-abduction plus the external rotation mechanism originally described by Lauge-Hansen.

Mechanism-based ankle injury classification

- All ankle injuries can be classified by the injury mechanism.

* Supination-adduction Stage 1 fracture should be included here.
** Supination-adduction Stage 2 fracture should be included here.

References
