INTRODUCTION

- Spiral fractures of the metacarpal are unstable fractures prone to malrotation and shortening.
- These fractures are common and have a wide range of surgical indications: significant displacement, angulation and shortening, in open fractures and in multiple metacarpal fractures.
- A good understanding of fracture pattern is essential to guide surgical fixation.

AIM: To analyze the mechanism of spiral fracture formation by biomechanically inducing a torsional force on a chicken humerus model.

METHODOLOGY

Specimen Preparation

30 fresh frozen chicken humerus bones were dissected free from their soft tissues and divided into three groups of 10 (Groups A, B and C).

Biomechanical Testing

Each specimen were mounted onto a customized jig and subjected to torsional loading using the Instron 3343 Tester. Each group was tested at 3 torsional rates (Group A – 45°/sec, Group B – 30°/sec, Group C – 22.5°/sec).

Data Analysis

The fracture pattern, angle, and length were analyzed.

RESULTS

1. 24 out of 30 specimens failed in a spiral pattern along the shaft of the bone. 6 specimens that fractured through the metaphysis were excluded.

2. We observed that all spiral fracture propagated along the same direction as the torsional force applied.

3. There are two distinct components: a helical line that traverses the circumference of the bone and a longitudinal line that connects both ends of the helix. This creates the characteristic spikes of both bony ends as seen on radiographs.

3. A linear relationship was demonstrated for the different torsional rates applied: the faster the torsion, the smaller the fracture angle ($R^2=0.9957$) and the longer the fracture length ($R^2=0.9778$).

CONCLUSION

The direction of the torsional force applied predicts the direction of the fracture propagation, forming a distinct 3-dimensional spiral fracture pattern characterized by a ‘helical line’ and a ‘longitudinal line’.

CLINICAL RELEVANCE:

- Hand surgeons should be mindful about the fracture configuration and consciously identify the two components intra-operatively.
- Careful and precise screw placement can prevent catastrophic comminution, especially at the ‘spike’ ends.

REFERENCES


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