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Ankle fracture — Correlation of Lauge-Hansen classification and patient reported fracture mechanism

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ABSTRACT

Introduction: The genetic Lauge-Hansen classification is used for reconstruction of the mechanism of ankle injury. In this study, we addressed the question of agreement between the mechanism of the fracture as postulated by the Lauge-Hansen classification and mechanism reported by the patient in rotational ankle fractures.
Material and methods: Radiographs of 78 patients with acute malleolar fractures were analyzed and compared with fracture mechanisms reported by these patients.
Results: The patient reported mechanisms were in concordance with the mechanism deducted from the X-rays in 49% of cases. Only 17% of patients who recalled a pronation trauma actually had radiographs classified as pronation fractures while 76% of patients who recalled a supination trauma were also radiographically classified as having sustained supination type fractures.
Conclusion: The Lauge-Hansen classification should be used with caution for determining the actual mechanism of injury as it was able to predict the patient reported fracture mechanism in less than 50% of cases. A substantial percentage of fractures appearing radiographically as supination type injuries may have been actually produced by a pronation fracture mechanism.

1. Introduction

Lower extremity injuries, including those at the ankle joint, are common in medicolegal practice. From a medicolegal point of view the ability to explain the circumstances and the mechanism of injury may be crucial in terms of determining legal responsibility for the incident [1–3].

The genetic Lauge-Hansen classification is considered to be one of the basic sources of knowledge about fractures of the ankle and thus widely used in forensic medicine for reconstruction of the mechanism of injury [1–3].

The seminal work of Lauge-Hansen has been influencing our understanding of ankle fracture mechanism for over seventy years [4]. It provides a logical link between mechanism of both the bony and ligamentous injury to the ankle and the resulting X-ray. However, in more recent biomechanical studies the stages of this classification could not be reliably reproduced and there are several clinical and cadaveric studies questioning consistency of the proposed mechanisms [5–10].

In this study, we addressed the question of agreement between the mechanism of the fracture as postulated by the Lauge-Hansen classification and mechanism reported by the patient in rotational ankle fractures.

The ability to deduct the mechanism of the injury from the radiographic image of the fracture is of paramount importance in medicolegal reasoning. To the best of our knowledge – and to our surprise – the "real life" performance of the Lauge-Hansen classification in this respect has not yet been tested. This study aims at filling this void.

2. Patients and methods

2.1. Patients

The study was performed at the Traumatology Department of a regional hospital. Consecutive patients admitted to the

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Traumatology Department from November 2015 until February 2017 were screened for inclusion and exclusion criteria.

Inclusion criteria were ankle fractures (documented as AO/OTA types 44A, 44B, or 44C) [11] requiring operative treatment in patients aged at least 18 years and willing to participate in the study. Patients were excluded if they were unable to provide the circumstances of the injury, sustained the fracture while being intoxicated or sustained a high-energy fracture (for example high speed motor vehicle accident, fall from a height of more than 2 meters). Fractures of the tibial pilon (AO/OTA types 43) resulting mainly from axial forces were also excluded.

2.2. Methods

Patients meeting the inclusion criteria were approached within 48 h after admission and after obtaining verbal consent asked for details of their accident.

Patients were questioned by a surgeon from the team providing their treatment. First, the patients were asked about the circumstances of the accident (i. e. fall, stumble, vehicle accident, direct trauma, fall from a height, sports). This information was cross-checked with the charts for consistency. Next, the patients were asked to recall the fracture mechanism. At first, the patients were asked to describe the mechanism in their own words. If the patients experienced difficulty at this step, the investigator presented supination and pronation with the investigator's own foot (in random order). If this was not sufficient, photographs presenting these positions were presented to the patients. Due to complexity of the movement we did not introduce a question about internal/external rotation.

The ankle mortise and lateral radiographic views performed in the emergency department were then analyzed. In patients with fracture-dislocations, both the pre- and postreduction X-rays were analyzed. A senior orthopedic surgeon and an orthopedic resident independently classified the radiographs according to the Lauge-Hansen classification [4]. The supination-external rotation (SER) fracture was defined as a malleolar fracture with an oblique fibular fracture starting at the level of syndesmosis (Fig. 1). In pronation-external rotation (PER) fractures, the fibular fracture started proximal to the syndesmosis (Fig. 2). In pronation-abduction (PAB) fractures a multifragmentary, indirect fibular fracture was observed (Fig. 3). A completely infrasyndesmotic fibular fracture sometimes accompanied by an almost vertical medial malleolar fracture was considered characteristic for a supination adduction (SAD) fracture (Fig. 4). The stages of each fracture mechanisms were analyzed. Fractures were deemed to be low-stage injuries if they represented SER I–II, PER I–II, PAB I–II or SAD I. Fractures were deemed to be high-stage injuries if they represented SER stage III–IV, PER stage III–IV, PAB stage III or SAD stage II.

All discrepancies between the investigators were identified. These sets of X-rays were jointly reassessed by both investigators and the specific features characterizing each fracture type were discussed in an attempt to reach consensus. When assessing the X-rays, the investigators were blinded to the patients' response with respect to the fracture mechanism.

3. Results

3.1. Study population

In total 110 (55 women and 55 men with an average age of 47.8 years) patients with acute malleolar fractures were screened for this study. Of those 32 patients did not meet the inclusion criteria thus leaving a group of 78 patients for analysis. The study group consisted of 43 women and 35 men with a mean age of 47.8 (range 19.5–88.4) years. The reasons for exclusion were: high energy fracture in 10, inability to recall the fracture circumstances in 28, and intoxication at the time of injury in 7 (multiple reasons were possible).

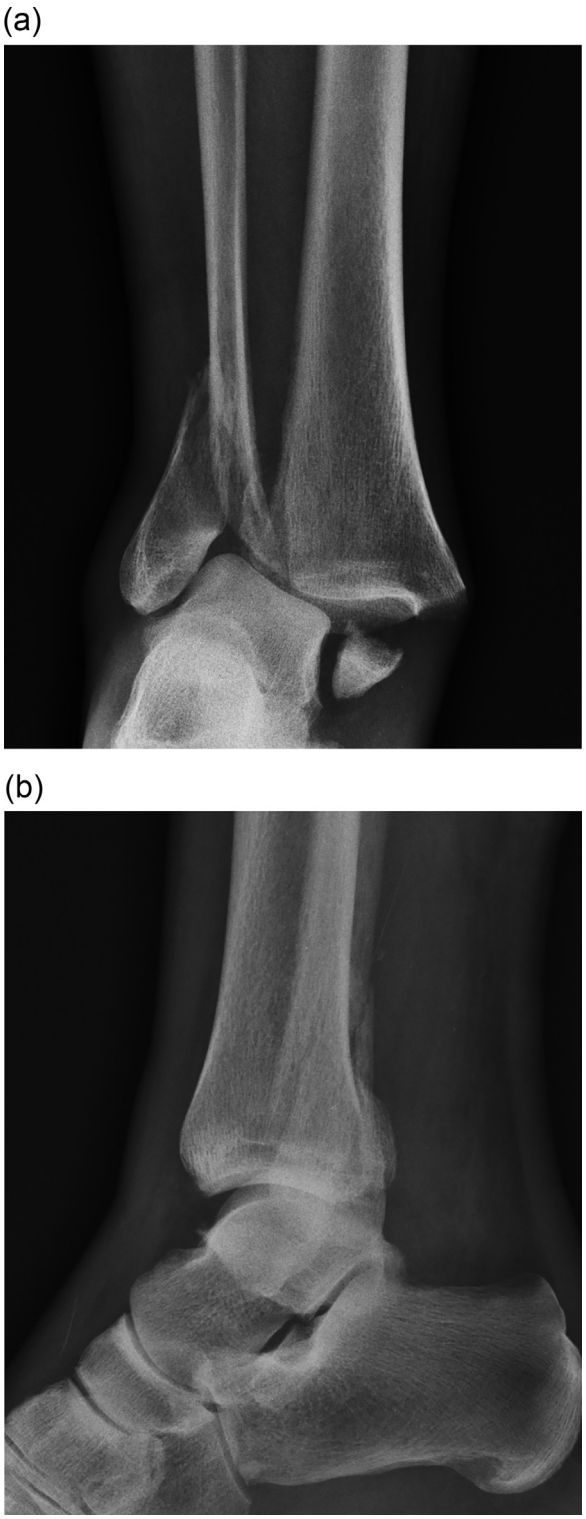

Fig. 1. Example of SER-type fracture X-ray — (a) mortise and (b) lateral. This patient sustained fracture while biking, in pronatory mechanism (toes striking the obstacle with the foot on the pedal).

3.2. Patient reported mechanisms

The majority (35/78 = 44.8%) of patients reported pronation as their fracture mechanism, 27 (34.6%) patients reported