

# INDICATION FOR CLAVICLE FRACTURE OSTEOSYNTHESIS BASED ON SHORTENING: HOW TO MEASURE IT?

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## Introduction

Indication for midshaft clavicle fracture surgery is based on shortening evaluated on standard radiographs. This method may not be reliable because shortening result from three-dimensional displacement of fragments. Our first objective was to assess reliability and accuracy of three previously described clavicle fracture shortening measurements recorded on standard radiographs and compared to CT with 3D reconstruction and virtual reduction. The second objective was to assess impact of fracture pattern on shortening.

## Methods

We created five synthetic fractured bone models and acquired standard radiographs and CT. Shortening measurements were validated comparing fractured and reduced states with a caliper and after virtual reduction on dedicated 3D reconstruction software. Twenty patients with midshaft clavicle fractures imaged by standard radiographs and CT because of polytrauma were then retrieved.

Shortening was measured independently by a musculoskeletal radiologist and an orthopedic surgeon according to three methods (Jeray, Silva and Smekal et al.). Measures were compared to the ones recorded on 3D reconstruction. The effect of fragments displacement according to 6 degrees of freedom on shortening was finally correlated to shortening in order to assess impact of fracture pattern.

## Results

Mean difference in shortening between caliper and CT was 0.7 mm [-2.5; 4.0] ( $p = 0.56$ ). Inter-observer reliability was 0.99 for Jeray, 0.97 for Silva and 0.97 for Smekal. Mean difference between CT and standard radiographs was 11.7 mm [7.1; 16.4] for Jeray, -1.2 mm [-5.9; 3.4] for Silva and 9.1 mm [4.5; 13.7] for Smekal. The results based on a mixed linear model didn't show significant difference between Silva and CT measurements ( $p = 0.51$ ). The only component of fracture pattern significantly associated with shortening was the translation about the axis (z).

## Conclusion

Clavicle fracture shortening measured on CT has an accuracy of 2–4 mm when compared to direct measures. Radiographic measurement according to Silva et al. achieved good inter-observer reliability and an accuracy of 4 to 6 mm. We recommend its use for further studies. Fracture pattern according to 6 degrees of freedom did not influence shortening in this model. We cannot recommend its assessment for indication to therapeutic modality.