Summary

Ankle fractures can be serious and complex injuries with variable prognoses. In our department, ankle fractures are the third most common fracture behind fractures of the distal radius and the proximal femur. Ankle fractures present with considerable variability with regard to the extent of injury to bones and ligaments, with each injured structure requiring appropriate treatment.

We analyzed a group of patients that were surgically treated, in the Orthopedics and Traumatology Clinic, 3rd Medical Faculty of Charles University, for ankle fractures, with a particular focus on the epidemiological, clinical, and morphological parameters of the fractures. Our objective was to supplement existing information regarding the morphology of ankle fractures.

Furthermore, we wanted to experimentally verify certain aspects related to ankle fractures. Our first step was to focused on the structure of cortical and cancellous bone in the fibula by carrying out a biomechanical study of the distal fibula after treatment with various types of fixation.

The structure of fibular cortical bone was analyzed, using superficial sections, from dry preparations of a human fibula. By rubbing Indian ink into polished sections of cortical bone, we were able to visualize both the direction and organization of the central vascular channel network as well as get a realistic picture regarding the spatial orientation of osteons. We observed that the bone had adapted to external loads in such a way that the resultant arrangement of osteons was optimal for the transmission of mechanical forces within the bone. Using μCT tests, we described the orientation of the columns of cancellous bone in the distal fibula with regard to the dominant direction of stress as indicated by the orientation of the osteons.

The field of biomechanics uses numerical analyzes to model fibula fracture fixation, relative to load, as well as compare different methods of fibula fracture fixation. Three models were evaluated for a type B (Weber's classification) fracture of the fibula. The finite element method (FEM) was used to study the primarily stiffness of the overall system, followed by stress analysis of the individual components of the model. We found that for both physiological and osteoporotic bone, the stiffest model involved fractures fixed using lag screws and a plate with three screws proximal and three screws distal to the fracture line.