

THE INFLUENCE OF PRE-DRILLING ON THE MECHANICAL PROPERTIES OF THE HUMAN FEMORAL HEAD BONE

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Summary: Femoral neck fracture is one of the most common surgically treated types of human bone fracture. The standard fixation method is closed reduction and stabilization with three parallel cannulated screws. Unfortunately, in over 30% of patients the fixation fails within 3 months post surgically. One of the possible reasons is that the screws can dislocate inside the fixed bone fragments when bone union is still in progress and enlarge the screw canals, what destabilizes the fracture.

The main aim of our study is to analyze the biomechanics of femoral neck fracture, taking into account the different screws configurations and various fixation methods in a standardized fracture model. The first step concerns the identification of the strength properties of the femoral head/neck bone including analysis of the bones with and without the hole pre-drilled for the guide wire. The tests have been performed on the femoral head bones collected from 24 donors. From each femoral head two cuboid specimens of almost equal dimensions were prepared. The first part of samples was pre-drilled through with the drill bit of diameter 3.2 mm, while the second part stayed unchanged. Before testing, the apparent density of each specimen has been also recognized. Both types of samples from the same femoral head (pre-drilled and not drilled) underwent uniaxial compression tests on the Zwick/Roell Zo20 strength machine. The displacements of specimens have been followed by the videoextensometer. The recorded data have been used to calculate basic mechanical properties of the both parts of each femoral head bone.

The future step of the proposed analysis will be a comparative study of the whole fixation using the numerical model of the fixation and tests performed on the fixations made of artificial human bones. Therefore, to identify the required material properties used in numerical simulations, the proposed above experimental methodology has been realized upon the artificial femur heads as well. The utilized experimental methods, statistical analysis and necessary comparison between results obtained for natural and artificial human bones, both pre-drilled or not, will be included in the presented research.